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POLICE INVESTIGATION MANUAL OF OFFENCES AGAINST BIODIVERSITY

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POLICE INVESTIGATION MANUAL OF OFFENCES AGAINST BIODIVERSITY

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Any comments on this study are welcome and can be sent to
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INTRODUCTION

This manual was developed out of the need to provide environmental police officers within Europe and beyond its borders with a basic conceptual tool that covers the most important aspects of the investigation of crimes committed against biodiversity. We are aware of the enormous heterogeneity of the vast European territory in terms of its natural resources, police typology and also in terms of nationalities, languages and cultures and, therefore, although it is difficult to include in a single text all the singularities of the crimes in each region, we have tried to include the characteristics and investigation methodology that are most common to all of them.

The act of shooting a common buzzard (*Buteo buteo*) is apparently the same whether committed in Spain or in Austria – both shots are fired using a very similar shotgun and 12 calibre ammunition. However, behind the trigger the motivation and *modus operandi* of the shooters is different. While one part of the crime is comparable, the other elements of the puzzle are not. Similarly, the most frequent "typical" crime committed in Portugal bears little apparent relation to the one in Germany.

When we look at biodiversity crimes in a pan-European-Mediterranean context, the first thing that stands out is that they all differ according to regions and cultures, but when we analyse them in depth, we find that they all have a number of similarities. In turn, it should be remembered that, while humans define their existence in terms of limits, borders and barriers, wildlife does not. A good part of the crimes that are committed in North Africa, for example, affect bird species that come from European countries and, inversely, a good part of the reptiles plundered in North Africa, for example, are destined for illegal sale in Central European countries. We could provide a great number of examples of the international criminal relationships between our different countries, but this would merely emphasise what we have already asserted. Passports may distinguish us, but the environment unites us; we are all sailing in the same boat and heading towards the same objective, which is to conserve the environment by fighting crimes and infractions committed against our still extraordinary biodiversity.

In this context, therefore, it makes no sense to address these crimes in an isolated and closed manner, simply because it would not work. We must implement our methods within the scope of our competencies, but always bearing in mind that in today's world, if criminals join together in international networks, those who fight crime are forced to do the same. Today the fight against crime is not a singular, but a collective effort. This manual clearly reflects our vocation to collaborate and join forces for a common goal.

This manual has three main goals:

- To explain the fundamental steps in addressing the investigation of the most common crimes against biodiversity, including those aimed especially at wildlife and their habitats, focusing on forest fires.

- To provide law enforcement officers and specialised technicians with essential criteria to identify in the field when this kind of crime has been committed by understanding the apparent cause of death of a wild or domestic specimen in the natural environment or the destruction incurred on a specific habitat.

- To analyse the tools for cooperation between the different entities involved in a criminal investigation, both at national and international level, as well as between public and private entities.

Although the final report on the cause of death is issued by a forensic laboratory, when an agent finds the carcass of a wild or domestic species in the natural environment, they must open an investigation to clarify the facts. For this, some initial clues are needed that shed a light on the cause of death and thus point the corresponding investigations in the right direction. This manual pursues this main goal.

The manual presented here is based on the two basic reference texts that make up the technical training program for the Agents of the Environmental Authority in Andalusia, Spain, mainly the Environmental Agents and, to a certain extent, also the Nature Protection Service (SEPRONA) of the Civil Guard. The first of these was published in 2009: *Biodiversity Legal Protection Manual for Agents of the Environmental Authority in Andalusia*, with four editions. The second text is a supplement to the first one and it was published in 2016: *Environmental Police Techniques Manual – On-site Identification of Causes of Death in Wildlife*. This new manual summarises the contents of the two previous ones, but with updated information adapted to international circumstances, seeking to provide basic elements that are valid for all the territories covered in Europe and the Mediterranean Basin, although extensible to other territories with similar problems and contexts.

The structure of the manual follows a logical sequence, beginning with an introduction about the need to investigate crimes against biodiversity and the singularities that make them one of the greatest challenges in law enforcement today. Subsequently, the manual explores concepts related to victimology, i.e., what useful information can be obtained through the interpretation of the findings in the crime scene investigation (CSI), and later shows how to identify criminal causes of death in the most frequent cases in the natural environment, such as poisoning, shooting, trapping, electrocution, collision, roadkill, illegal trafficking, etc.

Further on, the manual focuses on the investigation of environmental crimes: its phases, main obstacles and standardised methods. A key part of the manual is dedicated to the importance of specialised forensic laboratories, which are vital for the whole investigative process to the point of blocking police action if they are not available. Information is provided on fundamental aspects such as forensic entomology, forensic toxicology e.g. for cases of poisoning, and the correct interpretation of forensic reports. The relationships between the police, forensic and judicial phases are explained in detail, as they form an integrated chain that ultimately results in the resolution of the case. Toward the end, organised crime is addressed, a very specific type of environmental crime that generally takes the form of international networks trafficking in some form of wildlife. This type of crime is dealt with separately by experienced international police specialists.

Last but not least, the manual addresses the collaboration between different public and private entities for the reporting, investigation and resolution of criminal acts. Thus, taking the trafficking of illegal species as a reference point, the document focuses on cross-border cooperation and the role played by NGOs and citizens in the promotion of investigative and legal processes and even the means to carry out police action.

In short, this manual provides a fairly comprehensive and integrated overview of the entire procedure, from the first report of the crime until the case is sent to court for trial.

This publication was prepared within the framework of LIFE Nature Guardians (LIFE17 GIE/ES/000630), a project funded by the European Union's LIFE programme, which aims to improve the effectiveness and efficiency of actions aimed at fighting crimes against nature. It is coordinated by SEO/BirdLife and its beneficiary partners are the Agriculture, Livestock, Fisheries and Sustainable Development Department of the Autonomous Government of Andalusia, the Sociedade Portuguesa para o Estudo das Aves (SPEA) and the Nature Protection Service (SEPRONA) of the General Directorate of the Civil Guard. It is also co-financed by the General Directorate for Nature Protection of the Canary Islands Autonomous Government, the Agriculture, Environment, Climate Change and Rural Development Department of the Valencia Autonomous Government and the Spanish Ministry for Eco-

logical Transition and Demographic Challenge (MITECO).

Disclaimer

This manual contains information related to the police investigation of crimes. It does not criminalise legal activities such as hunting, fishing, agriculture, livestock farming or outdoor sports. By no means should any link be established between illicit activities and these socially significant sectors and any such association is misleading and would merely be an interpretation by the reader.

Similarly, while driving under the influence of alcohol is criminalised, no one questions the honesty of the majority of drivers who carry out this activity in accordance with the law.

This manual addresses individual behaviours outside the law, the investigation of which is the duty of the environmental police in all European countries, whether or not they belong to the European Union. Under no circumstances are sectors or legal professional activities judged from an ethical or ecological point of view, and no position is taken in favour of or against activities such as hunting, fishing or gathering forest products, since in any case these activities are covered in the legal system in force.

Where this manual establishes connections between unlawful individual actions and certain professions that are carried out in the natural environment, it refers to cases of professional malpractice and not to the legal professional activities per se. Following the example above, a drunk driver may be penalised, but in doing so the action of driving is not condemned, but rather the unlawful conduct of being drunk behind the wheel. The Courts of Justice themselves have established these links between the convicted individuals and the aforementioned activities, considering the proven facts in the preliminary hearing and through transparent trials and procedures carried out under the rule of law.

Along the same lines, this work does not question or judge the persons who are responsible for the investigated actions. The sole purpose of this manual is to outline investigation techniques on individual actions that are deemed unlawful by the legal system, and in no case to question or to judge those who commit them, which is the exclusive task of the Courts of Justice. This manual focuses on actions, not on people.

Additionally, it should be stressed that the environmental police forces in Spain and Europe having competences in the investigation of crimes against biodiversity are incredibly heterogeneous. It is impossible to mention each and every one of them throughout the text of the manual. For this reason, generic reference will be made to the agent(s), and it should be understood that the term encompasses all of them in a broad sense, without any intention of discriminating against any body or group.

This technical manual makes constant and recurring reference to environmental law enforcement officers, which must be taken to mean all law enforcement professionals whose functions include environmental policing and biodiversity matters. For the purpose of brevity, generic reference will be made to the agent or agents. The reader must understand at all times that this is not in any way intended to avoid inclusive language and gender equality, and is asked to accept our most sincere apologies in the event that anyone may feel excluded as a result of this gender treatment.

01. GENERAL CONTEXT ON THE INVESTIGATION OF ENVIRONMENTAL CRIMES

Psychological perception of biodiversity crimes

A few years ago, the Andalusian Autonomous Government conducted a small and informal visual perception test using a large and varied group of people (n=47): undergraduate biology students at the university, professors at the same university, environmental agents specialised in working against poisoning, environmental agents with no poison-related training, field biologists, environmental technicians and the general public.

All of the selected individuals were shown the photograph below for a moment and then asked the same question: "What do you see in the picture?"

Photo 1.1 Photo of a vulture used to analyse the perception of biodiversity crimes.

The answers were revealing:

- Biology students and professors replied unanimously: "a dead cinereous vulture".
- Agents with no specific training in crimes against wildlife replied: "a dead vulture".
- Field biologists responded: "an adult specimen of cinereous vulture, probably of reproductive status", but did not mention whether the bird was alive or not.
- Environmental technicians simply replied: "a vulture".
- The general public replied in alarm with another question: "a dead bird?"
- Environmental agents with experience in poisonings stated unequivocally: "a poisoned bird", with no mention of the species.

The moral or conclusion of this interesting perception test is clear: we lack an intuitive sense for perceiving the existence of a wildlife crime, unless we are professionally trained for it. Not even the respondents with general professional knowledge about the environment perceived anything other than a dead animal.

This means that, unlike other types of crimes that affect human life, where there is greater awareness and intuitive perception, in the case of wildlife it is more difficult to identify when illegal actions are committed, and even less so if they occur in the natural environment.

The immediate consequence of all this is quite simple: only a fraction of the crimes that are actually committed are detected, and others – most of them – go easily undetected, sometimes even by professionals.

This manual was created as a response to the reality that was revealed by this experiment in psychological perception and to enable us, through advanced training, to reduce that fraction of crimes against biodiversity that goes unnoticed in the natural environment to law enforcement officers. Training has unquestionably proven to be the best tool.

Object of the investigation: Criminal and intentional non-natural mortality in wildlife

Wildlife has coexisted with humans in the natural environment for millennia, sometimes peacefully and sometimes in conflicts that often end up wiping out the populations of the most strongly impacted species. Coexistence is hardly ever harmless to wildlife, and this has a direct impact on the mortality of the species living in the wild.

As mentioned at the beginning of this manual, it is necessary to have an approximate idea of the cause of death of an animal on site in order to be able to adequately direct both the CSI and the subsequent police investigation.

In this regard, we have a maxim: everything that is born must die, but not necessarily prematurely. In other words, we have to consider whether there are signs that could lead us to believe that we are dealing with an intentional death and, if so, whether a possible offence or crime has been committed. In general terms, wildlife mortality can be classified as follows:

Natural mortality: mortality that would occur anyway following natural patterns, without human intervention. It usually affects very young, inexperienced or maladapted specimens, or those that are very old, sick or injured due to natural causes. In theory and under normal circumstances, this is desirable. Every protected wild animal should reach the end of its life due to natural causes.

Non-natural mortality: mortality caused directly or indirectly by human beings. It often affects healthy, strong specimens that would otherwise carry on living normally in the natural environment. While this is not at all desirable, reality shows us that more often than not when we find the carcass of a wild animal, the human hand is behind its death.

In turn, within non-natural mortality we have two broad categories:

Intentional mortality: mortality deliberately sought and brought about by human beings. For instance, shooting a hare (*Lepus europaeus*) at close range. It usually involves previously planned preparatory actions.

Accidental mortality: mortality that, although caused by humans, is not intentional but is the result of an accident. For example, when an Iberian lynx (*Lynx pardinus*) runs out onto the road in the dead of night and the driver has no margin to avoid the impact.

Photo 1.2 An Iberian lynx that has been run over unintentionally.

Alternatively, the following classification is also possible:

Criminal mortality: mortality that is presumed to have occurred under illegal circumstances and, therefore, should be investigated.

Lawful mortality: for example, an animal that has been killed within the framework of the law in the exercise of sport hunting.

Apart from that, there is another type of factors or causes of mortality, slightly more subtle, whose connotations are important to the law enforcement officer investigating the circumstances of death:

Immediate cause of death (direct): the cause that led to the actual death of the animal. For example, an imperial eagle suffers an electric shock when it lands on a poorly insulated power line.

Antecedent cause of death (indirect): even though an animal may die from a specific cause, there could actually have been a previous factor that had weakened it to the point of making it vulnerable to a risk of death that otherwise would not have materialised. For example, in an actual recent case, an imperial eagle had ingested poisoned bait and, feeling sick, went to perch on a dangerous power line. Although it died from electrocution (the immediate cause), the antecedent factor was actually poisoning. It is quite possible that the poison would have caused direct death had the eagle not been electrocuted. Identifying these underlying causes is more difficult.

Now that the concepts are clear, it can be said that not all species are subject to the same patterns of non-natural mortality. For example, nocturnal open-space raptors such as the barn owl (*Tyto alba*) or the little owl (*Athene noctua*) are extraordinarily prone to die as a consequence of collisions with vehicles, while eagle owls (*Bubo bubo*) or long-eared owls (*Asio otus*) rarely suffer road collisions.

Photo 1.3 Species such as barn owls are prone to be killed by collisions.

The living habits of each particular species are reflected in their mortality patterns and therefore, the more we know about a species, the more we will be able to adjust their expected mortality patterns. From a police and conservation point of view, this knowledge is fundamental for a simple but important reason – you cannot solve a problem you do not know about and you cannot clear up the case under investigation if you do not know the factors involved in the death of the animal.

Continuing with the series of examples, not all species of an animal group are equally vulnerable to a particular mortality factor. Thus, while between 2000 and 2013, 84 griffon vultures (*Gyps fulvus*) were found electrocuted in Andalusia, during the same period and in the same territory no deaths were recorded for cinereous vultures (*Aegypius monachus*). From this we can conclude that different behaviours, living habits and risks lead to different mortality patterns specific to each species.

Photo 1.4 Griffon vulture electrocuted on a power line.

In line with our objective, this manual focuses on the causes of non-natural, criminal and intentional mortality, i.e., those causes of death that constitute a criminal or administrative offence according to the provisions of the legal system of each country in the European Union.

In this context, it is important to highlight a newly introduced forensic concept in this field of wildlife, called forensic victimology (Turvey, 2011). This is a crucial concept in the investigation of serial crimes against the sexual freedom of individuals. Even though it is not legally possible to speak of victims, according to jurists and wildlife specialists, because this concept is reserved only for crimes committed against humans, associated concepts can be partially applied to wildlife in investigations and expert reports. Forensic victimology is the study of the ecological and behavioural aspects of a particular species that can explain and provide answers to help solve a crime and answer its key police questions: who? when? where? and why?

Let's focus on a specific example. If, for instance, we find the carcass of a red kite (*Milvus milvus*) in a place with a repeated history of intentional persecution of birds of prey, applied forensic victimology tells us that, based on the specific ecology of the kite, as a first working hypothesis we must consider that the animal died from ingestion of poisoned bait. If, on the other hand, the animal we find dead is a honey buzzard (*Pernis apivorus*), according to forensic victimology, gunshot wounds would be the top priority to investigate. Investigative work must take into account what makes a red kite so vulnerable to poison baits and what makes a honey buzzard less so. The answers can be found in the principles of victimology and the information provided can be very useful for agents and government authorities in solving illegal actions against wildlife. When used properly, the police and forensic implications of victimology, in terms of malice and intentionality, are enormous and to date have been decisive in some specific cases that have been forensically assessed by the Autonomous Government of Andalusia.

In sum, when we find ourselves faced with a carcass during our professional work, the first step is to identify its exact species. In those cases where we cannot verify the species with absolute certainty, we will record that fact in the corresponding records and must abide by what the forensic laboratory establishes in its report. We will then consider whether the death was natural, non-natural, intentional, accidental, criminal or lawful and whether antecedent factors may have been present, which will ultimately also be determined by the expert forensic team itself. Lastly, we will analyse whether forensic victimology can provide any relevant information.

Photo 1.5 Poisoned red kite in a hunting reserve.

Based on this, we can proceed with the investigative work, which is discussed in the following chapters of this manual.

Why should crimes against wildlife be investigated?

Let's imagine for a moment the busiest street of a city we know, at twelve o'clock noon on a sunny spring Saturday. The street is full of people who have come out to enjoy a day of rest, family shopping, leisure, hustle and bustle, etc. Suddenly three shots are heard in the middle of the crowded street and one person runs away, while another collapses to the ground and falls dead on the spot. A murder has been committed, which is a crime under the Criminal Code of any country today.

Photo 1.6 Some crimes such as illegal trade in protected species may go unnoticed by the majority of the public and professionals, like these Mediterranean pond turtles captured for illegal sale.

Let's try to mentally reconstruct the scene. What would happen next?

For a few moments panic would ensue, scenes of people screaming in shock, while others rush to attend to the person who has been shot and is lying lifeless on the ground. In the meantime, almost everyone present talks about what happened over and over again, because this is a human mechanism for releasing post-traumatic stress. It is even possible that the CCTV cameras placed by the authorities in the streets may have recorded the scene and, failing that, passers-by may have done the same with their mobile phones, to the point that it is even possible that someone has posted the images on YouTube, Facebook, Twitter and Instagram. A few minutes, perhaps just moments later, while the smell of detonated gunpowder is still in the air, law enforcement forces and health care services urgently arrive at the scene and cordon it off, amid a deafening noise of sirens, police cars and ambulances, while the officers try to keep the crowd that is curiously approaching the scene at bay. It is even possible that among the passers-by there might be a medical professional who has offered to help the victim. Less than half an hour later, some police officers, notebook in hand, are taking statements from witnesses, who are standing in a long line eager to testify to what they have seen. In the meantime, other agents collect and photograph the numerous traces left during the crime: bullet shells, a balaclava dropped by the alleged murderer, etc. By this time, television cameras and the media have already informed the entire country and they are publishing interviews with people who witnessed the scene. At the end of the day, the police have all the information about the victim (name, nationality, age, affiliation, lifestyle, etc.) and even more, they have a comprehensive and detailed description of the perpetrator, including a facial composite, as a result of the statements of the long list of witnesses who voluntarily wanted to testify. Possibly by the next morning there will already be detentions. Case closed, at least for the police.

Photo 1.7 Goldfinch that was illegally captured for sale on the black market. This crime could easily go unnoticed.

But now let's get away from the hustle and bustle of the city and its crowded streets. Let's travel to any of the numerous remote wild areas we have in Europe or Africa – to the natural environment.

Let's now imagine a young golden eagle flying over the mountains in search of prey that, faced with the scarcity of food, has decided to feed on the carrion of a domestic animal. It has spent the night not far from there, in a lonely and inaccessible rocky area. It is Saturday, the same day and the same time as in the previous example, but that matters little, because in the mountains the hours and days have a different pace. For the young eagle, it is a day like any other. Suddenly it begins to feel sick, something is wrong and it feels the urge to get down and land on the ground as soon as possible. As soon as it does so, it drops dead on the spot; it has ingested poisoned bait. Another crime has been committed here, also classified as an environmental crime in the legislation of any European country. If we also try to mentally reconstruct the scene here, what would happen next? Simply put, nothing. It is highly likely that the carcass will never be found by anyone and if it is, there is also no guarantee that he or she will notify the authorities. At best, days, weeks or months will have passed when the notification is processed and by then, we will only find a heap of feathers and bones where poison and tissues have already decayed, or the carcass will have disappeared completely either by the action of natural scavengers or by those interested in eliminating evidence.

The key feature of crimes against wildlife in the natural environment is that there are no witnesses; there are no long lines of people eager to declare what they have seen, as was the case in the bustling street in the city. Additionally, we have to factor in the difficult access, since the crime may have taken place in a location that is reachable only after a long journey in off-road vehicles or walking on steep slopes.

Photo 1.8 Poisoned young Iberian imperial eagle.

Photo 1.9 Many crimes are committed in the vastness of the natural environment, as in the case of this otter that was captured and killed in a trap.

In light of the above, the mere fact of knowing that a crime has been committed against wildlife in the natural environment, the so-called "*notitia criminis*" in legal terms, is already good news, because it is no easy task to obtain that kind of information. Fortunately, in some European regions we have very good monitoring systems and human resources to increase the detection rate of animals that die in the countryside, but this is not the case in all corners of the world.

In most cases, by the time an agent reaches the scene, sometimes after exhausting physical (and occasionally even risky) efforts, if the carcass is still there, it will be so deteriorated that forensic experts will be able to extract little or no information from it, not to mention that the most relevant evidence in forensic science will have disappeared or will have decayed to the point of becoming irrelevant.

So, faced with this panorama of desolation and helplessness, what can be done? If you search for it, there is always an answer and a solution to every problem, and for crimes against biodiversity this solution is called *police investigation*, which is the true vocation of the environmental police and the basis of this manual.

When a criminal is caught red-handed by chance, no investigation is necessary, but unfortunately the countryside is huge and this happens only once in a thousand cases. That is why it is necessary to investigate: to follow the tracks that we find during the crime scene investigation, nothing more and nothing less. If the officer does not open an investigation, his work will be nothing more than simply collecting the remains of a dead animal in the countryside to swell the numbers, but he will not have performed his important role in the environmental police force.

The investigation of any crime committed against the environment seeks to find answers to the following questions:

—Who has committed it?

—Where?

—Why?

—How?

—When?

Apart from finding the answers to these questions, the investigation has another very specific fundamental objective: to reconstruct how the events took place as accurately as possible.

Not until we have a firm and decisive answer to all these questions can we consider the investigation to be closed so that the case can move on to further levels, such as the judiciary, but this is a different matter that is not addressed in this book.

In Europe today, the prosecution rate for crimes against biodiversity is astonishingly low compared to other common crimes, as mentioned above.

This manual explains the reasons for this and analyses which practices have room for improvement in order to increase results.

Where do we stand in terms of the investigation of environmental crimes?

The investigation of crimes against biodiversity can be defined as the art of transforming bad news into good news. It is just another way of doing conservation work, which is neither better nor worse than other contributions. If we look at any of the numerous publications[1] on the endangered species of our continent and go directly to the section on causes of extinction, we will immediately see that one of the main reasons are crimes against biodiversity. For decades, shooting, poisoning and other massive and non-selective methods of hunting and capturing animals, plundering, illegal logging, fires, etc., have had an impact on species such as bears, lynx, imperial eagles or bearded vultures, as well as their habitats. Certain entities and organisations are beginning to address one of the most severe threats to our future as a society: the loss of biodiversity.

The loss of biodiversity and, particularly, crimes against it are considered one of the greatest threats to the environment and consequently to our future, as has recently been recognised by all major international agencies, from the United Nations[2], to the European Commission and from EUROPOL[3] to the Member States of the European Union[4].

Environmental crimes have become extremely important in recent years, undoubtedly as a result of globalisation. Whereas in the past the impact of crimes committed against wildlife, for example, had only a local effect, in today's world the theft of glass eels in southern Spain may have originated in Beijing, and the theft of Eastern imperial eagle fledglings in Hungary may have been destined for a residential district in Bonn. Today's world is borderless and so is the criminal world. While crimes in the past were usually committed in the countryside, nowadays they can also be perpetrated in the intricate universe of the Internet.

This situation poses new challenges and needs, and EU Member States have started to address them especially since 2017, when they approved the inclusion of biodiversity crime as one of the ten EU priorities in the fight against serious and organised crime during the political cycle.

Some of these crimes are carried out on a small scale with a local or one-off impact, and constitute the type of crime that environmental police forces have been tackling with varying degrees of success over the years. However, a significant proportion of environmental crimes is not committed by isolated individuals or patterns, but by organised networks that professionally engage in crime. In these cases, the damage caused to the environment is not only local and its effects are not limited. In these circumstances, the effects of environmental crime transcend the limits of ecosystem recovery, to the extent of bringing them to levels of collapse or, in ecological terms, to the extinction of biodiversity. As we have seen, demand for a given product at a given location on the planet generates a large organised criminal network, which has the capacity to directly and indirectly deplete entire ecosystems found thousands of miles away.

[1] For example, in relation to birds and terrestrial mammals, we can cite these two publications: SEO/BirdLife (López-Jiménez, N. Ed). 2021. *Libro Rojo de las aves de España*.
Palomo, L. J., Gisbert, J. and Blanco, J. C. 2007. *Atlas y Libro Rojo de los Mamíferos Terrestres de España*. Dirección General para la Biodiversidad-SECEM-SECEMU, Madrid, 588 pages

[2] Wildlife and Forest Crime (unodc.org)

[3] European Union Serious and Organised Crime threat Assessment (SOCTA) de 2017 y 2021. EUROPOL.

[4] Wildlife Crime report. Policy Department A. Policy Department A of the European Parliament. Committee on the Environment, Public Health and Food Safety. 2017

Photo 1.10 Specialised police investigator collecting information at the scene.

For better or for worse, all Member States have a responsibility to fight this new threat, because they are either the origin, destination or simply a transit country of the bio-commodities involved.

Experience has shown us that each region or country on their own cannot cope with the threats of a changing, modern and globalised world. For example, some species of large raptors that breed in one country often find food in up to three different countries, where they may end up being killed under criminal circumstances. Small passerines born in a particular country may die from gunshots in another country during their migrations, all within a period of less than a week. There is no point in developing costly long-term conservation projects in one territory if a few miles away they don't play the game by the same rules. In such a context, it is clear that only international cooperation and coordinated work can be effective against threats that are no longer local, but global.

The fight against environmental crime is no longer the task of just a few police forces. In the past this may have been effective to some extent, but even so certain types of crimes have managed to evade the control of the public authorities, and as a result, numerous populations of scavenger birds have disappeared due to the action of a single crime: poison.

In Central and Mediterranean Europe today, multidisciplinary work is undoubtedly the only tool capable of bringing biodiversity crimes under control. Experience accumulated over the last twenty years has shown that only by integrating different technical and scientific disciplines is it possible to stay one step ahead of people who make environmental crime a way of life. The approach of using police alone has proven to be insufficient to eradicate crimes such as poisoning or shooting of protected species. In fact, as of today, while the rate of solving conventional crimes such as theft, mugging, crimes against sexual freedom or terrorism in and around Spain reaches figures above 80-90%, the success in solving shootings of endangered wildlife is less than 0.01%, according to official data published by the Spanish Government's Ministry of the Interior. Significant progress has only been made in the few instances when different specialists and entities have joined forces.

Another reason why the rate of solving biodiversity crimes has not matched that of conventional crimes is the lack, until recently, of laboratories and specialised forensic personnel. Fortunately, this factor is tending to be reversed, albeit slowly.

There are still few forensic services that provide the necessary scientific and legal guarantees so that the courts of justice can determine possible administrative and criminal liability when crimes and infractions are committed against endangered wild fauna.

In the European Union and in all other Western countries, the official certification of the cause of death of an animal species can only be carried out by accredited professionals with the necessary academic qualifications. Although the most influential laboratories have now been in existence for two decades, new teams of highly qualified and highly skilled specialists are now appearing in most countries connected with the European Union, tasked with issuing the corresponding expert and forensic reports.

Only specialised forensic laboratories have the capacity and competence to determine, for example, the causes of death of crimes investigated in Spain or neighbouring countries and to provide invaluable information that helps establish an adequate reconstruction of the investigated facts. These laboratories must be certified by quality controls according to international standards and regularly undergo numerous international certification tests (UNE-EN ISO/IEC 17025), which validate them as reference laboratories. They are subject to strict internal and external quality controls guaranteeing a reliable service to support the work of law enforcement officers and specialised technicians.

The official certification of the cause of death is issued once the autopsy and additional tests have been performed, the results of which are recorded in a complete and thorough written report validated by the scientific community, which triggers the opening of the case and is incorporated as a fundamental part of any judicial and administrative files and reports that may be generated. Later, during the preliminary hearing, the experts and specialists have to give an account in court about their statements and expert reports, being held liable for their assertions by the judge, the prosecutor, the defence attorneys and the private prosecution. It is precisely here where this legal and scientific guarantee is backed by the accreditation, qualifications and forensic experience of the professionals involved.

As we can see, effective police performance is useless if it is not accompanied by thorough biological and forensic work. Only when this combination is a reality within Europe as a whole will the rates for solving these crimes begin to improve.

Most of the specific legal systems for criminal procedures in Europe establish that environmental police officers, in addition to removing the carcasses and collecting evidence, have the fundamental mission of clarifying the circumstances of death through the corresponding investigation. In those cases where the investigation reveals the existence of an administrative offence or an alleged crime, the agent must report this to the corresponding police, environmental and judicial authorities, so that possible liability can be established through the relevant legal channel as determined in each country.

The investigation of biodiversity crime in today's Europe is one of the greatest challenges not only for law enforcement, but also for modern societies. At present, almost all of Spain's neighbouring countries already have excellent and highly trained police forces, having specialised forensic technicians and facilities that are equipped to carry out the most advanced forensic investigations.

Photo 1.11 Investigator analysing the site where an illegal snare for the capture and killing of predators has been placed.

Consequently, we have the best conditions to develop a solution that will help significantly improve the environmental richness indexes in and around Spain. The only thing left to do now is to start working and learning how to arrange the different factors in order to find the best solution.

Multidisciplinary approach and teamwork

Strictly speaking, the success of a police investigation is achieved when the perpetrator as detected and reported by the agents has been legally held accountable. But an investigation is a part of a very broad process that has many more elements apart from the inspections that the agents carry out in the field.

As an example, in an important case involving the poisoning of two bearded vultures in Andalusia, which resulted in a guilty verdict against the perpetrator, the number of agents that took part in the first phase of the initial CSI was five. However, the total number of professionals who played a direct role in the entire forensic/administrative/police/legal procedure was 44, of which only ten were agents.

In terms of working days, the following calculation has been made: the agents dedicated 9 full working days to the case; the forensic lab technicians (from the Centre for Analysis and Diagnosis of Wildlife (CAD)), 62 days; the technicians at the Agency for Environment and Water of Andalusia (AMAYA) and the Autonomous Department of the Environment, 41 days, and the legal professionals, around 17 hours.

In summary, in this particular case, the agents (Environmental Agents (AMAs) and Civil Guard) represented less than 30% of the total number of workers and working days. The workforce belonged to the following groups: law enforcement officers, veterinarians, biologists, dog handlers, lawyers, solicitors, clerks, administrative staff and drivers. They belong to diverse entities: Civil Guard, Environmental Agents, environmental technicians from the Provincial Delegation and Central Services, clerks at the Delegation, Central Services and CAD, technicians and assistants at AMAYA (Andalusian Recovery Plan for Scavenger Birds and Andalusian Strategy to Fight Poisoning), high- and intermediate-level technicians from CAD, personnel outsourced by AMAYA, lawyers for the Autonomous Government of Andalusia, private lawyers and solicitors. Each and every one of the professionals involved played a crucial role, to the point that it is impossible to say who had the greatest specific weight in the procedure, which, as we have said, resulted in an enormous success. Cooperation is never easy, but it was precisely the spirit of cooperation that allowed them to achieve their goal.

Another example is a similar case, also in Andalusia, which involved the poisoning of eleven griffon vultures (*Gyps fulvus*). Here, 8 Civil Guards, an Environmental Agent, two technicians from the Andalusian Strategy to Fight Poisoning, a forensic expert from the General Directorate, five forensic experts at CAD, a dog handler, a technician from the Andalusian Recovery Plan for Scavenger Birds, two members of an NGO and a lawyer for the private prosecution hired by a different NGO all worked on the case. The number of agents (from both forces) is lower than the number of technicians and other professionals.

Although we have cited just two examples, if we were to describe other cases, the result would be identical: behind the front-line work of the agents, there is a small multidisciplinary army of professionals who allow this work to progress.

In addition, the need for proper coordination and cooperation has an impact on the success and effectiveness of police investigations. Thus, the prevailing trend is that the classic EU police forces (e.g. Civil Guard, GNR, Carabinieri, etc.), which have enormous experience and effectiveness in crimes committed directly against people, are trying to solve crimes committed against wildlife following the same methodology, i.e. by themselves and in a secretive manner. In these circumstances, significant mistakes are frequently made because essential factors such as forensic victimology or the specific behaviour of the affected species are not taken into account or because elements of operational or strategic intelligence are lacking. In other words, experience and statistics overwhelmingly reveal time and again that police techniques for solving crimes against people are extraordinarily effective in that task, but clearly show room for improvement when it comes to crimes against biodiversity.

However, there is also the opposite trend, this time among environmental and forestry police forces in the EU. Although in many cases they have tools that the previous group lacks – extraordinary expertise in victimology and the behaviour of the affected species, as well as valuable local information – this valuable information is not shared for investigation purposes with the previous group, which is often the only one that has the legal and operational capacity to implement essential forensic science techniques to successfully complete the process.

In this regard, the widespread error that has been perceived until now is that criminal investigations are considered the exclusive domain of one force or another and the concept of teamwork is not contemplated. Investigations are carried out in an isolated manner, often with the excuse of following reporting restrictions or complying with procedures and regulations. In practice, each force considers that relying on another is a sign of weakness, when actually the opposite is true. In this regard, it should be noted that, despite our efforts, we have not found anywhere in the procedures or regulations that the different forces cannot undertake joint investigations and share information, or that the direct support of specialised forensic experts violates the law. Similarly, we have not found a single court ruling, not even under appeal, that invalidates or questions multidisciplinary and/or team-based research.

The statistics are revealing and certainly prompt reflection. For example, the number of Iberian lynxes that have been killed in Andalusia in allegedly criminal circumstances in the last twenty years is 59 individuals. Only four people have been sentenced for these actions (a meagre 6.7% of the known unlawful mortality), two others were charged and their respective criminal cases were dismissed, and a further two are currently awaiting trial. It should be noted that the investigations of the four convicted individuals, the two acquitted defendants and the two defendants awaiting trial (totalling 8 cases), were all carried out jointly and based on teamwork between different police and government forensic bodies. In the remaining 93% cases that were lost, there was no joint investigation and we are not aware of any such investigation having been opened. This means that whenever a joint investigation was opened, there were always results – the suspects were at least charged and also a good number of cases ended up in convictions. On the other hand, whenever the cases remained in the hands of a single police force, they were never prosecuted and we do not know if the suspect was ever identified.

Analysing bearded vulture deaths in the same period of time, we can see that 9 specimens died in criminal circumstances. For these crimes, five people were convicted (55%) and two others were charged. This means that almost 78% of the bearded vulture deaths had an identified and prosecuted suspect and more than half of these were convicted. These cases were solved thanks to investigative teamwork and to the participation of government forensic experts. Two out of the 9 cases were handled just by one police force, so they never led to any charges, just as was the case with the lynx.

In sum, it has been proven that regardless of the species studied, whenever there has been a well-coordinated multidisciplinary investigation, coupled with forensic and wildlife specialists and joint investigation between police forces, almost all cases have been solved. In contrast, crimes were never solved when one police force acted in isolation from the others, at least in Andalusia.

In view of the results, it is currently incomprehensible that any particular group would be willing to work independently. If the main objective is wildlife conservation, the interests of the public and the enforcement of the current legal system, from a technical point of view, working independently simply reduces the effectiveness and efficiency of the investigative action and does not allow for optimal results to be achieved.

As we have seen, crimes against wildlife have nothing to do with conventional crimes and are characterised by certain peculiarities that must be taken into account if the case resolution rate is to reach the same level as the rate for crimes committed against people. If the objective is to be effective in clearing up these crimes, the stakeholders must take these results into account.

How is the success of investigations and police work measured?

It is universally understood that a police investigation or a crime has been successfully investigated when the final result is a conviction and the guilty party is behind bars or pays a penalty.

In some ways this statement is true, but not entirely. Strictly from a police perspective, this may be the case, and after the conviction we may congratulate ourselves for the achievement and even see headlines in the press. But actually, our work goes far beyond a judicial act, which will be forgotten a few months later. The true success of investigating biodiversity crime is measured by other success factors that are very different from those of other crimes.

It is not uncommon to find that no suspect is identified in police actions that are carried out intensively in a given area, and even if a suspect is identified, we may not be successful in the judicial phase of the case on the grounds of not being able to prove their involvement. Although it is not possible under these circumstances to talk about police success per se, we are nevertheless making other achievements that are in fact important. For example, we may be deterring criminals from planting more poison due to an unusual police presence that prevents them from carrying out their unlawful activities. The result is that the poison that was going to be placed in the natural environment has not been placed and this is important. We have numerous examples of this and these are undoubtedly important steps.

The real success of our work is not measured in the convictions, or even in the number of traps or amount of poison that we seize, but in the amount of poison or shots that we are preventing from being directed at protected species. The problem is that this real success is rarely reported in the media, unlike other more media-friendly conservation actions, such as the releasing of protected species or putting culprits in jail. However, in more and more European regions the declining populations of some species are beginning to recover, largely thanks to this silent work, often ignored and demanding, but which is there and is truly necessary.

We should never consider a case that does not result in a conviction as a failure, because that will only generate frustration, and frustration is our true enemy. Let's not forget that our job is not to put people in jail or punish them, but to fight for the conservation of endangered species and biodiversity.

When we contemplate the flight of an imperial eagle or a majestic brown bear wandering through the forest, or a bearded vulture throwing bones from the heights, we must know that each of these wonders is a small miracle and that in each miracle we see there is a piece of our work and the work of many others across the continent who, like us, make this possible day after day.

02. PROHIBITED TRAPPING DEVICES AND ILLEGAL USES

When talking about crimes against biodiversity, we must necessarily talk about how they are committed and the methods used. This chapter describes prohibited trapping devices and illegal uses, with the aim of understanding these forms of trapping animals that are used in the natural environment. In the following sections we will analyse, from a forensic and police perspective, the consequences, signs (especially carcass dispositions) and evidence left by their use, in order to facilitate the investigation.

Throughout the course of history, a wide range of methods for capturing wildlife have been devised, used and optimised across the fields and mountains of Europe and the Mediterranean Basin, with the dual objective of obtaining food on the one hand and eliminating natural competitors on the other. Traditional systems were normally selective methods, rarely exceeding the limits of sustainability. Captures were intended for self-consumption and subsistence and were kept in relative balance with the natural environment, which, in turn, was in excellent health conditions.

In addition to the existence in the past of non-conservationist regulations, such as the provisions established by the Vermin Extinction Boards[5], which contributed to the depletion of many animal populations that are now protected or endangered, the current scenario is very different from that original balance – new technologies have allowed the development of indiscriminate trapping devices, whose uncontrolled use has had highly negative effects on wild species, to the extent of having contributed significantly to their local extinction and to an alarming decline in Europe and the entire Mediterranean Basin. This, together with the impact of other causes of extinction, such as habitat loss, the indiscriminate use of pesticides, the intensified extraction of natural resources and changes in livestock and agricultural management practices, have led to the virtual disappearance of many populations.

The most vulnerable species in this regard have been those referred to as specialists, which are not very adaptable and are highly dependent on a given resource or environment. On the other hand, generalist species, capable of surviving under a wide range of conditions and environments, have not been affected to the same extent; their populations have even increased in some areas, producing certain imbalances in the natural environment. The clearest examples of these categories are the Iberian or European lynx and the fox (photos 2.1 and 2.2). The lynx is known as a clear example of a specialist species, in this case depending on a specific prey or a small group of them. Among the various causes that have led to its extinction in most of Spain, for example, is the use of leghold traps. In contrast, the fox is clearly a generalist species. Despite also being a frequent victim of these devices, its populations have not been reduced, and have even benefited from the disappearance of its natural enemy, the lynx itself.

Photo 2.1 Iberian lynx, a specialist species.

[5] Decree of 11 August 1953 of the Ministry for Agriculture (Spanish Official Gazette no. 261, 13 September 1953).


Photo 2.2 A European fox, a generalist species.

Given the enormous risk that many of these devices pose not only to endangered fauna and ecosystems in general, but also to the health and safety of people, the laws of the EU (art.15 Habitats Directive) and of most of our neighbouring countries and regions expressly prohibit the possession, use or sale in our territory of all types of instruments and procedures that may cause the local disappearance of species or seriously alter the living conditions of their populations[6]. The devices whose use, possession and sale are prohibited are addressed in this chapter.

It should be understood that it is beyond the scope of this manual to elaborate a detailed catalogue of all the illegal methods used in Europe, the Mediterranean Basin or other parts of the world. Including all of them would be an impossible task, because they are astonishingly diverse. However, we can describe those methods most frequently reported in criminal use. Professionals involved in environmental policing and fighting biodiversity crime will certainly know how to apply the elements described here to their respective territories. We have opted to include these methods, largely also because a great deal of the devices used in Italy, for example, are identical or very similar to those you find in Spain and, in turn, most of the Spanish ones are the same as the Portuguese and French ones. After several years of studying these devices, we can categorically assert that the European/Mediterranean country with the greatest diversity, complexity and abundance of illegal trapping devices is Spain. In Spain, methods are used that are Spanish in origin, but traditions and elements from all over the region have also been found, including North African, British, French, German and Egyptian devices, as we will see below.

We must begin by saying that, in most of the countries around us, law enforcement officers are legally entitled to confiscate prohibited trapping instruments, without giving rise to a right to compensation, and to destroy any that can't be legally purchased. Similarly, territorial legislation determines which methods are authorised and to what extent.

It goes without saying that law enforcement officers that are responsible for fighting biodiversity-related crime must be familiar with and be able to recognise these trapping devices and prohibited uses. This is the main objective of this chapter.

Concepts and definitions

Before describing the most common prohibited methods in our territory, we must clarify some terms that are important for the work of law enforcement officers.

According to most national and regional legal systems, when agents come across any devices whose possession and use are illegal, they are required to seize them and must prepare the corresponding report as stipulated by law in each case. Recovered objects such as traps, snares, or similar objects, shall be deposited with the competent authority as determined by the regulations of each country and must always remain under custody. The corresponding provisions and/or court decisions will determine their ultimate destination. In most cases there are already specific places where seized items are officially deposited, with the exception of

[6] The prohibition is clearly stated, for example, in the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), and other conventions such as the Convention on Migratory Species (CMS) have passed binding resolutions on illegal hunting and the use of prohibited devices.

firearms, which are usually handled differently by law. Therefore, agents must know the closest deposit point to their assigned district.

They have to be familiar with the legal conditions established for the return of confiscated devices to the possessor, since the mere possession of these devices, let alone their use, is illegal and no return or compensation are due to the possessor, even if the latter has paid the corresponding fine. The officers involved in the case will make sure that the seized items are not illegally reused. This is fundamental, since it is something that happens regularly in many areas of the world. An interesting case worth mentioning was investigated by Spanish agents and expert technicians in Africa. In most African national parks, law enforcement officers, often risking their lives, make superhuman efforts to remove tens of thousands of trapping devices (traps and snares) that have been illegally placed to obtain meat for human consumption (*bush meat*). Photo 2.3 Once a significant quantity of them has accumulated, these devices are destroyed to prevent their re-entry into circulation. These agents recently participated in solving a case in which some industrial containers full of prohibited devices that had been shipped as scrap to some Asian countries entered port in other African countries, where their cargo was distributed among organised networks of poachers for ivory and bush meat capture. Given that there are precedents of similar events in the EU, albeit on a smaller scale, law enforcement officers must take extreme precautions to ensure and certify that these confiscated devices whose possession is illegal are destroyed.

Photo 2.3 Seized trapping devices used to obtain meat for human consumption in Africa.

However, two extremely important concepts must not be confused: there are devices whose mere possession is illegal (and also of course their use) and there are devices that can be legally possessed but are being used illegally. In these cases, the agents will also act in accordance with their country's regulations. A clear example of the latter is the use of sport diving compressed air cylinders for extractive fishing (photo 2.4)*;* you can legally possess this device for sport diving, but it is prohibited for use in spearfishing and extractive activities in many countries.

Photo 2.4 Diver with compressed air cylinder carrying out illegal shell-fishing activities.

In the above example, if a diver is reported for spearfishing with the aid of air cylinders, in many cases the seized cylinders may be returned to their rightful owner, but not definitively confiscated. If the offender flees from the agents, abandoning the diving equipment without having had the opportunity to be identified, then the cylinders and everything left behind shall be confiscated, and the facts shall be recorded in the corresponding report. As already mentioned, all these details are essential to determine the agents' actions, and it is crucial to know the regulations in each country or region in this regard.

Very similar cases are recorded involving people who capture finches in an apparently legal manner. While capturing them is completely illegal in the EU, it is still legal in other countries. There are times when animals are captured in a lawful manner, but other violations are committed, such as surpassing limits or lacking some minor documentation. In these cases, depending on national regulations, the nets may be confiscated and the owner may be able to recover them once the corresponding infringement proceedings have been resolved. If, on the other hand, the reported person lacks any type of authorisation and supporting documentation, then the nets may be confiscated and will not be returned. In this case it is not a minor infraction for not having a document of little relevance, but a serious one or even a crime for the use of prohibited devices.

Agents must be very cautious, knowing exactly which devices they can and must confiscate, and under what circumstances, and which ones cannot even be possessed. Depending on the circumstances and the country, the possession of a net may constitute a simple administrative infraction or a serious criminal offence. In many countries, as in Spain, the mere possession of the following trapping devices is illegal: leghold traps, snares, cage traps, mechanical calls, poisons, all-wire snap traps, glue traps, albeit with local exceptions as established by law. Logically, to avoid problems and to guarantee that our work is impeccable, the confiscation of any trapping device must be accompanied by the corresponding report, whether derived from a complaint or simply from a chance finding in the countryside, reflecting all the relevant details: description, owner (if any) and all the necessary information so that in the subsequent penalty phase it can be determined whether it is necessary to return or to eliminate the confiscated device.

Photo 2.5 Young fox killed by a snare. In many regions, hunting foxes with shotguns is legal, but illegal if using other means.

Another fundamental concept is the difference between prohibited trapping devices and trapping procedures. As mentioned at the beginning of this chapter, the variety of trapping devices in Europe and North Africa is worthy of a museum. It is not possible to list all the existing devices because each region or community has its own models or particular variants. In addition, their creativity sometimes goes beyond the limits of imagination, and using totally legal and natural elements (a simple stick and a stone, or even the mane of a horse) an experienced person can place a surprisingly effective trapping device in a matter of minutes (photos 2.6 and 2.7). Therefore, in many countries the law specifies that it prohibits "*... all types of traps and snares...*" and speaks of "*trapping devices and procedures*". Therefore, following the above example, even though we cannot report anyone for carrying a stick and a stone, we will be able to do so for using specific types of traps and following procedures clearly leading to the unauthorised capture of wildlife, however simple and rudimentary they may be.

Photo 2.6 An expert placing a selective trap to capture partridges in heat.

Photo 2.7 Handmade trap made with a simple stone and wooden sticks.

Targeted species and intended use of the prohibited devices

In order to adequately carry out our inspection work as law enforcement officers, we must have a good knowledge not only of the most common prohibited trapping devices in our district, but also of the species they are predominantly aimed at.

These devices are placed in the countryside for two main purposes. On the one hand, we have poaching or illegal hunting, i.e. unauthorised capture, retention or killing of edible wildlife, unbeknownst to the owner of the land or the operations or the law enforcement officers; captured animals are usually intended for sale, trade or consumption, and generally belong to game species. As a general rule, this practice is usually carried out by outsiders.

Photo 2.8 Red-legged partridge, a game species that is highly appreciated in Mediterranean cuisine.

When poaching is carried out by or with the awareness of the owners of the land or the operation, it is called self-poaching. On the other hand, we have devices that are placed for the elimination of predators of small game species or domestic livestock, mainly carnivorous mammals (wolves, bears, jackals, hyenas, foxes, mongooses, mustelids, feral dogs and cats).

Photo 2.9 Iberian wolf, a species that is frequently targeted for illegal predator elimination.

Contrary to poaching, the eradication of carnivores is almost always carried out with the awareness or consent or at the request of the managers or owners of the land or the hunting or livestock farming operations. In this case we call it illegal predator control. IMPORTANT: Please note that in many European countries and regions, predator control is carried out legally; in that case, it is necessary to verify which devices are used and whether they are legal.

Most frequently used prohibited devices in Europe and the Mediterranean Basin

The following list is not intended to be a comprehensive catalogue of all the prohibited or regulated devices, but it does include the most commonly used devices that every law enforcement officer must essentially be familiar with.

1. Devices used for the illegal capture of terrestrial species

1.1 Leghold traps

Leghold traps are mechanical devices that are made up of several parts. Together with snares and cage traps, they are the most common prohibited devices in Europe – less so in North Africa –, especially for illegal hunting and predator control.

Leghold traps have been used for centuries, dating back to before the Middle Ages. In the beginning, they were mainly intended for hunting large predators, especially wolves and bears. Due to the complex European mountainous terrain, geographic isolation between the different regions and territories led to the appearance in each area of traps of wide-ranging shapes, generally built using wrought iron and, sometimes, pieces of wood. They were unwieldy contraptions that were handcrafted in small numbers and, therefore, were only available to the few who could afford them. Among these antique devices, there are some authentic works of craftsmanship.

Photo 2.10 Brown bear, a species commonly targeted for capture by leghold traps since the Middle Ages.

It was not until the late 18th century and early 19th century that models of the modern traps we all know today began to appear, built in larger quantities and mass produced. From then on, their use became popular, especially for hunting rabbits as a staple food in most of rural Europe, and their effects on the populations of some species of specialist predators began to be felt.

However, the widespread use of leghold traps failed to significantly reduce rabbit populations, nor did it significantly affect the populations of wolves, foxes and other carnivores. Only the appearance of the first easily distributed poisons, especially strychnine, managed to make a dent in some of these species, especially the wolf and the bear, which were eradicated from most of the continent in a few decades.

Leghold traps remained in high demand in Europe until well into the second half of the 20th century, with great local variations, and then began to decrease, notably due to their ban and governmental pressure to eradicate them. For example, up until the 1980s in Andalusia it was common to place up to 2,500 rabbit traps per day on medium to large farms. Working days were measured in batches of 250 to 500 traps, which were transported on the backs of pack mules.

Dangerous traps

Fortunately, the number of people who use leghold traps has decreased considerably and few of them are as skilled as the old poachers, called "*alimañeros*". However, there are still professionals who act outside the law, and they should be investigated by environmental agents due to the risks they pose, not only for wildlife, but also for the safety of people. We cannot forget that nowadays the natural environment is widely intended for public use and leisure activities by the general public, who visit many places scattered throughout Europe. We have heard of numerous cases of hikers enjoying a splendid day in the countryside who have had to go to an emergency room because they have been victims of these mechanisms placed by poachers. In addition, there are a number of other cases in which the victims were dogs walking leisurely with their owners in the wild, suffering severe amputations and even death as a consequence of these devices. We also know of several cases in which environmental police officers were caught in traps while performing services next to wire fences in hunting reserves; thanks to the use of long field boots rising above the ankles, the injuries were minimal, although they required medical assistance. Today, their number has decreased dramatically thanks to surveillance efforts, with a good number of these devices being removed each year.

Leghold traps are not currently used evenly throughout European territory. There are areas where they have historically been firmly entrenched, usually coinciding with wolf and bear regions, while in other places their use is much more limited. However, where leghold traps are less common, alternative trapping devices are used.

The leghold traps currently in use in Spain are either very old (over 30 years old) or come from workshops that mass-produce them clandestinely. However, around 80% of the traps that are seized each year are old, loose and over 20 years old, with just the remaining 20% being newly manufactured.

Photo 2.11 Massive seizure of illegal trapping devices, including leghold traps, weapons, poison, snares, cage traps and nets.

These figures clearly show that, although the use of leghold traps has dropped greatly in recent years, there is still a significant amount that needs to be removed from the wild. In Andalusia, this removal from the countryside is combined with research on distributors within the autonomous community. At present, both lines of work are being successfully developed.

Recently, intelligence work has revealed that there is an illegal trafficking of traps manufactured in North Africa to areas of where wolves are present in Spain, undoubtedly as a result of police pressure on illegal trap manufacturing workshops in Spain.

Southwest Iberian leghold trap

The most common model in a large part of Portugal and Spain is the so-called “Iberian leghold trap” (photo 2.12). This is a rabbit trap that has gone unchanged in its shape since it first appeared more than a century ago, which proves its extraordinary effectiveness. It is a characteristic step-in trap (as opposed to those that capture by luring the prey), with a longspring and a pan cover, lacking teeth in the jaws. It is approximately 42.5 cm in total length and its jaws are 24 cm long and 30 cm wide when activated.

Photo 2.12 Southwest Iberian leghold trap .

It is by far the most common type of trap throughout the Iberian mainland areas of Mediterranean influence; for example, in Andalusia it accounts for almost 85% of all seizures from 2000 to 2020. Although its main purpose is to capture rabbits, as it is a non-selective method, it kills individuals of many other species of wild and protected fauna. In fact, they are also used to intentionally capture predators.

Although its shape has changed little throughout its history, the materials used for its manufacture have. The older ones are handcrafted using wrought iron, while the more modern ones are mass produced and use lighter materials, including some pieces in plywood (photo 2.13). Due to its wide distribution and availability compared to the other types, the Iberian trap has been and is used in different ways depending on the person who places it. Occasionally it has been modified locally to adapt its use for the capture of other species, especially the partridge, used along with hunting calls, given the widespread social and economic value of this species. To this end, poachers enlarge the width of the jaws by hand, attaching a net to them to capture the birds alive (photo 2.14). These devices are usually positioned around leks.

Photo 2.13 Old (right) and new (left) Iberian leghold trap.


Photo 2.14 Iberian trap adapted for the illegal capture of partridges.

This trap is so effective that there is a significant demand for it in countries such as the USA and other European countries.

Iberian leghold trap for predators

Due to its widespread availability, the Iberian leghold trap is also the most widely used for the illegal capture of carnivores. For this purpose, they are either made larger than the previous variant or a chain and an anchor are attached to the conventional trap, so that the trap and the prey are not lost. We must recall that leghold traps are expensive (25-30 Euro/unit), difficult to come by and, therefore, increasingly valued in the market, so anchoring them is a sensible idea so that the fox or some other captured carnivore cannot make off with it.

Although a chain or a cable are usually used as weights, casual elements such as a block of metal or a bundle of rebar hooked to a chain are also used; they can be fixed or allow the captured animal a certain degree of mobility (photo 2.15). Weights are anchored to fixed elements such as trees, fences or rocks using hooks, blocks or logs. Thus, if a rabbit trap is linked to a chain and its corresponding weight or anchor, this is an almost unmistakable sign that it is being used for the purpose of capturing predators, not for poaching or self-poaching of small game. Therefore, the finding is more likely to be related to poor management on the part of the operators of the hunting reserve than to the capture of small game by outsiders unrelated to the hunting reserve.


Photo 2.15 Leghold trap for predators, weighted down with a chain.

One characteristic feature of Iberian traps modified for illegal predator control is their teeth. Unlike other models, with teeth inserted in the jaws, the Iberian model does not have them by default. Thus, triangular pieces are welded to the inside of the jaws (photo 2.16) clearly aimed at causing more severe injuries to the predator and ensuring that it cannot escape once the jaws have closed on it.

Photo 2.16 Trap with teeth welded to the jaws for capturing predators.

Sometimes this model is further modified by reinforcing it with a spring, in handcrafted copies of other models that are typical in the north of Spain. For this purpose, the end of the longspring is cut off with a radial saw, a piece of motorcycle shock absorber is welded onto the device and then the end of the longspring is reattached (photo 2.17). In this way, when the trap is triggered, it closes with several rebounds, causing much more severe injuries to the captured carnivore.


Photo 2.17 Trap using a motorcycle shock absorber spring to increase its effectiveness.

Another typical modification of predator-specific traps is their increased size. In areas where the use of traps is most widespread, the seized Iberian leghold traps are usually larger than those of the typical model, reaching 49 cm in total length with a 29x30 cm jaw when activated (photo 2.18). These are old wrought-iron traps, fitted with teeth and weights, and their appearance in the natural environment is increasingly rare, as they do not seem to be manufactured nowadays. One peculiarity of this type of carnivore traps is that they are often not placed on a path, but rather buried in the ground under a piece of bait (a rabbit, chicken or pigeon) hanging from a tree. In this way, when the carnivore finds the bait and tries to reach it, it falls into the trap.


Photo 2.18 Large-sized traps.

Navarrese leghold trap

Like the other models discussed below, this type is not common in Andalusia. Its use is widespread in the regions of southern France and northern Spain, from Catalonia to Galicia, especially in some Pyrenean areas and well into Castile and Leon. These traps are fitted with longsprings and teeth, come in two sizes (30 and 34 cm total length), and are designed to capture both rabbits and predators as they step in on them. They differ from the conventional Iberian model in that they do not have a pan cover and their teeth are part of the jaw by design (photo 2.19). We have evidence that confirms that they were introduced in southern Spain by forestry workers who migrated seasonally in the past to the north of the Iberian Peninsula, where they would purchase them.

Photo 2.19 Navarrese leghold trap.

Turtle or rat leghold trap

Although this model is little known on a global scale, it was very popular until recently in certain areas of southern Europe. It is a multi-functional trap that can be used both as a step-in trap and as a bait trap, is fitted with teeth and a longspring and has variable dimensions (photo 2.20). Its main characteristic is its small size, having an open arc of only 11 cm, which made it a basic tool in the past for capturing pond turtles and rabbits for self-consumption, especially in the Guadalquivir marshes. Secondarily, it has also been used for the eradication of rats, garden dormice and foxes. Its use is currently very limited for the same reasons as the conventional model.

Photo 2.20 Turtle or rat leghold trap.

French leghold trap

French leghold traps have no longspring but rather use other spring mechanisms to close the jaws when activated. The French leghold trap is a medium-sized toothless rounded device (21 cm diameter) (photo 2.21). It is typical of the French Mediterranean coast, spreading from there along the Iberian east coast down to eastern Andalusia, which is the only area where we have documented its presence, though quite seldom (only two cases are known).

Photo 2.21 French leghold trap.

Since they lack a longspring, French leghold traps can be mounted on poles or on perches commonly used by predators. Although their use is versatile, they have been widely used against birds of prey, and are known to have wreaked havoc on certain populations of eagle owls and medium to large diurnal raptors in Europe.

Bear leghold trap

This is undoubtedly the most exceptional, spectacular and terrifying prohibited trapping device of all those that have been known in Spain. We are delighted to say that almost all of them are very old traps and we only have evidence of one recent handcrafted sample, which was seized by the Civil Guard's SEPRONA force in central Spain (photo 2.22).

Photo 2.22 Large bear leghold trap that had been handcrafted very recently and was confiscated in central Spain. The actual risk that these devices pose to people's lives when they are placed in the countryside is fairly obvious.

Bear traps have different shapes and are completely handcrafted. The most common version is identical in shape to the conventional Iberian leghold trap, with the exception of its enormous weight and size, as can be seen in the comparative photo (photo 2.23), reaching 100 cm in length and weighing 40 kg. These toothed traps are very old, possibly up to two centuries old. They are made of wrought iron and are intended for bear trapping. Due to their enormous dimensions, they must be opened using a rotating winch, in the absence of which it is not possible to open the jaws to activate them or collect the prey.

Photo 2.23 Large-sized bear trap and conventional Iberian trap for capturing rabbits.

Their use in Andalusia has been recorded on four occasions. Apparently, they come from the northern Iberian mountains (Palencia-Leon-Burgos), brought to Andalusia by seasonal workers on pack animals, following the Ruta de la Plata, with the aim of using them to capture wolves. This practice seems to have continued until the beginning of the 20th century.

As wolves disappeared, so did its use, limited only to the capture of wild boar on an exceptional basis.

Other leghold traps confiscated in Andalusia

Although few in number, law enforcement officers regularly seize trap models originating in other parts of Spain, especially Asturias and Galicia; traps of German, British or Dutch origin have also been found, mostly designed to capture predators. The photo here 2.24,

Photo 2.24 Leghold traps of various European and African origins seized in Andalusia.

shows some of these recent seizures, very diverse in terms of characteristics and dimensions. Special mention should be made of the so-called Moroccan traps (photo 2.25) still used today for capturing rabbit and hare. The latter are Moroccan-made. An anecdote worth mentioning is the recent discovery, during a canine inspection in a state-owned forest, of a rusty old Moroccan trap that, according to the tracking and documentary evidence, had been brought and placed by the African personal guard of the dictator Francisco Franco over 60 years ago to capture rabbits.

Photo 2.25 Two Moroccan-style traps flanking an Iberian trap for comparison.

1.2 Snares

If one had to say which trapping device is the most widespread in the world, the answer would undoubtedly be the snare. There are snares for elephants and for rodents, for birds and for wild boars, antelopes and buffaloes.

Their universal success lies in their simplicity, in the same way as simple viruses rule the world. These mechanical devices are as simple as they are lethal. They are made up of a single piece, generally a wire rope of variable thickness depending on the species for which they are intended (photo 2.26). Sometimes the material is horsehair, fishing nylon or other materials when the snare is targeting partridges or small insectivorous birds and thrushes.

Photo 2.26 Conventional snare for predators.

Unlike leghold traps, snares are very easy to come by (a cable can be legally purchased in any shop), assemble, activate and hide, as well as being much lighter and cheaper. At the end of their lifecycle, which is very short compared to leghold traps, they are abandoned in the countryside. While a single leghold trap can be used for decades to catch animals and even reach a century of service life, snares can only bear up to a few captures, as they tend to deform and deteriorate due to the agony and struggle of the captured animal until it dies. This is especially evident in the case of wild boars and predators, which fight to the point of exhaustion to try to free themselves.

In Europe, snares are currently the most widely used prohibited trapping device, together with poisons, for the illegal control of predators, and are also the most widely used for poaching small game as well as wild boar among big game species (photo 2.27).

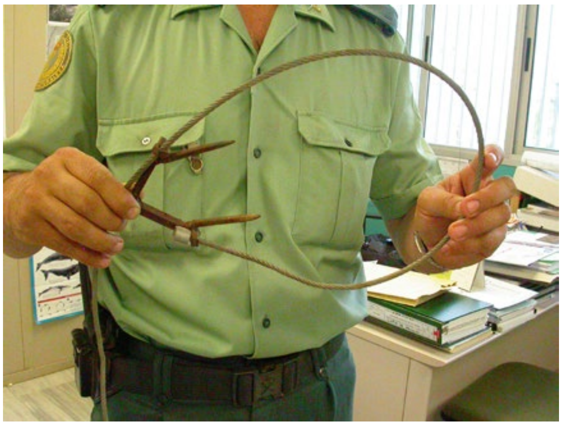


Photo 2.27 Snare for capturing wild boar.

It can definitely be said that no two snares are the same both in terms of construction and in the way they are placed; each snare usually bears the personal imprint of the person who created and placed it in the countryside. This double imprint or offender's signature (photo 2.28) is an element of enormous value in the police investigation of infractions and crimes, since it directly links the prohibited device with the person who has violated the law, as explained in other parts of this manual. The work of environmental agents has made it possible to successfully identify and report offenders, thanks to the offenders' signatures left on the snares. Snares are placed on paths and rarely combined with pieces of bait or attractants. Wire fences, enclosures, walls and similar structures are generally chosen to install these devices, making the most of the passages used by the fauna that is intended for capture. It is relatively common for snarers to block up these passages with branches, logs or stones to guide the animals toward the spot where the snares are placed (photo 2.29). When there are no enclosures or fences as support, snares are installed on branches or taking advantage of some other natural element. In many areas of Spain this device is mounted on one or two thin sticks that are driven into the ground, fitting the wire into notches at the free end (photo 2.30) These offenders' signatures are highly valuable in forensic science.

Photo 2.28 Offender's signature in a snare.

Photo 2.29 Path blocked to guide the predator to the snare.

Photo 2.30 Snares fitted into sticks for support.

For a snare to be effective, it must be correctly placed and also in a suitable location, at wildlife crossings. This implies both a skilful handling of the trapping device and a thorough knowledge of the transit paths of the target species and their habits. Obviously, for these reasons, not everyone in the countryside is able to successfully use snares, as this activity requires a large number of field days of attentive observation of the habits of wildlife in the first place. In addition, those who have mastered an effective method of placement have usually learned the technique from previous generations. All this explains why the most effective snarers are middle-aged individuals that have spent most of their lives in the countryside. On the other hand, poison baiting, by contrast, does not require the same level of field knowledge, which explains why, comparatively speaking, the proportion of younger people reported for poisoning is higher.

The most common types of snares used in Europe are described below.

Wild boar snare

It is aimed at the poaching of wild boar. This is the same snare that can be found in Sub-Saharan Africa and Asia to capture animals for human consumption. It is characterised by the use of thick braided steel wire (3-5 mm) (photo 2.31), because if it is thinner than that, the prey can break it and escape. For the same reason, the knots are more robust than those used to capture other species. It should be noted that these animals cause great destruction when they get trapped and fight against everything around them, inflicting severe neck lacerations on themselves.

Photo 2.31 Wild boar snare.

With regard to our inspection work, it is important to point out that poachers do not care at all, as a general rule, about the destruction that the animal causes when struggling, and they do not hesitate to install and anchor their wild boar snares on fences found in the vicinity, since these do not belong to them. It goes without saying that in these circumstances the structural damage can be substantial, entailing high repair costs. In cases of self-poaching, this damage is avoided by using heavy trunks as anchors for the snare, arranged in such a way that, once the animal is trapped, the branches of the tree or the trunk itself get caught in the vegetation to prevent the animal from escaping. They usually allow a short drag to increase injury to the animal and hasten its death.

Wild boar snares are to blame for most of the deaths of brown bears (*Ursus arctos*) linked to snares in Europe.

Predator snare

It differs from the above in that the wire is thinner, about 2 mm thick (photo 2.32). For its construction it is common to use bicycle brake wire or, increasingly over the past few years, industrial wire rolls of identical characteristics. This snare is not placed for poaching purposes, as the captures have no commercial, hunting or culinary value. Its sole function is the elimination of predators – mainly wolves, bears, foxes, jackals, feral cats and dogs, hyenas and mongooses – although it can be specifically targeted at other species such as martens, genets or badgers depending on the circumstances.

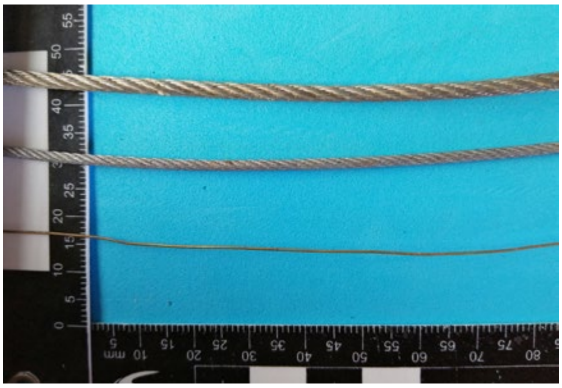


Photo 2.32 Detail of wires of different diameters for making snares. From top to bottom, to capture wild boar, fox and rabbit.

When we come across this type of device, the first thing we have to find out for sure is whether it is illegal or authorised in our country or region. If it is illegal, it is necessary to know whether the criminal motivation is hunting or livestock related. As a general rule, when law enforcement officers report the use of these snares, the accused will almost invariably allege that the snares are intended for poaching game and, therefore, have not been placed by them. For this reason, we must always be very attentive to distinguish them from true poacher's snares, whether they are wild boar snares, which are much thicker, or rabbit snares, which are much thinner (photo 2.33).

Photo 2.33 Braided steel wire of different thicknesses for capturing wild boar.

As in all cases, the success of a snare is based on its placement on pathways or near the burrows of the targeted species or specimens, so it is essential for the individual placing the snare to have a good knowledge of the daily habits of each predator. This is another reason why its use cannot be attributed to individuals unfamiliar with the hunting reserve. Only someone with strong ties to a place can so fully understand the behaviour of its wildlife, especially if it is nocturnal wildlife.

It is worth mentioning that in some jungle regions of the planet, it is common for law enforcement officers to use metal detectors to find and eliminate snares, as well as in Asia in protected areas where tigers (*Panthera tigris*) are present.

Stopped snares

These are predator snares equipped with a metal stopper that prevents total closure and, therefore, death by strangulation (photo 2.34). Their purpose is to capture the animal without killing it, in order to be able to release it later if it is a protected species. European public administrations sometimes resort to this device to authorise, on an exceptional basis, the legal control of predators in their respective territories. However, in practice it is difficult to comply with this condition, because freeing an animal trapped in a stopped snare requires great skill – and courage – to avoid injury to the animal and, of course, to avoid the damage that the animal will try its best to inflict on those nearby.

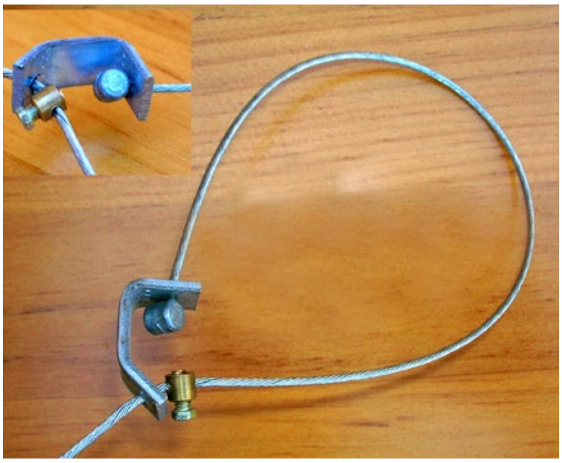


Photo 2.34 Stopped snare.

Rabbit and partridge snares

These are specific snares for two small game species, the rabbit and the red-legged partridge and, therefore, specific to activities related to poaching or self-poaching. Rabbit snares are much more widespread, especially in some European Mediterranean regions, while in North Africa partridge snares are quite frequent.

As for rabbit traps, although they are made of many diverse materials, they generally consist of a very fine single wire, 0.5-1 mm thick, or of hand-twisted copper wires (photo 2.35). Due to their size and characteristics, they are more difficult to detect than the above types, although this is compensated by the fact that they are found in large numbers.

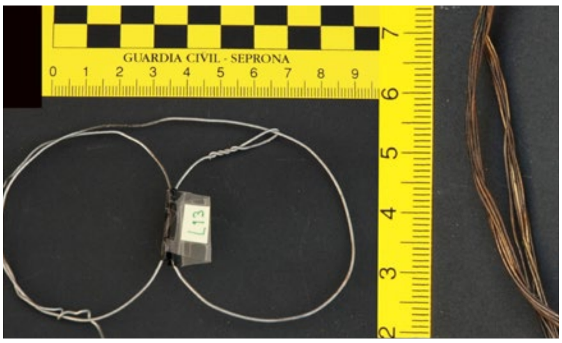


Photo 2.35 Seized rabbit snare.

As for partridge snares, they are only placed by highly experienced people, since they are only effective if you have a great knowledge of the species, the placement location and the technique. They are generally aimed at the capture of live males for decoy partridge hunting, either for private use or for illegal trade. These snares are installed around rutting places and leks. They are made out of a wide variety of materials, although braided horsehair, nylon and thick thread prevail. They are placed in small numbers, unlike rabbit snares, and are typical of those regions where this type of hunting is historically deeply rooted. We must mention here the elaborate twitch-up snare, typical of some parts of the Mediterranean coast (photo 2.36), consisting of a snare arranged on a metal rod that is stuck in the ground, bent and tensioned, which is automatically triggered when a stick lattice is touched. Sometimes a nearby plant, usually a rockrose, replaces the rod because of its flexible stem.

Similarly, the partridge box has the same purpose as the twitch-up snare. This snareless device consists of a tilting box that is buried in the ground, its use being limited to very specific areas.

Photo 2.36 A trap for catching birds such as partridge.

Passerine snares

These snares are designed to capture small birds, such as thrushes or other passerines (photo 2.37). Their use is related to migration and densely travelled flyways. They are usually made of nylon thread and are placed in large numbers on isolated trees that are used as communal roosts during the winter. Their use is widespread in the countries of the Mediterranean Basin. We should highlight here the popular “encijera”, (photo 2.38), a highly selective combined snare and trap system used for the live capture of finches, typical of the southern Spanish countryside, but now in disuse. Spring-loaded encijeras have recently become popular in some areas. These are similar to the above, but somewhat more sophisticated (photo 2.39).

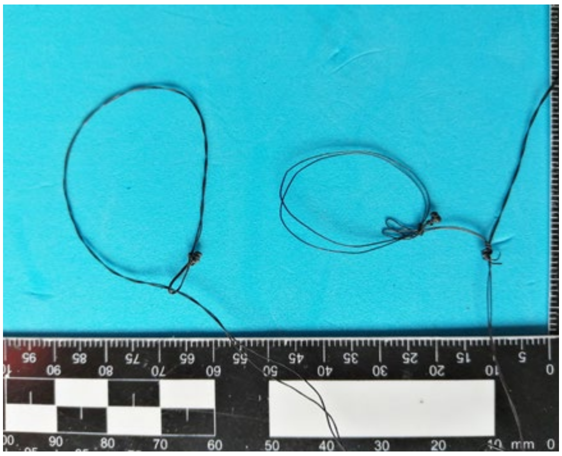


Photo 2.37 Nylon-made thrush-specific snares.


Photo 2.38 Traditional *encijera* .

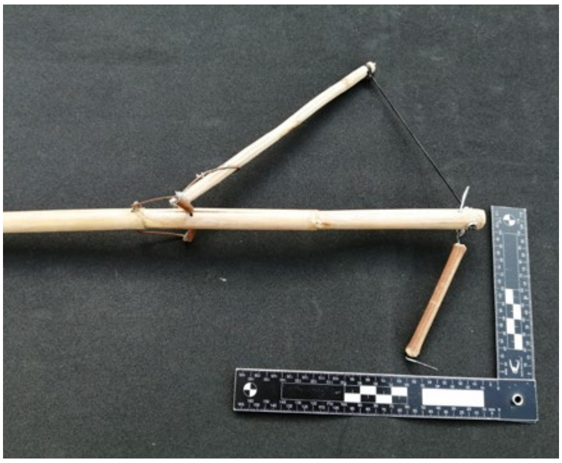


Photo 2.39 Spring-loaded *encijera*.

Automated snares

A few years ago, several models of more or less complex devices, a mixture of traps and snares, such as the Belisle® or the Collarum®, among others, came out on the market and became popular. In many European regions, their use is completely legal, so the agent must be aware of their regulatory status.

1.3 Cage traps

Along with traps, snares and poisons, cage traps are today the most common prohibited trapping device category for eradicating generalist predators in Europe. Their use for poaching is non-existent, as they are not intended for game species. It should be emphasised here that in many regions and countries their use is permitted, while in others it is not. Where their use is conditionally permitted, violations are detected as a result of non-compliance with the conditions.

Cage traps come in various types and sizes, ranging from 30 cm to almost 2 m long. (photos 2.40 and 41). There is a large number of cage traps on the market, with one or two entrances, with a device for live or dead bait and with a guillotine or tilting closing system. Handcrafted cage traps can also be found. One very recent model is made of PVC pipes of different lengths and diameters, placed on slopes, and closed at one end but open at the other. Once the animal enters the pipe, attracted by the bait, it is prevented from escaping by the narrowness of the pipe, dying inside from stress or starvation/dehydration. Sometimes the pipe has a small hole to insert a metal spike and kill the animal, as described in the corresponding section.

Photo 2.40 Cage trap illegally placed in the countryside, found by the Andalusian Canine Unit.

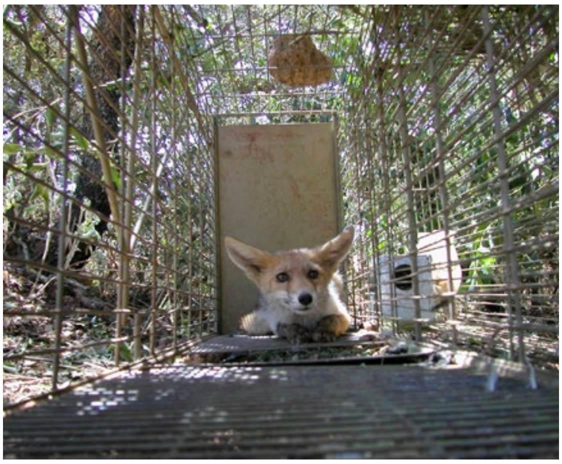


Photo 2.41 Cage trap with a fox trapped inside.

Due to their size and cumbersome nature, cage traps are easily detected during inspections by law enforcement officers, who seize a certain number of them every year. This, together with their high cost, means that their use is limited. They are mainly used in large hunting reserves, generally within a closed perimeter where police inspections are infrequent, as mentioned above, because they are easily detectable.

Unlike other devices used to eliminate predators, cage traps are usually placed in a single location, since they are more difficult and inconvenient to transport. Consequently, they are what we might call fixed capture stations, which is an extraordinary advantage for our inspection and surveillance work. Even if the trap is removed, it is common to find the grassless area and the cage mark on the ground (photo 2.42).

Photo 2.42 Location where a cage trap has been placed.

1.4 Passerine wire traps (all-wire snap traps and clap-bow traps)

Although in previous sections we have already discussed traps, these devices require a specific section due to their specialisation and extent of use.

The oldest records mentioning the use of this illegal trapping device date back 8,000 years in what is now Egypt. They are therefore one of the oldest trapping devices. Their original design was made from plant-based ropes and branches, later also adding fragments of domestic mammal ribs (hence "*costilla*", their Spanish name meaning 'rib'). In the 20th century they were built with wire, adopting the form in which they have survived to the present day. These devices are extremely popular from Portugal to China.

They are usually small-sized traps (photo 2.43), designed for catching small insectivorous birds, although they are sometimes modified to capture partridges and pigeons (photo 2.44). They can be entirely wire-made (all-wire snap traps) or fitted with a stick shaft (olive or asparagus sticks) or wood shaft (clap-bow traps). In the most sophisticated models, the stick may be painted black for camouflage purposes and the ring or jaw has a lateral opening to prevent incomplete closure in the event of catching stones or branches.

Photo 2.43 A Seized wire traps for passerines.

Photo 2.44 Modified wire traps, including a piece of netting for catching birds.

All-wire snap traps are aimed at capturing insectivorous birds for human consumption. In Europe, they are the cause of death of thousands of insectivorous passerines that are captured in winter during their migration throughout the Mediterranean Basin (photo 2.45). As a general rule, those who use all-wire snap traps do so to sell their captures to establishments where they are clandestinely served to the public or for self-consumption. In this regard, in Europe, this can be a triple violation depending on the region, since in addition to the placement and use of prohibited trapping devices, we are also talking about the capture of protected species and their sale, irrespective of the public health violations that may ensue. These devices are either handcrafted or mass-produced in clandestine workshops. Recently, a certain trafficking of these objects from China over the Internet has been detected, since the number of experts who can build them is declining.

Photo 2.45 Birds captured with all-wire snap traps, destined for self-consumption or trade in restaurants or markets.

Given that all-wire snap traps are traditionally built in many different places by craftsmen, it is common for each master to leave his imprint or signature on the traps he has built. Therefore, there are multiple variations (photo 2.46). depending on the region, district and producer. Again, these manufacturing variations have extraordinary value as forensic evidence.

Photo 2.46 Local variations of passerine traps or all-wire snap traps .

Their relatively low cost and the need to place large quantities of them in the countryside to make the captures profitable mean that the number of all-wire snap traps used in the wild is very high. An estimated 2.5 million of these traps have been built and sold in Andalusia alone over the last three decades. Although fortunately their use is decreasing due to legal and police pressure, a significant number of all-wire snap traps is seized every year as a result of intense surveillance work by environmental agents (photo 2.47).

Photo 2.47 Seizures of all-wire snap traps can be very large in numbers.

All-wire snap traps are normally baited with live prey, usually a winged ant, which is placed in the central hook (photo 2.48). For this reason, for the detection of these devices in the countryside it is extremely useful to look at the anthills in the surveyed area in autumn and winter. If they have been dug up with a hoe, it is a clear sign that winged ants and larvae are being collected to bait the traps.

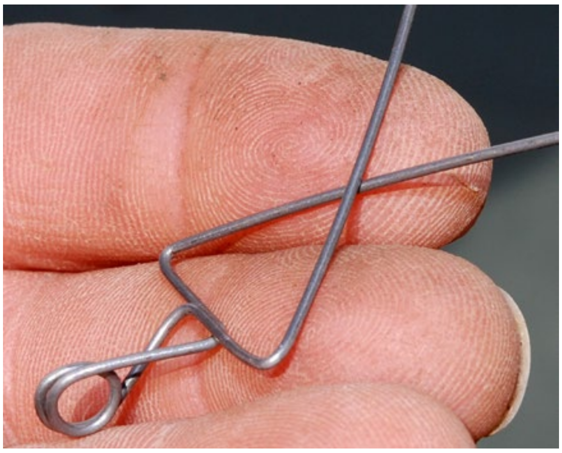


Photo 2.48 Central hook under construction.

Once these suspicions are confirmed, we will proceed to look for ideal places for the placement of all-wire snap traps, such as hedges or property lines or even on the branches of trees used as roosts. We must remember that they are placed in large quantities, so if we find one of these objects, we will find others nearby, as they tend to be scattered on the ground in rows, squares or circles, often marked with a sign to prevent loss. Again, each offender marks the exact location where they have placed their traps in a particular way, and if we are able to recognise the way they work, we will be able to find and remove most of them. The lines of action aimed at eradicating the use of all-wire snap traps in the natural environment must contemplate the prosecution of direct use, but it is equally or even more important to investigate the sources where these traps are produced. Dies are the most valuable parts, because a single die may have produced several thousand traps over a few years. Logically, we will have to focus all our attention on detecting these devices to seize them. The process of manufacturing an all-wire snap trap is simple, shown in this photo sequence (photo 2.49), obtained from a master trap maker in Seville. Some master craftsmen are even able to build the traps manually, without the help of dies, but this is rare.

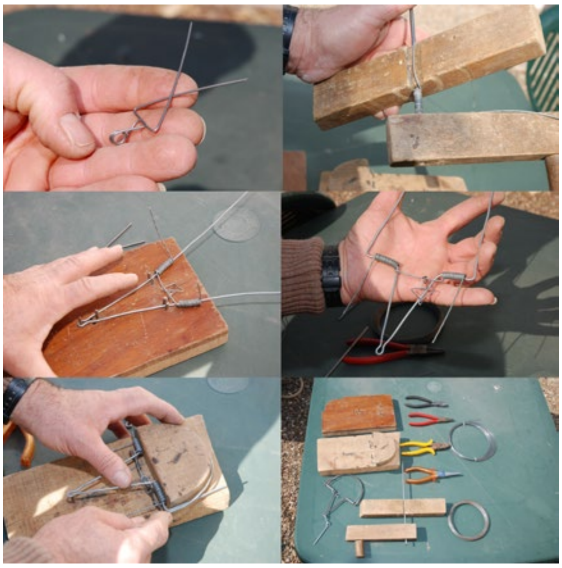


Photo 2.49 Sequence showing the manufacturing process of an all-wire snap trap for passerines.

1.5 Hooks

Although they are more commonly associated with fishing, hooks are sometimes used to capture or kill terrestrial wildlife species. They are used both for poaching seed-eating birds (anatids, little bustards, partridges and lapwings) and in the illegal control of predators. For the illegal control of predators, two forms of use have been detected in Spain. In one of them, treble hooks of variable sizes (photo 2.50), baited with meat, are hung from a branch or bush so that the target predator is forced to jump to reach the bait. As it jumps, the animal is caught by the hook, which usually tears its lips, tongue and palate, or dislocates the animal's jaw, leading it to starve to death because it is unable to feed after being snagged or because of infections from the wound. The other system detected consists of pieces of raw meat bait with dozens or hundreds of hooks or pins inside, generally of small size, which are placed along paths (photo 2.51).

Photo 2.50 Fishing hooks seized in hunting reserves that have been used to capture and kill carnivorous predators.

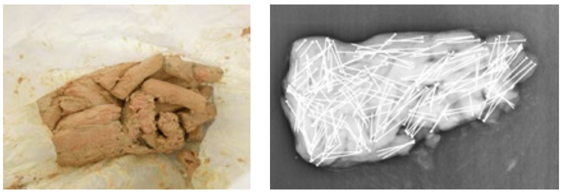


Photo 2.51 Example of pin-filled bait.

1.6 Glue traps

They are widely used in southern Portugal and Spain. They have different names depending on the region. Setting a glue trap entails impregnating branches, esparto grass sticks, thistles, bushes, etc., with sticky substances to capture the finches that perch there (photo 2.52). In Spain this has been used especially in the so-called parany or barraca hunting system, which consists of a wooded area where glued sticks are installed to capture mainly thrushes (Turdus philomelos) with the help of hunting calls (photo 2.53). Combined with this practice, troughs or food bait are sometimes used to attract the birds, and it is also common to use a commercial synthetic version of the product in these circumstances. However, due to the fact that the possession and sale of this product is strictly prosecuted, it is becoming increasingly difficult to obtain it in most areas. Handmade glue traps made of burnt rubber are also used, typically in the eastern provinces of Andalusia, even resorting to commercial glue for rats, which is much stronger, leading to a high number of bird deaths due to stress and suffocation.

Photo 2.52 Sticks and glue for capturing birds.

Photo 2.53 *Parany* set-up in Valencia.

1.7 Light sources

Here we include all sorts of active or passive elements, simple or sophisticated, that can emit light or transform it into the visible spectrum: headlamps, spotlights, flashlights, dazzling mirrors, lasers and image-intensifier night scopes (photo 2.54). In Spain, the vast majority of light sources are used for poaching small game (generally rabbits, hares, partridges and passerines). The use of spotlights and flashlights has two purposes, either to dazzle the prey or to illuminate the target. In big game poaching, it is common to connect a powerful spotlight to a motorcycle or car battery, as evidenced by the numerous interventions carried out to date (photo 2.55).

Photo 2.54 Night hunting with a scope.

Photo 2.55 Intervention against poachers using a night scope, spotlight, motorcycle battery and rifle and shotgun ammunition.

Almost exclusive to this type of poaching are night scopes, mounted on rifles equipped with silencers.

Mirrors were part of the equipment of plunderers of small raptors for many years in the western Andalusian provinces, but this practice has almost disappeared today. Their use for capturing partridge fledglings is occasionally detected in the countryside of Mediterranean countries. They were used by reflecting a concentrated beam of sunlight directly into the eyes of the bird, so that it was left temporarily blinded and stunned, and that instant was used to quickly capture it either manually or with a stick.

Although only locally relevant, the capture of frogs for human consumption has an enormous impact on natural populations. The consumption of frogs' legs is very popular in some areas, to the point that their natural populations are literally wiped out by illegal gathering. As a result, people that are specialised in their capture and trade sometimes travel to other regions to gather amphibians in large quantities for sale in areas where demand is high. The devices used are lamps and sticks, operating at night. Seizures during such actions often attract quite a lot of attention.

1.8 Chemicals

Chemicals are used throughout Europe and the rest of the world for poaching purposes to obtain the highest possible return from illegal activity. In some countries, potent poisons are even used to kill water birds that are subsequently introduced into the human food chain, resulting in deaths among the population[7] .

Most commonly, offenders who resort to chemicals often obtain a direct economic benefit from their actions, since their captures are used for trade on a considerable scale. It is no longer a matter of light poaching for self-consumption or small-scale trade, but of profit-seeking activities with significant gains, which is clearly considered an aggravating circumstance in the infraction. Their use is most widespread for big game poaching.

The chemicals can be attractants, such as the classic salt for ungulates or diesel oil for wild boar, or repellents, such as naphthalene or camphor balls, bleach, etc., used to scare animals away from hunting grounds on the days prior to a *monteria* hunt or beating. There have also been cases where repellents have been used to guide predators to areas where traps and snares have been strategically placed. Occasionally, piles of carpenter's sawdust may be used around fox traps as an attractant, as is sometimes the case in some regions.

Certain chemicals are used to stun the captures so that they can be easily gathered. Burnt sulphur is placed under roosts of wintering passerines to capture and subsequently sell them as "fried birds", and butane gas or vehicle exhaust fumes are piped into rabbit holes so that the animals can be trapped in nets placed in the entrance as they flee.

1.9 Ferrets

The use of ferrets is thoroughly regulated and it is legal in Spain for the management of rabbit populations within hunting reserves, albeit with a permit and on an exceptional basis. In these cases, the animals must always have the proper documentation. However, outside this framework, unauthorised rabbit poaching with ferrets is relatively common, which is a frequent cause of administrative complaints in many areas of Spain. Regarding this method, the specific regulations in each country must be consulted to determine its legality.

1.10 Nets

Throughout Europe and North Africa, nets are used almost exclusively to capture finches, which are highly valued for their song, either for trade or for personal enjoyment. They are also frequently used in the Maghreb countries to capture migratory birds of prey for sale and for falconry.

The nets can be either collapsible nets or haul nets, but in any case, to be effective, they must be baited with food (which in itself is an administrative infraction in many regions) or use living caged bird decoys. Once again, we must insist that in many regions the use of nets to capture finches or song birds is a legal practice, although in the European Union it has already been banned.

It is also possible to find mist nets made of fine black thread, which are installed vertically to intercept the birds as they fly. Their use is intended for the capture of insectivorous birds, not finches like the above nets, and they are always illegal in the EU. The only exception is scientific banding, based on the strictly regulated use of these nets, which must have a specific administrative authorisation. Scientific banders must always carry valid permits with them and be ready to present them to law enforcement officers.

Photo 2.56 Capture made with a mist net.

[7] Martin Odino en Richards, N, Edit. Carbofuran and Wildlife Poisoning, 2012, Wiley-Blackwell

In the photo below 2.57 the differences between a mist net and a collapsible or haul net can be seen. On other occasions, small nets can be found for catching rabbits in combination with the use of ferrets, or mounted on reed frames to catch live partridges at night. An example of this is the so-called "*El Santo*" method, typical of the Andalusian countryside. For the capture of hares in the open countryside, large nets, up to 30 metres long, may be used.

Photo 2.57 There are different types of nets: mist nets, collapsible nets and haul nets.

Large gun nets are strictly intended for scientific use and are triggered by explosives, requiring a specific and very restricted permit provided by the national authorities.

1.11 Bait and explosives

Their purposes and procedures are similar to those of chemicals and, therefore, they are used by more or less professionalised poachers. The practice consists of placing corn, wheat or similar bait in unauthorised feeders to attract big game (mainly deer and wild boar) or small game (red-legged partridge). We must not confuse these illegal poacher feeders with the supplementary feeding points that are found in hunting reserves. The former are usually simple piles of food on the ground, located far from roads and well hidden; some balanced stones are often placed next to them so that the animal knocks them over when eating, alerting the poacher with the noise. Not far from these food piles, usually just a few metres away, is located the hunting hide behind branches and bushes, either on the ground or in trees. On the other hand, legal supplementary feeders tend to be either linear troughs or the feed is arranged in specific structures for this purpose.

Photo 2.58 Feeder with corn to attract big game species.

Finches do not escape this practice either, and it is relatively common to bait the surroundings of collapsible nets with sunflower seeds or other grains, specific mixtures and/or water (photo 2.59). . It is also quite common to place bait around traps to capture foxes (photo 2.60).

Photo 2.59 Nets arranged over a drinker used to attract finches.

Explosives deserve special attention. Their use is completely forbidden, with the sole exception of pyrotechnic articles used to mark the beginning of *monteria* hunts. The illegal use of explosives has always been occasional and on a reduced scale for very specific purposes; among them is the detonation of powerful rockets inside foxholes, which can burst the eardrums of the animals, combined with the placement of snares at the exits to trap them during their escape (photo 2.61).

Photo 2.60 A hen used as bait to attract foxes to a trap.

Photo 2.61 Pyrotechnic material for use inside foxholes.

We have also mentioned pieces of meat bait suspended from tree branches, that are used to attract carnivorous mammals to leghold traps placed underneath. In other cases, several pieces of meat bait are placed around a trap.

1.12 Hunting calls and decoys

Hunting call and decoy types are as diverse as their usage. Decoys are visual (they can be live, dissected or plastic-made and articulated) and calls are acoustic (they can be mechanical or electronic). In most of the cases detected, calls and decoys are used for illegal hunting (anatids, thrushes, finches, etc.), but they are also known to be used to capture foxes (the popular rabbit calls) or to hunt corvids and raptors with owls, although this latter usage has practically disappeared.

Photo 2.62 Owl used for illegal hunting of birds.

In the past, small electronic sound devices were purchased and used to reproduce the song or sound of the species to be imitated. These battery-powered devices were easily detectable and they could be seized. At present, mobile phones are used as hunting calls. These may be confiscated in so far as they involve the unlawful use of a lawful object. If the agent finds that the mobile phone is being used as an illegal means for an illegal purpose, this may be attested and the phone may be confiscated, so that the competent criminal or administrative authority may decide whether returning it is in order or not.

1.13 Forbidden weapons and ammunition

In many European countries, the following weapons are considered prohibited for hunting: gas weapons, especially air guns, automatic or semi-automatic weapons with more than two cartridges and .22 calibre rifles or carbines (photo 2.63). In addition, all legal firearms equipped with silencers, spotlights, lasers or night scopes are prohibited (photo 2.64), as well as muzzle-loading firearms (those that are loaded through the muzzle) and handmade firearms activated by wildlife movement, examples of which have recently been found in our territory (photo 2.65). There are not many cases involving the use of muzzle-loading and black powder weapons in Europe, although in North America they are so popular that there is even a "black powder week" in which for one week it is only legal to use these weapons. With regard to ammunition, depending on the laws of each country, it is generally prohibited to use pellets, .22 calibre rimfire bullets, war ammunition, buckshots (with pellets weighing more than 2.5 g), explosive bullets, manipulated ammunition and lead projectiles in areas where this metal is prohibited.

Photo 2.63 Seized weapons with silencers.

Photo 2.65 Muzzle-loading firearm used for poaching.

In Spain, .22 calibre rimfire cartridges, buckshots, silencers, night scopes, lasers and explosive bullets are commonly used in poaching, generally for big game hunting. The rest of the prohibited weapons and ammunition, such as gas weapons or tranquillizer darts, are rarely or exceptionally used in our territory.

Also, handmade weapons manufactured for poaching cannot be ignored in this manual and in this section. Some of these can be disassembled and they either use conventional .12 or smaller calibre shotgun bullets or rimfire ammunition, mainly 22LR (photo 2.66).

As a final example of how complex and dangerous firearms found in the countryside for poaching can be, there have even been reports of self-firing weapons that are triggered by the animal (or human being) passing through

Photos 2.64 Different firearms equipped with scopes, spotlights and lasers, whose use is prohibited.

the forest (photo 2.67). It goes without saying that they are absolutely illegal, but on top of that they are also extremely dangerous for the user and a great risk to public safety.

Photo 2.66 Disassembled craft weapon.

Photo2.67 Assembled handmade weapon.

Agents must thoroughly search for both detachable and handmade weapons and, in general, all types of weapons, in different recesses of the vehicle, in the wilderness, or any place where they may be hidden. Modified weapons are almost invariably illegal and their possession is a crime. Experience has shown that when it comes to hiding weapons to avoid inspection there is an extraordinary amount of creativity and, with few exceptions, criminals are far ahead of police abilities to detect them (photo 2.68).

Photos 2.68 Stash in the underside of an off-road vehicle to hide weapons for poaching.

More often than not, officers are faced with doubts as to whether the possession/use of a particular type of ammunition found during searches and investigations is legal or illegal. For a better understanding of the nature, classification and functioning of ammunition, we recommend consulting the Biodiversity Legal Protection Manual for Agents of the Environmental Authority in Andalusia[8].

[8] This manual has been prepared by the Autonomous Government of Andalusia and is only available to law enforcement officers.

First of all, it should be stressed that each country's regulations establish which weapons and ammunition may or may not be used and it is not the purpose of this manual to describe each case. However, a brief overview is provided for Spain, where we can talk about the overall situation.

Ammunition is divided into two main groups: rifle/carbine ammunition (photo 2.69), also called metallic ammunition, and shotgun (photo 2.70). Ammunition for air guns or other gas weapons is prohibited and, therefore, when it is found, it must be seized and a fine must be issued, if applicable, according to local regulations.

Photo 2.69 Rifle/carbine ammunition.

Photo 2.70 Shotgun ammunition or semi-metallic ammunition.

Within rifle/carbine ammunition, in turn, we have two groups, rimfire ammunition (photo 2.71) and the more numerous centrefire ammunition (photo 2.72).

Photo 2.71 Unfired and fired rimfire ammunition.

Photo 2.72 Unfired and fired centrefire ammunition.

Regarding rimfire ammunition, it is worth mentioning that, as a general rule, in and around Spain (unlike in North America, where they are wildly popular), we only find the 0.22-inch cartridge, better known as "the 22". There are different variants of this popular cartridge, such as the LR (Long Rifle) (photo 2.73). This photo shows several metallic rimfire cartridges, for military (bottom row) and commercial (top row) use. Despite its extraordinary popularity, this cartridge is actually completely banned. This is possibly the most widely used type of illegal ammunition for poaching at short/medium range due to its effectiveness, low noise and the small size of the weapons, which can even be disassembled and are very easy to hide in a vehicle. Moreover, it is easy and cheap to adapt an air rifle to this ammunition, thus avoiding legal controls on the weapon and, as if that were not enough, they can even be manufactured by hand, as we saw earlier. In most cases the possession of ammunition and weapons is illegal. Other rimfire calibres are allowed for hunting, such as the 17HMR, which is actually a 4.3 mm.

Photo 2.73 LR cartridge, third from the left in the top row.

The centrefire ammunition category includes most rifle cartridges, both legal and illegal, in which, as we know, the firing pin strikes a piston or percussion cap isolated from the powder and located in the centre of the base of the cartridge case. In this case, unlike the previous one, it is important to note that practically all the ammunition on the market is legal, with the exceptions mentioned below.

The main proviso is that military ammunition or FMJ (Full Metal Jacket) is prohibited for hunting. The reason is that this ammunition is designed to produce wounds and ricochets, rather than instantaneous deaths, and therefore its civilian use in areas where people are present is highly dangerous. In African countries, this type of ammunition is used for hunting large mammals because they penetrate further into the body and reach vital organs. Legal hunting ammunition tends to expand, either violently or in a controlled manner, so that it transfers all the kinetic energy to the animal's body through expansion and deformation, thus accelerating the animal's death.

For the officers, this prohibition poses the difficulty of having to determine whether a cartridge is for military or civilian/commercial use, basically because the most popular hunting ammunition has military equivalents. This is the case of the famed 7.62x51 mm NATO military cartridge, for example (photo 2.74). Its legal commercial version for hunting is the 308 Winchester (photo 2.75). They are almost indistinguishable to the naked eye, which explains the enormous difficulty agents have in identifying ammunition during their inspections. Similarly, the well-known and popular 30-06 rifle cartridge, widely used in big game hunting, is an adaptation for hunting of a legendary military variant. Even the famous AK-47 Kalashnikov cartridge (7.62x39 mm), used illegally in hunting, has legal hunting versions for sporting and hunting use, although these are not popular in Europe for big game hunting due to their ballistics.

Photo 2.74 7.62x51 mm NATO military cartridge, third from the left. The two cartridges on the left are commercial and the third is for military use.

The use of war ammunition for hunting has been detected, allegedly for ballistic reasons. Agents can tell if it is one type or the other largely from the butt or base of the cartridge (photos 2.76 and 2.77). Military cartridges have their own codes, sometimes encrypted for reasons that are not relevant here, or even have no marking at all. On the other hand, all commercial ammunition for legal hunting use is marked with the type of cartridge and the manufacturer.

Photo 2.75 Winchester cartridge, legal for hunting.


Photo 2.76 Military cartridge butts that are illegal for hunting .

Photo 2.77 Legal commercial cartridge butts.

Other metallic ammunition cartridges that are illegal for hunting are all those that have been manipulated in any way, either their cases, powder or bullets, such as grooves for greater expansion. It goes without saying that the use of these cartridges entails serious risks for the user.

Semi-metallic cartridges are much simpler than metallic cartridges in some ways, but also more complex in others. Their simplicity lies in the fact that practically all of them are for civilian use, and therefore there is no prohibited military or war ammunition of this type. On the other hand, however, they are more complex because the cartridges can shoot a single projectile (as in metallic cartridges) or many of them (up to approx. 300) (photo 2.78). What the general regulations establish is that pellets weighing more than 2.5 g within buckshots are completely prohibited for hunting in Spain (photo 2.79). Buckshot pellets can be loose or linked together for incredibly devastating effects (photo 2.80), As mentioned, all of them are prohibited for hunting in Spain. This photo 2.81 shows the difference between legal no. 7 birdshot pellets and illegal buckshot pellets.

Photo 2.78 Loading a cartridge.

Photo 2.79 Pellets used in modified cartridges.

Photo 2.80 Linked pellets have a more devastating effect.

Photo 2.81 Differences between legal no. 7 birdshot pellets and much larger illegal buckshot pellets.

It is important to note that, although in Europe most metallic ammunition cartridges are single projectile, in North America, in contrast, variants known as snake shots are very popular. These carry multiple projectiles of very small size, although as we have said, in Europe they are practically non-existent now (photo 2.82).

Photo 2.82 Cartridges with multiple projectiles.

There are also semi-metallic single projectile cartridges (bullet cartridges), which are legal for big game hunting. They can have the same calibre as the weapon (photo 2.83) or be sub-calibrated (Sabbot) (photo 2.84).

Photo 2.83 Single projectile cartridge of the same calibre as the weapon .

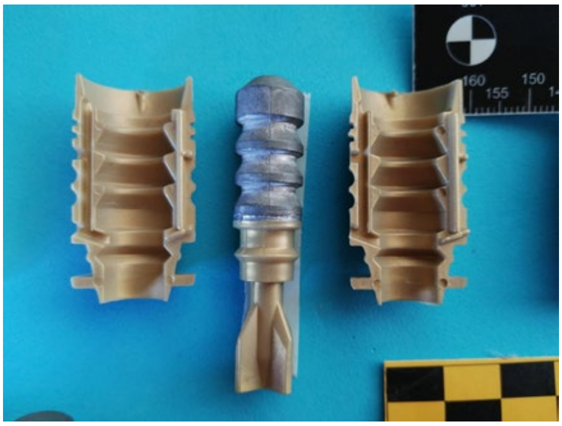


Photo 2.84 Sub-calibrated single projectile cartridge.

So, what makes ammunition legal or illegal? Actually, there are two aspects that determine this. First of all, as we have seen, there is ammunition, whether metallic or semi-metallic, that cannot be used for hunting in Spain or in other EU countries and, as a result, not only the use, but also the possession of such ammunition is prohibited in many autonomous regions. Within this category, we have .22 calibre rimfire cartridges, centrefire ammunition for military use and any ammunition that has been tampered with. As for semi-metallic ammunition (shotgun cartridges), buckshots are illegal.

Secondly, we must bear in mind that even if the ammunition itself is lawful, it may be used in an unlawful manner. For example, a wrench is a tool we can lawfully purchase, possess and use for the purpose for which it was designed, but it is unlawful to use it to assault someone. Likewise, any lawful ammunition shall be considered unlawfully used if the offender, for example, uses it for poaching or to shoot an endangered species.

The agent will have to carefully consider and assess whether it is one case or the other or both at the same time. A few years ago, an individual was prosecuted for shooting an Iberian lynx with a .22 calibre gun and lodging the projectile in its spine. In this case, not only was there an accusation of shooting of an endangered species, but also the aggravating circumstance of shooting in a protected area, in addition to the use of illegal ammunition and an illegal weapon.

2. Devices used for the illegal capture of aquatic species

Compared to the devices seized and confiscated for terrestrial species, the devices used for aquatic species are less numerous, which is why they are treated in less detail. However, their impact is important in humid regions such as tidal marshes and certain rivers.

River fishing regulations establish which devices are prohibited, including those that are legal but used irregularly. Nevertheless, it is important to mention at least some devices that are prohibited under all circumstances. Thus, in many European regions, river fishing with pieces of nets that are anchored or fixed on one or both ends, whether fixed or mobile, is prohibited, with the exception of auxiliary landing nets. Fish traps and crab pots are authorised for crab fishing, but only locally. Harpoons, pole spears and tridents are also forbidden, as well as paralysing or vibration-producing electrical devices, poisonous substances, bleach and bleach-like products and explosives of any kind. However, we insist that agents need to be aware of the applicable legislation in their corresponding areas.

Finally, the use of fish and crabs as bait is also completely forbidden in most of Europe, albeit with exceptions. In some areas, the illegal use of exotic fish as live bait is causing serious problems in the natural environment. These fish are usually carried in large plastic water containers; when fishing is over, the offender dumps the remaining fish into the waterway. This is obviously a clear example of the introduction of exotic species into the natural environment, which can have devastating effects on Mediterranean aquatic ecosystems, as has been demonstrated on numerous occasions.

03. CARCASS DISPOSITION

Death is a natural process that involves a series of changes in carcasses affecting their posture and position. As they say in forensics, carcasses speak volumes, and with proper training it is possible to understand their language and get some interesting readings about the animal's circumstances in the moments before its death.

The position in which we find carcasses is in itself crucial and enormously informative. The combination of the general position of the animal's body, the posture of the head, the arrangement of the limbs and other details is known as carcass disposition. Carcass disposition is greatly important in the investigation of wildlife crimes for an absolutely crucial reason: it provides us with information about the final moments of the animal's life. Once this is known, it can help us directly or indirectly to infer or suspect the cause of death, so that the field agent alone can obtain a basis for initiating an investigation.

As we all know, blood flows within living organisms and, in a nutshell, this makes the body flexible, enabling it to move. After death, blood flow is interrupted and body fluids stop, accumulating in the lower part of the body due to the action of gravity. These moments are crucial, because everything that happens from a few moments before the heart stops beating until a few hours after the actual death takes place will be reflected in the carcass disposition. The moments before death are known as the Ante-Mortem Phase, while everything that happens to the carcass after death is known as the Post-Mortem Phase.

However, as there are determining events from a police and forensic point of view that take place exactly at the time of death and are closely related to it, this period of time that includes the moment of death is known as the Peri-Mortem Phase, which is the most important phase for our work, because the position in which we find the body was adopted precisely in that phase and can provide useful information as to what happened, even if we arrive hours, days or weeks later.

As mentioned above, carcass disposition takes shape in the peri-mortem phase and will not be modified thereafter, unless the carcass is tampered with. Once the carcass has adopted a specific disposition, this will be maintained indefinitely over time, until the tissues and bones disintegrate over the years. Our mission is to find out whether any such potential post-mortem manipulations have taken place and if so, to find out if they were caused by natural circumstances (scavengers) or individuals involved in perpetrating an alleged crime or infraction.

Photos 3.1 Carcass in the process of decomposition .

To understand these key aspects, let's look closely at these diagrams (Diagrams 1 and 2). Shortly after death and sometimes even before death, insects typical of cadaver fauna enter the carcass to lay eggs and larvae. Many of these insects find refuge on the underside of the carcass to take shelter from the light, in direct contact with the ground. This insect layer, together with the cadaver decomposition island produced by the decomposition acids in the vegetation, make up the so-called layer of decay. This layer always indicates which side of the carcass is the underside that has been in contact with the ground. The un-

Diagram 1. Position of the carcass before and after death.

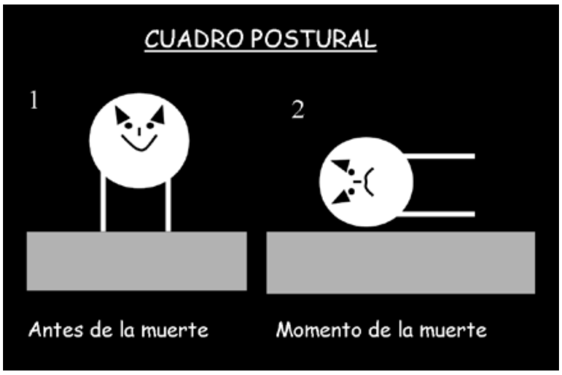
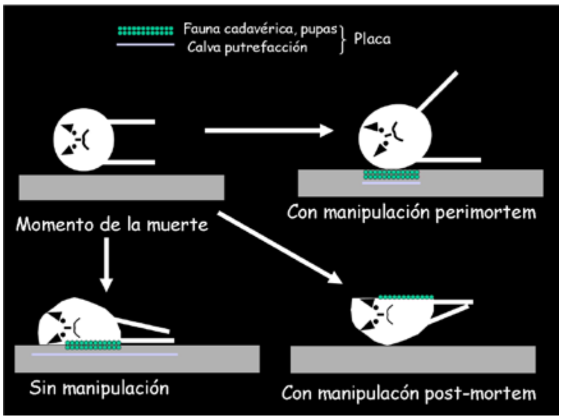


Diagram 2. Position of the carcass in different post-mortem scenarios.



derside has caked feathers or fur and an easily identifiable typical appearance, as is also the case of the underlying soil, due to the accumulation of empty larval cases of cadaveric insects (photo 3.2) and the acidification of the vegetation. A practical way to find out where the layer of decay is, is to see where the body is most deteriorated. Tissues in contact with this layer decompose more rapidly, as can be seen in the photos 3.3. This rule may be al-

Photo 3.2 Set of empty larval cases .

Photos 3.3 Animals showing decomposition in contact with the layer of decay.

tered if one of the sides has perforations due to external wounds (e.g. gunshots), which accelerates the entry of cadaver fauna and degrading bacteria, but in any case, the differences are recognisable to an observant eye. We must compare both sides of the animal. Wherever there has been a carcass in contact with the substrate, there will be some evidence of this (photo 3.4), even if the offender has eliminated the carcass.

The intact scenario in diagram 2 represents natural circumstances without tampering of any kind. Once death has occurred, the carcass takes on a convex-curve profile or convex profile, due to the accumulation of fluids flowing towards the ground due to gravity, as shown in the drawing. The layer of decay is facing down, in contact with the ground. Let's imagine a bottle that is half full of water. We will see that the water occupies the lower half, due precisely to the action of gravity. If we turn the bottle upside down and reverse its position by facing the cap downwards, the water will occupy the lower half again by the same law of physics. In a carcass, exactly the same principle applies and once the blood and fluids stop circulating thanks to the pumping of the heart, they immediately accumulate in the area in contact with the ground, giving rise to this particular profile.

Photo 3.4 Mark of an animal that has been in contact with the substrate during the decomposition period.

A fundamental concept in this section is mummification (photo 3.5). This natural process consists of an abrupt dehydration of the body's tissues, so that when the water is eliminated from the body, the cellular structure of the dead tissues is conserved for an extraordinarily long period of time. We rarely realise how important mummification is, as its mere existence already provides a lot of information. For a carcass to mummify, several essential conditions must be met. The first condition is that there must be very high ambient temperatures, the second is that there must be an accelerated dehydration of the tissues, basically produced by that temperature, and the third and most important one is that there must be significant wounds on the carcass. A carcass mummifies only if there are wounds (for certain physical and chemical reasons) and this fact is already important in itself in the context of a police investigation..

Photo 3.5 Mummified animal.

If post-mortem manipulation has occurred, it is common to find the layer of decay upwards, or in some other unnatural position. We will see that the convex profile of the carcass has been altered. If we look for the cadaver decomposition island on the ground, we may not find it or it might be at a location that does not match the crime scene.

As repeatedly stated throughout the text of this manual, it is necessary to highlight that the original carcass disposition is altered by the agents when handling the dead animal during the removal of the carcass and the CSI, especially once it is forced into the bag to be sent to the forensic laboratory. In these photos we can see photo 3.6, a cat received at the laboratory for analysis, which had been transported inside conventional bags (photo 3.7). Let us compare the carcass disposition of the cat transported in a plastic bag with the original disposition of cats found dead in the countryside (see the images in the poisoning section). It is easy to see that, upon arrival at the laboratory, the original carcass disposition has been completely deformed and lost and, with it, all the information it contained, which is essential for the agent to be able to solve the case.

Photo 3.6 Cat received at the laboratory .

Photo 3.7 Several carcasses transported in bags.

Post-mortem manipulation

The third of the scenarios in Diagram 3.2 includes the case of animals that have been manipulated during the peri-mortem phase or have suffered a violent or troubled death. These are easily recognisable when we observe unusual postures or positions that are preserved even in the post-mortem phase and are highly informative.

These photos 3.8 show the carcass disposition of an Iberian lynx that died as a result of two gunshots, after which it was hidden under some bushes. We can see that the posture is permanent, remaining unaltered even when the animal was lifted by the agents or later after being dug up, and even when it was on the necropsy table in the laboratory. The necropsy findings, together with the meticulous study of this peculiar carcass disposition, helped to reconstruct the facts with a high margin of certainty, as reflected in the diagrams (Diagrams 3 and 4) which were transferred to the courts of justice. In the case of the lynx, it was determined that the animal had been tampered with by dragging it.

Photos 3.8 Photos of a lynx shot dead and hidden in a bush .

This photo 3.9 was taken by a camouflaged agent and shows a poacher who has just shot a wild boar with a firearm (peri-mortem circumstances) and is dragging the carcass by one leg to the place where he is going to butcher it. This posture adopted by the animal will be preserved post-mortem and we could find it if we find the carcass. If we look again at photographs 3.3, showing the carcass of a dog found during an inspection by the poison specialist agents of the Andalusia Autonomous Government, we can clearly see which side of the animal the layer of decay is found on and even deduce the post-mortem circumstances, based on its peculiar carcass disposition.

Diagram 3.3 Carcass manipulated without contact with the ground and without dragging

Diagram 3.4 Carcass manipulated by dragging it

The implications of carcass disposition for the police are even more relevant when we suspect the existence of manipulation. If we go back to the examples of the lynx and the wild boar, it is important to notice the points on the animal's carcass that were used by the offender to grab onto (manipulate) it. Let us now look at the photo 3.10 of an individual holding a snare and several dead raptors. It is highly likely that this individual's deoxyribonucleic acid (DNA) has rubbed off on the legs, wing or tail feathers that are in contact with his hands. Having to grip tightly in order to transport the capture, friction is produced, which removes epithelial cells from the hands. These are transferred to the legs and feathers of the birds, following the well-known supreme guiding principle of criminology, Locard's exchange principle: in every crime committed, the offender leaves traces of his own at the crime scene and/or on the corpse and takes with him traces from the crime scene and the corpse.

Photo 3.9 Poacher dragging a wild boar.

Photo 3.10 Individual with several birds and a snare.

In general, the points the offender uses to grab the carcasses are the points we ourselves would intuitively use to grab them as well in order to move them from one place to another. At these strategic points, the forensic laboratory can (and does) extract samples that may contain the offender's DNA. It is likely that the offender's DNA is already deteriorated by environmental action, but it is also possible to find it if we follow the appropriate procedures to do so. Obviously, it is essential not to contaminate the sample with our own DNA, and therefore we will use a mask covering our mouth and we will use latex or nitrile gloves to remove the carcass (photo 3.11). Of course, we must avoid touching the carcass at the same points the offender may have used, so as not to damage the sample.

Photo 3.11 Agents removing a carcass wearing gloves and mask.

Law enforcement officers should always accurately describe and photograph the carcass disposition and provide this documentation to the forensic laboratory so that the most important findings can be certified. We have to bear in mind that, once the carcasses are removed, they will be sealed and placed in plastic bags and then frozen for shipment to the laboratory. Upon arrival at the necropsy table, the original carcass disposition will have disappeared and the body will have been deformed into the shape of the bag or drum that contained it, so many pieces of the puzzle that the forensic team needs to correctly assess the cause and circumstances of death will have been lost.

Specific carcass dispositions according to the most common causes of mortality

We have already mentioned the importance of carefully observing the disposition of domestic and wild fauna carcasses found in nature and have pointed out the large volume of information obtained from their analysis. We have also noted that carcass dispositions can even point to a possible cause of death, which is something we will address now.

It has also been emphasised that only the laboratory can officially certify the cause of death of the carcasses submitted and it is preferable not to take an alleged cause for granted, even if it is evident on site. Occasionally, there have been recoveries of raptor carcasses found electrocuted under a power line which had previously ingested bait poisoned with large quantities of carbamates. In a word, caution must be the first working tool.

As we already know, the usual causes of non-natural death in and around Spain tend to leave signs on the carcasses, although not always, and if we know how to interpret them, we can have an approximate idea of the circumstances surrounding the final moments of life of the animal whose death we are investigating. Knowing this information on site is crucial to immediately open the relevant police investigations, before it is too late due to the disappearance of evidence. Action cannot wait for the official results in the specialised forensic laboratory report and this manual can be very helpful in this regard.

Once at the crime scene, the key is to carefully observe what disposition the carcass has – or does not have – when mentally comparing it with another carcass of the same species in a normal physiological position. A normal physiological position is understood as the position an animal has after a "normal" death – relaxed, without trauma or accidents, in a natural and calm manner (photo 3.12). The differences and small nuances provide quite a lot of information, which is exactly what we will be looking for during the crime scene investigation.

Photos 3.12 Examples of animals that have experienced a non-traumatic death.

In the following chapters, the specific carcass dispositions for each cause of death, as well as the most significant injuries, are discussed.

Are birds face up or face down?

It makes little sense to speak of face up or face down in the case of mammals, since their anatomy is arranged in a laterally compressed manner. Mammals are found dead on one side or the other and it is rare to find them facing upwards or downwards unless there are reasons that force the carcass into that position (a snare, for example). Reptiles are indeed dorsoventrally compressed, but they are not as often found in cases of poisoning (basically only large and small lizards) compared to birds and mammals, and also the rigidity caused by their scaly skins makes it difficult to interpret carcass dispositions and facial gestures (they have no lips and the muscles are hidden under the dermal scales).

On the other hand, for birds we can talk about whether a carcass is face up or face down, and this is a variable to which we must pay special attention because of its importance in pointing toward one or another possible cause of death.

What generally explains why the body is in one position or another is determined by the relative height at which death occurred. Thus, when the bird has suffered a sudden death while flying or while being perched at some high point and falls to the ground as a dead weight due to gravity, then it is very likely that the carcass will be found face up. In contrast, if death occurred while the live animal was on the ground, then it is likely that the carcass will be face down. This is explained by the laws of physics.

Let's imagine for a moment a booted eagle in flight. For the bird to maintain this position, with the ventral side down while moving through the air, considerable effort is needed – an equilibrium of physical and aerodynamic forces that entails a high energy cost. At a given moment the eagle is shot and dies instantly, and by the action of gravity it falls to the ground from a considerable height. As it dies in the air the position is lost and then it falls like a dead weight. As it falls, the inert body adopts a position of equilibrium between the forces of gravity, potential energy (*Ep*=mass x gravity x height) and the animal's own anatomy. As a result, a few seconds after starting its fall, the carcass begins to take the shape of a drop of water, which is the standard form of balance of a fluid in free fall (photo 3.13).

The greater the body mass and the height, the greater the potential energy as defined in the equation and, therefore, the greater the tendency to resemble the equilibrium position. When the carcass makes contact with the ground, it does so on its back and it is left face up. However, for this to be the case, the height must be considerable and the carcass must fall in a perfectly vertical line, since the physical forces acting in an oblique or horizontal fall (as a result of a hit-and-run accident, for example) are more complex and the position of the body is more random. If a bird like a goshawk is flying fast at low altitude and is suddenly killed by a gunshot, its fall will not be in an absolute vertical line, but in a descending one. Once it reaches the ground it will roll to a complete stop and the carcass disposition will be completely random, possibly appearing face up, face down or even on its side. The same happens if the bird falls in an exact vertical line, but the ground is not a perfect horizontal plane, but rather an inclined one. In these two circumstances a rolling effect is the consequence and the observer must be careful to interpret it correctly.

Photo 3.13 Sequence of the drop-shaped fall of a bird in flight.

The causes that result in instantaneous death while the animal is flying and in a straight vertical fall are the most likely to leave the carcass face up (photo 3.14) and, in our field, these are vertical shooting deaths and electrocution. By contrast, collisions with electric cables and shots fired horizontally at low heights usually generate a rolling effect on the carcass disposition.

If the same booted eagle or a vulture in flight begins to feel the first symptoms of poison and has enough time, it will almost invariably descend to alight on the ground. Once on the ground, convulsions appear and when death occurs, the bird will collapse to the ground.

Photo 3.14 Bird in face up position .

We are aware of very few cases in which the bird has died suddenly from poison in flight without having had time to land on the ground, including one very interesting case of a Bonelli's eagle. Usually they either begin to feel the effects of poison while they are feeding on the poisoned bait (perched) or they are flying and have enough time to descend to the ground still alive and then die shortly thereafter, but in any case, death occurs while the bird is already perched on the ground.

When the bird dies on the ground, it falls naturally forward. It is physically and anatomically difficult for it to fall backwards so that it is left face up, as if it had died in the air. If we look closely at the normal position of a healthy perched bird, we will see that it tilts slightly forward, shifting its centre of gravity (photo 3.15) and therefore it naturally tends to face down. Even if the centre of gravity were located at a perfect theoretical centre, the bird could not fall backwards, simply because the tail and wings act as a stopper that prevents it from doing so.

Photo 3.15 Birds have a slight forward tilt when they are at rest .

This rule is quite well established and we can say that approximately more than 95% of medium-large birds that have been found dead from poison (from a booted eagle to a cinereous vulture) appeared face down. For small birds (e.g., blackbirds) there is a greater variation and even for large birds we have exceptions that prove the rule, albeit few. We know of some griffon vultures that have been found dead face up and their death occurred while they were perched on the ground. The cause was that the poison ingested was slower acting (chlorfenvinphos) and the animal suffered extraordinarily strong convulsions for a very long period of time, to the point of overcoming the resistance posed by the wing and tail (photo 3.16). However, we repeat, these are exceptions and in order to be able to interpret a crime scene, it is absolutely crucial to have all the evidence and clues to avoid the bias of categorical assertion explained below.

When we find carcasses of birds of a considerable size, face up and with a clear disposition that points towards poisoning, we must consider the possibility that they have been subjected to some type of post-mortem manipulation (photo 3.17). To dissipate any doubts, we only need to observe where the convex profile points and where the layer of decay is located.

Photo 3.16 Poisoned vulture face down.

Photo 3.17 Carcass manipulated after death and found face up.

Important considerations to bear in mind

Law enforcement officers must avoid at all times one of the most frequent mistakes made when interpreting the cause of death and the disposition of the carcasses whose death they have to investigate.

The analysis of carcass dispositions most often gives rise to one of the least desirable induced biases for an investigator – categorical assertion of the cause of death on the basis of the carcass disposition. As we have seen, carcass dispositions are a faithful reflection of the final moments of the animal's life, i.e., they provide information about the peri-mortem phase. In turn, this can help to infer – though never assert – the possible cause(s) that may have generated the set of factors that shaped these dispositions. That is, knowing the animal's posture and what its final moments were like, we can infer the most likely reasonable cause that led to that posture. In the same way, a rational logical sequence can be determined leading from A (the carcass disposition) to B (what the animal's final moments were like) and from here we infer C (probable cause of death). The categorical assertion error consists of going directly from A to C, without first going through B and assuming that each position corresponds uniquely and unequivocally to a type of cause of death.

Consequently, it is highly recommended that all professional personnel with expertise in carcass removal strongly avoid this categorical assertion bias in their observations, reports or working hypotheses.

04. IDENTIFICATION OF DEATH BY POISONING

Poisoned bait is the most widely used method for killing predators worldwide[9]. Its use is motivated by the need to control predators and, in some parts of the world, also to capture animals for human consumption or use in traditional medicine. In Spain alone, it is estimated that between 1992 and 2017 some 200,000 animals died of poisoning[10]. In addition to death, poison causes cruel, horrible and painful suffering, even if it is sometimes quick.

At present, most of the cases of intentional poisoning in Europe (using poisoned bait) are caused mainly by substances whose possession is illegal, such as organophosphates and carbamates, or by substances that affect the nervous system in one way or another. In Spain, between 2005 and 2010, 50% of the cases involving poisoning were caused by the active substance aldicarb and 22% were caused by carbofuran[11]. In South Africa, between 2006 and 2008, 33% of poisonings were caused by aldicarb and 18% by carbofuran. The commonly found carbamates and organophosphates kill in a similar way: by inhibiting cholinesterase, which is a vital enzyme in the body that regulates the nervous system. Cholinesterase is specifically responsible for transmitting the movement orders that the brain sends to all the muscles of the body (arms, legs) and those that activate the lungs, heart and other organs.

In order to explain this in a simplified didactic way, we can say that if this important enzyme is inhibited by the action of the poison, then the nervous system goes crazy, experiencing something similar to a short circuit. The usual commands that the brain sends to the muscles do not get there correctly, sending contradictory and choppy messages instead. Therefore, when an animal or human being ingests bait that has been soaked with these substances, a lengthy string of convulsions, shaking, trembling and shivering, accompanied by sweating, vomiting, diarrhoea and external and internal bleeding occurs. The symptoms described here may be more or less violent, depending on the doses, the particular substance and the species. What remains unchanged is that if the animal ingests a dose greater than the lethal dose (something that happens in most cases), the agony culminates in death by cardiac arrest. Some forensic experts share the opinion that it is as if the animal is fighting a brutal battle against itself, culminating in its death in most cases.

As mentioned in the chapter on carcass disposition when discussing the peri-mortem phase, the carcass tends to retain the same posture it had at the time of death. This means that what happens in the peri-mortem phase is reflected in the post-mortem phase. Therefore, if death occurred with violent convulsions and sustained shaking, it is highly likely that the resulting carcass disposition that we are going to find on site will also show signs of that kind of death. After all, death by poisoning leaves a carcass disposition that in no way resembles the normal physiological position and clearly reflects the agony that the animal has suffered. If we visualise what the natural physiological posture looks like for that species and compare it with the one in front of us, we will see that they are two completely different things.

Carcass dispositions after poisoning are characterised by contractions in most of the external muscles, in the head and limbs (wings and talons or legs and paws) and even in the fur or feathers. In general, the first thing that will stand out is an abnormal position of the body, as if it had been forced that way as a result of writhing in sharp pain and muscle spasms. Another characteristic is salivation and drool production, especially in birds, although in warmer European regions this is more difficult for the agent to perceive when reaching the carcass,

[9] Márquez, C. J. M., R. Villafuerte Vargas, and J. E. Fa. "Understanding the propensity of wild predators to illegal poison baiting." Animal Conservation, 2012: 118-129

[10] de la Bodega, Cano, Mínguez, 2020. El veneno en España. Evolución del envenenamiento de fauna silvestre (1992-2017). SEO/BirdLife and WWF, Madrid.

[11] Bodega Zugasti, David de la. Estudio sobre las sustancias que provocan el envenenamiento de fauna silvestre. Madrid: SEO/BirdLife, 2012

as it probably has spent several hours or days in the sun. Salivation occurs in birds and mammals. It is also one of the signals that is better appreciated on site than in the laboratory. Even if the saliva has dried up, caking of fur or feathers is a very important sign to note during the CSI, because it may be linked to possible carbamate or organophosphate poisoning.

When we are faced with an animal whose death could be due to poisoning through the ingestion of poisoned bait, there is a very important question that we must ask ourselves, or rather, that we must answer by working hard to obtain all possible evidence.

This question involves finding out if the poison has been placed in the same spot where we found the carcass, or, on the contrary, the dead animal in front of us ingested the poison somewhere else. In the case of vultures, the site of ingestion may be dozens of miles away. We call this "long-distance poisoning": the carcass is in one place, but the crime was committed somewhere else with no direct relation to the investigated facts. In these cases, the operators of the place where the body was found are most likely not directly related to the facts.

Needless to say, if we have found poisoned bait in the place we are investigating in addition to the carcasses, then there is no room for doubt.

The biggest challenge, as explained, appears when there are only carcasses of birds of significant size that can cover long distances in a short time, such as griffon vultures. In these cases, the margin of error is greater and we must be very cautious to avoid making legal accusations about people who are not related to the facts and vice versa..

How can we know if it is one case or the other?

The answer to this vital question is that the devil is in the details, as they say. However, much more important than what we see is what we are not going to find and that is why it is necessary to pay extraordinary attention in the investigation work. We may be aware of the importance of what we see, but we don't usually pay attention to what we don't see. When working in the field of crimes against biodiversity, the agent must get used to considering what he sees, but above all what he does not see but could expect to detect under normal conditions.

The experience accumulated by the investigation teams of the Andalusia Autonomous Government and the Civil Guard reveals that when large quantities of poison have been placed on the ground, it is common to find dead insects (photo 4.1). Conversely, if there are none and the carcasses belong to large (and highly mobile) birds, the likelihood of long-distance poisoning increases. At this point it is important to mention that the insects that are found dead around a carcass are both those of the cadaver fauna that use the carcass to lay their eggs, as well as opportunistic scavengers that feed on the carcass. In relation to the first group, we would like to mention a fact that the agents themselves have observed on numerous occasions around poisoned carcasses – the significant malformations present in the anatomy of adult insects of cadaver fauna, mainly in their wings. The agents have noticed that the membranous wings of blow flies are stiffened and have an unusual appearance about them that is easy to perceive. The laboratory has confirmed that these are deformities that arise during the larval development of the insect, which are produced by the effects of the poison. Therefore, the mere presence of insects with these characteristics is another indication that poison is behind the events we are investigating.

Photo 4.1 Dead insects located next to a poisoned animal.

It is highly likely that if we have found not only bird carcasses, but also reptiles (photo 4.2), mammals, especially micromammals (photo 4.3) and, above all, insects, then we may be dealing with a poison that has been placed at the same location where the carcasses are found. The smaller and less mobile a dead animal is, the more indicative this is of the use of poison that has been placed at that same location.

Photo 4.2 Reptiles killed by poisoning.

Photo 4.3 Small mammals can also be directly or indirectly poisoned.

Another aspect to take into consideration is the spatial arrangement of the carcasses, especially if there are several of them. Of course, it is not the same thing to find a single body, in which case there is more room for doubt, as to find several carcasses. When this is the case, there are strong indications to suspect poisoning and also that the poison was nearby. The closer the carcasses are located to each other, the more likely it is that the bait was placed in the vicinity (photo 4.4).

Photo 4.4 Group of poisoned dogs.

We must be especially careful if we find dead vultures in roosting sites or breeding colonies. Although they may have died from ingesting poison, that does not mean that they necessarily ingested the poison on the spot. We have often seen poison with a delayed effect that allowed birds to return to their nest or roosting site after ingesting it elsewhere and once there, the poison took effect. For all these reasons, we must be especially cautious when interpreting the death of griffon vultures in their roosting sites.

Here we can see some differences between birds and mammals that are interesting to know:

Signs of poisoning in mammals

Mammals have evolutionary singularities that are unique to the vertebrate group and a number of them are important to our work, such as lips (specialised muscles for sucking milk during lactation), fur (stimulated by nerve endings at the root) and in some groups retractable claws triggered by tendons and muscles.

When poison takes effect, especially cholinesterase inhibitors (organophosphates and carbamates), the animal experiences the symptoms described above, until it eventually dies. The resulting post-mortem carcass disposition can be quite meaningful and useful for diagnostic purposes.

When we find a poisoned carcass, usually blood can be seen through the natural orifices of the body – anus, snout and mouth (photos 4.5 and 4.6), as well as abundant salivation. Let's keep in mind that poison causes internal haemorrhaging and makes the blood thinner, and in acute cases this blood may even leave the body in quite a noticeable manner. It is also possible that blood may not be seen through external orifices, but is found during the necropsy by the laboratory personnel when opening the body and examining the interior, in what they call "congestive organs" (photo 4.7). If the poison used in the bait is a rodenticide, then the haemorrhage will be external and also very conspicuous, since these are anticoagulant substances that liquefy the blood to such an extent that it flows abundantly to the outside (photo 4.8). However, rodenticides act more slowly compared to cholinesterase inhibitors.

Photos 4.5 and 4.6 Poisoning causes haemorrhages that can be seen in the body orifices.

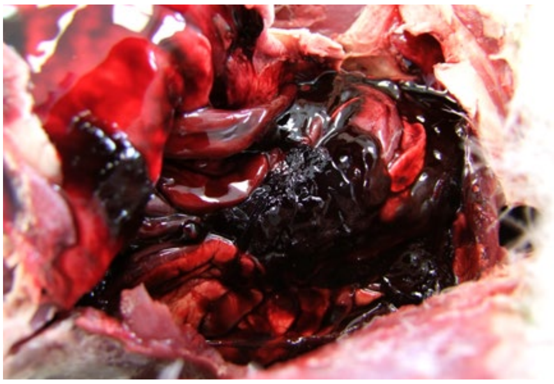


Photo 4.7 Most poisons cause numerous internal haemorrhages.

It is very important not to confuse the haemorrhages produced by poisoning with those produced by a blow or multiple trauma resulting in the rupture of internal organs (collision, gunshots, beatings, etc.). In these cases, we should also find external injuries and the circumstances of the finding may be completely different (photo 4.9).

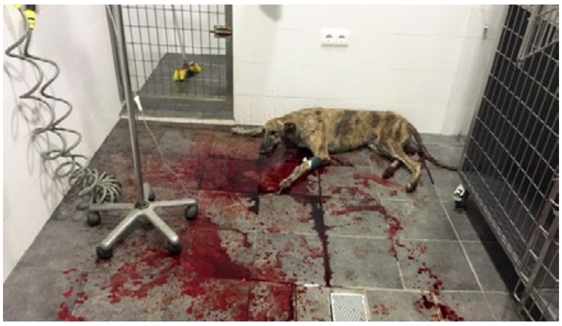


Photo 4.8 Rodenticides cause numerous haemorrhages because they liquefy the blood.

Photo 4.9 In the investigation of a poisoning case it is necessary to ascertain if there are external wounds that could have caused haemorrhaging.

Therefore, if we find a carcass with blood in its natural orifices, no external wounds, far from a road, without circumstantial evidence of any other type of injury, in the vicinity of other carcasses and presenting the disposition described below, then we can suspect poisoning.

The general carcass disposition of a poisoned mammal is evident. As stated above, the overall posture seems to be artificial, different from what we would consider a natural physiological position. The spine may be either abnormally extended or the opposite, i.e., very contracted, and the same is true for the hind and front legs (photos 4.10).

Photos 4.10 Several examples of different carcass dispositions caused by poisoning.

If we look more closely and pay attention to the details, we can observe piloerection or fur standing on end, especially on backs and thick tails (in felines and foxes), as a result of hyperstimulation of the nerve endings during convulsions.

Carcass disposition of poisoned canids

The canid (dogs, jackals, foxes and wolves) and hyenid (hyenas) families are characterised by a long snout with a powerful wide-opening jaw and a large tongue, which in turn implies long and strong lip muscles. The lips, like any other muscle, also undergo involuntary convulsions and spasms in the peri-mortem phase, which are then preserved in the post-mortem phase. Convulsions of the lips can be extreme, leaving very characteristic grimaces on the animal's face after death and giving it a look similar to a grim smile. In forensic science, this symptom is called sardonic smile, sarcastic smile or the smile of death, which is nothing more than the exposure of the animal's teeth due to the convulsive and involuntary contraction of the lips (photos 4.11). Given that the tongue is long, it is possible to find it sticking out of the mouth and even trapped between the teeth, although not too often (photos 4.12). In exceptional cases we may see dogs that have pierced their tongues with their fangs. The mouth may be found closed, fully open (photo 4.13) or partially open (photo 4.14).

Photo 4.13 The mouth of poisoned animals may be closed or fully open.

Photos 4.11 One of the typical carcass dispositions after poisoning is the so-called sardonic smile.

Photos 4.12 Tongue sticking out of the mouth or between the teeth is a typical poisoning symptom.

Photo 4.14 The mouth may be partially open in a poisoned carcass.

Usually foxes present just a faint sardonic smile, not as marked as that of dogs. In foxes we will often only see the lips raised at incisor-level (fangs), showing these in their entirety. In addition, dead leaves or grass may appear in the animal's mouth and teeth if the pain caused them to rub against the ground or bite these elements (photo 4.15).

Photo 4.15 Dead leaves may appear in the animal's mouth in a poisoning case.

Canids do not hide at the first signs of poisoning, with the exception of some foxes, which may seek cover under the bush once they start to feel sick and, therefore, may be more difficult to find. In general, canid carcasses are easy to find in the countryside. Actually, in many cases the effect of the poison is so fast with these substances that the animal barely has time to react. On the other hand, if poisons have a delayed impact or if only a small quantity was ingested, animals can cover longer distances to escape, but usually within a limited space. One fact has been observed in several domestic dogs that can provide useful information for police investigation – when some dogs start to feel sick after ingesting poisoned bait, they quickly run to their shelter and their owner. In these circumstances, the carcasses clearly point to where they wanted to go, leaving behind them the point where the bait they ingested is located.

The typical specific signs of poisoning usually provide a lot of information. There are few causes other than poison that can result in the same carcass disposition. Therefore, if in addition to the aforementioned findings, we observe a sardonic smile, drooling and/or blood in the oral cavity in the carcass disposition of a dog, fox or wolf, then we must seriously consider that the animal has been poisoned.

The presence of visible vomit on the ground and around the mouth should also be reported. This sample is also essential for detecting traces of poison.

Carcass disposition of poisoned felines

The felid family (in Europe and North Africa this includes domestic cats, wildcats, lynxes and, outside the region, also tigers, lions, leopards, etc.) lack the long snout or muzzle that canids have, but instead they have a tail covered by a thick coat of fur, a very rough tongue and retractable claws.

It is important to mention that sardonic smiles are unusual in felines of our environment. Their snout and lips are so short that physically they do not allow such a muscular contraction as in the canid group. In contrast, a slight opening at the corners of the lips and the tongue sticking out of the mouth and/or totally or partially bitten – a phenomenon that is common in this family of mammals – are frequently observed (photo 16). The mouth is usually found closed, unlike canids, which are more variable.

Piloerection in felines is more pronounced than in canids, basically because their fur is longer and silkier. This is best appreciated in the dorsal region and on the tail.

Unlike the dog family, cats have retractable claws that are triggered by tendons and muscles, so they will also suffer the effects of peri-mortem convulsions. If we find a domestic or wild feline with its claws out, there is a high probability that it has died of poisoning (photo 4.17). If we also find the other signs and symptoms we have been talking about, then the probability is certain. Although there are other causes that can produce protrusion of retractable claws in felines, such as electric shock, these are rare in crimes against wildlife.

Photos 4.16 In felines, the tongue is usually found sticking out of the mouth in deaths by poisoning.

Photo 4.17 Claws out are a clear indication of feline poisoning.

Another peculiarity of the cat group is that, unlike canids, the behaviour of hiding when they start to feel sick after ingesting poisoned bait does appear in cats (photo 4.18). As we have explained before, it is possible that if the bait contains a high dose of carbamates (e.g. aldicarb or carbofurans), the animal will die instantly on the spot and will not have time to move a single inch, as many references show. If this is not the case and it has a little more time, the animal will seek shelter where it feels safe. For this reason, it is more difficult to find poisoned feline carcasses than those of other mammals. It goes without saying that in this case the assistance of the canine unit for poison detection is really helpful.

Photos 4.18 Felines tend to hide after ingesting poison.

Regardless of the above, poisoned felines also show a cramped and agonizing general disposition that does not resemble the normal physiological position at all, as can be seen when comparing photo 3.12, showing a normal disposition, and the typical disposition of a poisoned feline as shown in the photos here (photos 4.18).

Photos 4.18 bis Carcass dispositions due to poison ingestion in felines.

Although this is discussed in detail in the section on snares, it is necessary to mention here that it is possible to find signs of kicking and struggling on the ground around the point where the carcass of the poisoned mammal has been found. They are not as noticeable as in the case of traps and snares, but they can be visible under certain circumstances.

Like canids, felines may vomit traces of poison, and there might be visible evidence of it on the ground and in the mouth. Likewise, a sample of this is also essential for detecting traces of poison.

Although in this manual we will not make an in-depth analysis into the physiological mechanisms produced by each chemical poison, we do want to mention the carcass disposition brought about by strychnine, still widely used in certain areas of Europe. Strychnine also acts on the nervous system, but unlike the classic acetylcholinesterase inhibitors (carbamates and organophosphates), its main target is the central nervous system – in other words and in a nutshell, the spinal column. One immediate visual feature of strychnine carcass dispositions is the backward arching of the spine and the contraction of most of the dorsal muscles, giving the animal a very dramatic and characteristic position, as can be seen in this photo 4.19. Death from strychnine is so fast that vomiting does not normally occur, because there is no time for the animal to even have the reflexes to do so. This is a very important difference with respect to carbamates and organophosphates.

Photo 4.19 Strychnine poisoning causes the arching of the spine by affecting the nervous system as reflected in the carcass disposition.

Signs of poisoning in birds

As we know, birds lack some mammal-specific adaptations: lips, fur, teeth and retractable claws. However, evolution has provided them with other unique features, which are also relevant for our forensic work.

The most prominent limbs on a bird's body are the wings. The position of the wings in the disposition of the carcass may shed some light on the cause of death, more specifically whether poison had something to do with it. The reason is simple: wings are very muscular structures and the more muscle a locomotor limb has, the greater the effect of the contractions, shaking and convulsions after ingesting a cholinesterase inhibitor poison. If the wings are large and heavy, as in vultures, the disposition of the wings is less striking, but still clear enough. If, on the other hand, the bird is smaller, such as a kite or an eaglet, then the wings are less dramatic and better display the movements of the convulsions, which is also reflected in the carcass disposition, as can be clearly noted in the images that are referenced and shown below.

Therefore, when we approach the carcass of a bird of a species prone to poison during a crime scene investigation, we must pay attention to the posture. If it is not the normal physiological position we can expect when birds die from other causes, we should look at the wings. If the one or both wings are open or half-open, we can suspect poisoning, but we cannot be certain of it (remember the need to avoid the categorical assertion bias). The same can be said of the tail. If it is raised and upright, the probability of being a poisoning case increases (photos 4.20).

The specific anatomy of each species also plays a role here. For example, for species with long necks, such as griffon vultures or white storks, it is common and symptomatic to find the neck twisted, as a result of pain and involuntary contractions.

In extreme cases, in medium-sized raptors we can find what we call a fan-shaped carcass disposition, consisting of a full protraction of the wings, which even extend forward until their tips meet, with the tail erect and completely unfolded (photos 4.21), typical of bird poisoning. The wings and tail look like unfolded fans, hence the name that defines this disposition. If we find a fan-shaped disposition, it is almost certain that poison is the cause, even if the laboratory cannot find the poison because it

Photos 4.20 Different carcass dispositions due to poison ingestion.

Photos 4.21 Examples of birds with a fan-shaped carcass disposition.

has degraded or the agent has not submitted the correct samples for analysis.

Birds may also display blood or bloody matter coming out of their natural orifices, especially in the cloaca and the mouth, as well saliva, as we have said, although this may have dried up and may go unnoticed at first. Caked feathers around the beak are another sign that should be documented during the crime scene investigation, because after collecting and freezing the carcass, this important detail is often no longer visible in the laboratory.

Birds do not have an anus, which is exclusive to mammals. The anus is an opening through which only faeces are excreted, located where the digestive tract ends. Birds and their reptilian ancestors share a single common orifice and duct for eliminating faeces, urine and sexual products – the so-called cloaca.

However, we must note that the expulsion of blood depends on the clotting factors of each particular species. Given that birds have more clotting factors than mammals, their wounds heal sooner and severe haemorrhages are less frequent, so they are less likely to bleed to death. In raptors, coagulation speed is even higher, as a survival mechanism in the event of accidents occurring during the capture of prey. In line with this, in poisoning cases in birds it is not as common to find external blood as in mammals, although it does happen with some frequency. These photos offer a comparison of the cloaca of a bearded vulture that has been killed by causes other than poison with that of another bearded vulture killed after ingestion of bait poisoned with the carbamate aldicarb (photo 4.22 and 23).

Photo 4.22 Cloaca of a bearded vulture killed by causes other than poison.

Photo 4.23 Cloaca of a bearded vulture killed by ingestion of aldicarb.

Photos 4.25 Talon of an Iberian imperial eagle.

One of the most revealing clues of the existence of poison in the carcass of a bird is undoubtedly the finding of one or both talons tightly closed. Obviously, this fact is more evident in raptors due to the prehensile capacity and the existence of strong tendon structures in the claws. When the cause of death of the bird is poisoning, the talons are usually completely closed (photo 4.24 and 4.25), sometimes even piercing the skin, and as happens with foxes' mouths (photo 4.26). The closed and stiffened talons of the carcass of a poisoned raptor may contain dead leaves or branches that have been trapped during the agony and the convulsions suffered before death (photos 4.27, 4.28, 4.29 and 4.30). Under normal conditions or when death is due to a cause other than poison, the legs tend to be found facing backward (although not always). In poisoning cases, it is very common (although not always) that one or both legs are facing forward as shown in the photos here (photos 4.31).

Photos 4.26 Some raptors can even pierce their own skin with their talons .

Photos 4.24 Talon of a bearded vulture .

Photos 4.27 Red kit talon.

Photo 4.28 Black kite talon .

Photo 4.29 Buzzard talon.

Again, the griffon vulture shows another peculiarity in terms of carcass disposition due to poisoning, in addition to its twisted neck. As is well known, this species is the most evolved vulture, having abandoned predatory habits earlier than other European vultures, which more or less sporadically may capture live or dying prey. Griffon vultures have completely lost anatomical features designed for killing: their talons cannot close completely and their claws have lost the necessary curvature and sharpness to kill with accuracy. This explains why this scavenger is an exception and only a small proportion of griffon vultures are found with closed talons after dying of poisoning. Other vultures, such as Egyptian vultures, cinereous vultures and bearded vultures, on the other hand, do appear with one or both talons completely stiffened, as shown in the photo here (photo 4.32). It is important to emphasise that we should not fall into the error of associating stiff talons with poisoning cases, as they can also be found in birds that have been electrocuted or killed by acute trauma. In short, in any process where the nervous system is affected, we may see stiff talons. As we say, poison is very frequent, but not exclusive.

Photo 4.30 Bearded vulture and imperial eagle talons, both having died from causes other than poison.

Photo 4.31 Deaths of poisoned birds with forward-facing legs.

Photo 4.32 Scavenger birds appear with stiffened talons.

One last aspect that has enormous importance is the discovery of food or vomit in the dead birds' beaks and/or talons. In these circumstances the probability of the cause of death being poison is very high indeed. In these cases the agents must take special care to collect and send to the laboratory not only the carcass, but also the samples, since it is very likely that this is where the toxicological analysis will show a positive result (photos 4.33 and 4.34).

Photo 4.34 Poisoned cinereous vulture carcass with vomit.

Although not directly related to the carcass disposition of the birds, there is an interesting fact that is closely related to the spatial arrangement of the carcasses. This fact is the polydipsia, or sudden, unquenchable thirst that birds and many mammals experience when the poison begins to take effect in their bodies. A significant proportion of scavenger birds that have been poisoned and collected in Andalusia over the last twenty years were found near ponds and water sources. Obviously, this only happens when the substances have a delayed impact or for some reason the animal has had enough time to reach a water source (this is more difficult for mammals, therefore). Consequently, when professionals examine vulture or raptor carcasses with the dispositions described above located around water sources, the likelihood of poisoning is very high. In addition, we should consider the possibility that it could be an organophosphate substance with a delayed impact or a carbamate ingested in small quantities or in bait with a delayed impact.

Again, we must stress that it is important to bear in mind that the concepts explained here are general rules, with exceptions and nuances. For example, it is perfectly possible for a vulture to be shot and killed near a pond or simply experience a natural death near a cattle watering place if its usual roosting site is nearby.

As a golden rule, the facts must always be interpreted in a global perspective, never in a biased way based on a few clues and ignoring the rest. One of the main errors detected so far is that we tend to reconstruct the facts based only on part of the evidence we have found, ignoring the rest.

Photos 4.33 Red kite carcasses with poisoned bait still in their beaks.

05. IDENTIFICATION OF DEATH BY SHOOTING

This chapter does not include the shooting down of game species carried out under authorised conditions, since this is a completely legal activity.

Wildlife shootings are perhaps the most common cause of non-natural death that agents and technicians encounter in the field during their professional work. Every year, official statistics reveal that wildlife recovery centres throughout Europe deal with a large number of specimens carrying lead projectiles in their bodies. Forensic laboratories, such as Andalusia's CAD, also frequently diagnose deaths caused by gunshot in species ranging from Iberian and Eurasian lynxes, bears and wolves to eagles, hawks, goshawks, vultures and even small passerines. These are obviously illegal activities that must be reported to the relevant authorities by the agent, according to the legal system of each country, so that possible responsibilities may be determined.

As we have said, the cause of death by gunshot is perhaps the most common in wildlife in European and Mediterranean countries, but at the same time, unfortunately, it is also the most complex and difficult to solve, as we will see below.

The range of circumstances is enormous, including shooting with firearms or compressed air, using birdshot pellets, buckshot pellets, bullets or rifle cartridges, shooting birds or mammals, and shooting protected species or catalogued endangered species. There is also enormous variation in terms of injuries, depending on the shooting distance and the number of impacts received. We have conducted comprehensive forensic studies and the conclusions vary significantly according to the number of impacts and shots received by the animal. In contrast to poison, where the types of cases are limited, gunshots are the greatest forensic and police challenge in the investigation of crime against wildlife.

The reconstruction of the events, which is the ultimate goal of any police investigation, can be complex if the crime under investigation involves firearm shootings. There are many variables involved and unfortunately none of them are simple. Weapons are a world unto themselves (shotguns can be side-by-side, over-and-under, single shot, etc.), not to mention ammunition, which has the additional complexity of LFB alternative ammunition (Lead-Free Bullets). Then we have hunter- or environment-related variables, which are countless, and finally, the variables that depend on the animal that has been shot, which are the most complex part. For example, it is not possible to investigate in the same way the case of one goshawk (*Accipiter gentilis*) that has been shot in the open with a vertical shot and another goshawk that has been shot while flying low inside a dense forest. This last section is truly complex from the point of view of both physics, terminal ballistics and the biology of each species. The legal implications are different if, for example, the animal was looking towards the shooter, fleeing, moving, flying high, flying through trees or doing any other action, and these factors are undoubtedly difficult to discern during a crime scene investigation.

It is clear, however, that an animal that has been shot must have wounds, although it is not always easy to find them. We must also highlight the fact that it is not the job of the acting officer to proceed with the analysis and excessively manipulate the carcass to look for entry points and projectiles, since this is the responsibility of the forensic laboratory. Among the various reasons for this is the need not to displace the projectiles internally and not to drop and lose them before the sample reaches the laboratory. However delicately the carcass is handled, this displaces the bullets or pellets that are lodged in the soft tissues and when these are analysed in the laboratory, it can significantly alter the results and diagnoses. One of the missions of the agent during the crime scene investigation is to maintain the chain of custody, which also includes guaranteeing that the carcasses and samples have not been previously manipulated unnecessarily and, if any type of previous manipulation is necessary, to ensure that it is documented so that the forensic expert can correctly interpret the findings. When investigating a cause of death, it is necessary to follow the procedure, and this is even more necessary when there is evidence of gunshot.

Although in mammals it is more complicated to find the marks, depending on the type of ammunition, in birds that have been shot with shotguns and multiple projectile ammunition for small game, a complete examination of the plumage is essential to obtain information about the characteristics of the shot. Pellets create an unmistakable effect on the plumage. If the shot occurred at close range, numerous feathers that are cut, full of holes and with burst calami are found (photos 5.1 and 5.2).

Photos 5.1 Buzzard feathers pierced by gunshot.

These signs are more moderate if the shot was fired from a distance, to the extreme extent of being imperceptible to the naked eye. The marks caused by the projectiles create a small empty circle from which the feather fibres that have been cut are detached, creating a kind of "indentation" that runs parallel to the direction of the fibres. The existence of this kind of damage in the plumage requires us to carry out a complete inspection of the skin and to take x-rays to determine the presence of pellets. When the shot was fired at close range – less than 20 metres for hunting shotguns with multiple projectile ammunition – it is common to find a lot of down on the bird. A simple trick is to blow on the carcass to observe if a cloud of feathers and down disperses around it. This is an unmistakable sign of close-range shooting.

Photos 5.2 Iberian imperial eagle feather with the calamus burst by a shot using ammunition for small game.

In addition to all the circumstances mentioned above, which explain the difficulty of investigating shootings of unauthorised species, we must add another no less important issue. Shots fired at wildlife species do not always result in instant death. In the case of medium to large raptors, we have evidence that up to 30% of birds living freely in the wild carry old projectiles lodged in their tissues (photo 5.3). The same can be said of protected mammals, among which we have even found bullets lodged close to their spine. A significant number of lynxes analysed at Andalusia's CAD had projectiles lodged in their hind quarters. Obviously, in these circumstances it is virtually impossible to carry out any police investigation, since there are no records and it is not easy to find out where and when the events took place.

Photo 5.3 Short-toed snake eagle with plumage clearly showing impacts from a close-up shotgun blast using ammunition for small game. The bird is miraculously still alive.

In Spain and surrounding countries, it is forbidden to shoot firearms outside shooting ranges specified for this purpose or to carry these weapons openly in the natural environment. Therefore, it can be asserted that the presence of shotguns and rifles in the natural environment is almost entirely due to hunting, especially if they are present on dates and in places authorised for this purpose (photo 5.4). There are hardly ever exceptions that allow the shooting of non-game wild species and, excluding hunting, the carrying and use of firearms in the natural environment outside authorised shooting ranges is not permitted. There are also no other outdoor sports that could involve firing shots at wildlife species. The data collected so far throughout Europe show the correlation between the killing of protected/endangered species and the type of ammunition used in hunting, the existence of regulated hunting days and the incident taking place on land classified as hunting reserves. These technical data reveal that it is small game hunting that interferes the most with protected wildlife.

Photo 5.4 The markings on the sign show the presence of hunting activity in the area.

While investigating criminal acts involving poison is difficult, investigating shootings with firearms is, as we have said, the most technically complex task that an agent can face on the job. It is necessary to have an outstanding imagination and resources because these crimes involve a great difficulty. Agents who manage to build cases of this nature will undoubtedly have reached the environmental police hall of fame, but of course this will happen on rare occasions.

From the very moment that the acting officer suspects gunshots, they must focus their attention (and ingenuity) on finding traces of any kind that can confirm this from a ballistic and police perspective. For strategic reasons, it is advisable not to elaborate further on this fundamental aspect in order to guarantee the confidentiality of our procedures, because giving unnecessary publicity to specific research procedures could generate undesired effects. The officer must check the carcass for external injuries compatible with entry or exit holes of projectiles, as well as the presence of blood on the body and on the ground and possible trails. We mention once more the necessity to avoid falling into the bias of categorical assertion. The fact of finding holes alone does not imply gunshots. There are many cases in which the passage of fly larvae through the muscles can produce a similar effect, so it is important to pay attention to the general context of the findings in the animal's body and the surroundings in order to get an accurate idea.

The investigation of gunshots on wildlife requires perfect coordination between the work of agents and technicians (forensic laboratory, police forces, NGOs participating in the investigation and governments). A complex, full-fledged multidisciplinary investigation must be carried out.

The investigations include trajectory calculations (Trajectory Reconstruction Technique - TRT) as in the attached diagrams, (Diagram 5.1) (photos 5.5 and 5.6), terminal ballistics on the carcass and additional expert reports, and for these to be admitted by a court, they must be carried out by qualified technicians. The TRT must calculate/estimate as accurately as possible the shooting distance, the angle with respect to the horizontal plane, the angle of impact on the animal and the terminal ballistics on the body.

Photo 5.5 TRT in a shot mongoose.

Diagram 5.1 Different shot and trajectory possibilities that must be investigated

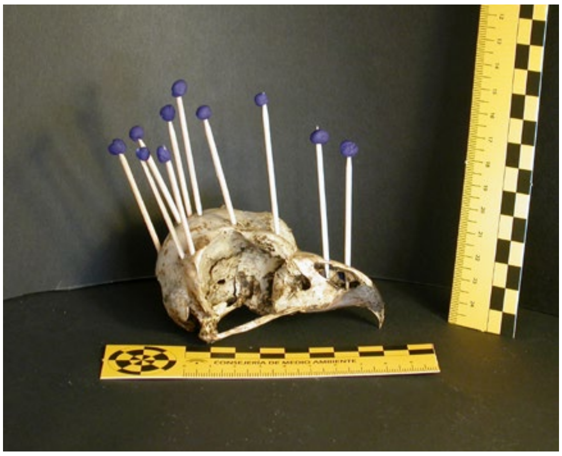


Photo 5.6 Eagle owl killed by a close-range shot to the head.

In a second phase, in which we return to the crime scene, we must proceed to the reconstruction of the facts, as this is known in forensic science. This will be carried out jointly by technical experts and the agents themselves, ensuring that the official criteria of forensic examination followed around the world today are met (Brent E. Turvey, 2011, Criminal Profiling, Academic Press), as shown in the images above.

In addition, it is important to remember that the most solid expert examinations are those carried out on the weapon(s) seized from the alleged offenders and suspects. Moreover, in order to ensure the highest levels of success, ballistic tests must be carried out, which also require comparisons and use of official databases. In the current regulatory context, these conditions have only been fully met when armed police forces have been involved in the investigations, whether gendarmerie or police, in a great example of multidisciplinary work.

It is not surprising, therefore, that the conditions for solving cases of this nature are rarely present in real life. In addition to the intrinsic difficulty of technical and expert analysis, there is currently also the difficulty of coordinating all the parties involved.

Based on accumulated experience, to sum up, we have the following phases of investigation and inquiry for firearm shootings on protected wildlife species:

1. Crime scene investigation by the agents and submission of samples to the laboratory. Please see the corresponding chapter.

2. Performance of clinical, forensic diagnostic and preliminary ballistic tests by accredited laboratory technicians. Establishing the TRT.

3. Development of possible hypotheses by the joint team.

4. If applicable, court order to seize weapons from suspects and transfer of these to the forensics department for complementary ballistic tests, verification of the criminal record of the weapon/ammunition (if applicable) and comparison with others in the sample bank.

5. Based on all of the above, on-site performance of Falsification Tests by CSI agents and accredited technicians (photo 5.7).

6. Judicial processing of the case.

Particular attention must be paid to detect evidence of tampering when a wild species has been shot and killed, especially if it is endangered. As a general rule, shootings of these species follow a pattern: they are intentional and unplanned. Although it can happen that animals are misidentified – glaring errors – these shootings often have a clear intention. Regardless of the motivation, it is true that these shootings are generally followed by remorse and fear of possible legal consequences, which in turn leads to concealment of evidence, i.e., peri-mortem manipulation of the carcass.

The information collected to date reveals that, at least in Andalusia, 30-50% of the shootings of endangered species resulting in death were subsequently manipulated by offenders/accomplices to conceal the facts. This is not surprising, since virtually every hunter today is familiar with the endangered species in his area and can identify them, as well as their

Photos 5.7 SEPRONA and UFOA agents of the Andalusia Autonomous Government verify the reconstruction of the facts through a ballistic test by firing the same ammunition used by the suspect, at the same range and with the same weapon seized from the suspect.

legal status, because this is part of the test to obtain an official hunting permit. In light of the above, the investigations must determine whether the shooting was accidental or whether it was intentional, despite knowing the nature of the species shot.

An investigation protocol or procedure, not forensic but operational in nature, has been followed on numerous occasions in Andalusia with excellent results. First of all, it is verified whether gunshots were the cause of death and, if so, it is certified from a forensic perspective that gunshots and death necessarily took place in the same location where the carcass was discovered. It must be attested whether the place where the carcass or wounded animal was found and the place where the shot was fired are the same and whether the site is located in a known hunting reserve. The date(s) on which the shots were fired and the exact location should be known as accurately as possible. Once these parameters are known, the police force must then proceed to take a statement from the person in charge of the hunting reserve, in order to determine which individuals were allocated to that particular area on those dates. Once these individuals are known, a court order will be issued for the seizure of their weapons for forensic comparison with evidence collected on site. In parallel, a statement will be taken from them for police and forensic purposes known to the investigator, and their movements may be traced by telephone tracking or other means within the investigator's reach. The main purpose of these resources is to pinpoint the suspect(s) in the right place at the right time. This protocol has been outlined in a very brief manner in order not to provide more information than is strictly necessary. To sum up, this protocol pursues two fundamental goals: a) to identify a suspect and b) to verify his/her presence at the corresponding place and time.

06. IDENTIFICATION OF DEATH BY SNARES AND OTHER LOCALLY-USED TRAPS

This chapter actually focuses on the various dispositions that carcasses can have as a result of traps. However, traps for capturing wildlife in general and predators in particular are extremely diverse in and around Spain. Considering the different varieties existing within a single region such as Andalusia, we cannot begin to fathom the enormous heterogeneity that exists in geographic areas stretching from Portugal to Bulgaria or from Morocco to South Africa.

For this reason, in order to provide an overview in this manual, we will discuss the findings and injuries derived from the three main types of trapping devices which are illegal in most European countries: snares, traps (in a general sense) and cage traps. Perhaps in other European regions or neighbouring countries these traps or illegal devices do not exist and other means are more common, but even in these cases the educational value of this manual is still useful. In reality, the aim of this chapter is not to show all the signs that traps leave on carcasses, but to explain how to interpret any clues we may find at a crime scene (photo 6.1).

Photo 6.1 Snares are one of the most commonly used illegal hunting methods.

Although death by poisoning is horrible because of its acute symptoms, at least it is a quick death, as we have seen. Accurate shots may cause painless death on the spot, but when they are not accurate, the animal is left badly wounded and may die a few days later from starvation, as the wounds prevent it from hunting and feeding normally. In other cases, the shot animal manages to completely survive the crime.

However, the slowest, most agonizing and cruellest death that an animal of any species can suffer is death caused by snares (photo 6.2), or traps. Although these devices are disgraceful from a humanitarian and ethical point of view, from a forensic perspective this unnecessary suffering becomes an advantage as it offers us lots of evidence to find the offender. The clues that we have to look for are found not only in the animal's carcass disposition, but also at the crime scene and are very useful for forensic and police work.

Photo 6.2 The agony and cruelty of death in a snare is evidenced by the expression of the animals.

To better understand what evidence is useful for the police, let us first recreate the actual circumstances in which a predator, such as a fox (*Vulpes vulpes*), is caught in a snare. We have chosen to give an example of death by a snare because it is certainly the most widely used handcrafted trapping device throughout the world, extensively documented in Europe, North America, Africa and Asia, used illegally in most circumstances, although it is legal in certain countries or regions depending on the species to be captured and/or circumstances. On a global scale it is undoubtedly the device with which we are most familiar.

Foxes are sly animals. It is not easy to capture foxes and the people who have the intention of doing so know this. The reason for capturing or killing such an animal with a snare is local predator control, which in itself is clearly informing us about the offender's circumstances. In rural settings there are only two human activities that seek the killing of foxes with snares: livestock protection and small game protection for hunting. There are no outdoor sports, recreational or leisure hobbies, sporting competitions in nature or rural professions with this purpose, except for the trade of hides of this species. For this reason, and basically as a golden rule, when we find a predator snare, under normal conditions we can be sure that it has been placed by someone whose professional activity is linked to the land and who seeks to protect assets of one kind or another (livestock or game), with the aforementioned exception of areas where hides are still collected in nature for commercial exploitation. Although there may be exceptions to this rule, we are not aware of them in practice today.

The mere placement of snares provides circumstantial evidence of the offender and whether the action is motivated by hunting or livestock farming malpractice. However, a proper and thorough crime scene investigation must be carried out in order to uncover the signs. As a general rule, livestock snares are placed in smaller numbers and are arranged around enclosures and structures containing livestock, whether sheep, goats or even chicken pens. They are intended to protect specific structures and we can see that they are placed to capture any predator trying to access a livestock-breeding location, which is a known asset that is guarded by its owner – in other words, a personal asset is protected. With a little practice it is easy to identify these subtle nuances.

On the other hand, hunting snares that are aimed at small game or big game species, widely used throughout Europe, do not protect well-defined small structures or spaces that house livestock and they do not guard personal property. Hunting snares for predator control seek to eliminate competitors, but not threats to an individual's direct property. The aim of hunting snares is not to eliminate a specific fox that hunts chickens in the same pen every morning, whose owner has already taken it as a challenge or as something personal against that particular animal. Hunting snares are placed in strategic locations over a much larger territory, far from livestock, almost exclusively in hunting reserves and in greater numbers, not trying to cut off predators from a certain location, but scattered around to eliminate the greatest possible number of predators wherever they dwell: foxes, mongooses, feral dogs or martens, in addition to other collateral species. While livestock snares serve as protection against threats stalking livestock in their enclosure, hunting snares attack where the predator takes refuge or lives. This is a fundamental detail. While it is not immediately easy to determine whether a snare has been placed for hunting or for livestock protection, since this detail is revealed through investigation, it is possible to obtain some clues based on the locations, as shown in the photos here (photo 6.3 and 6.4).

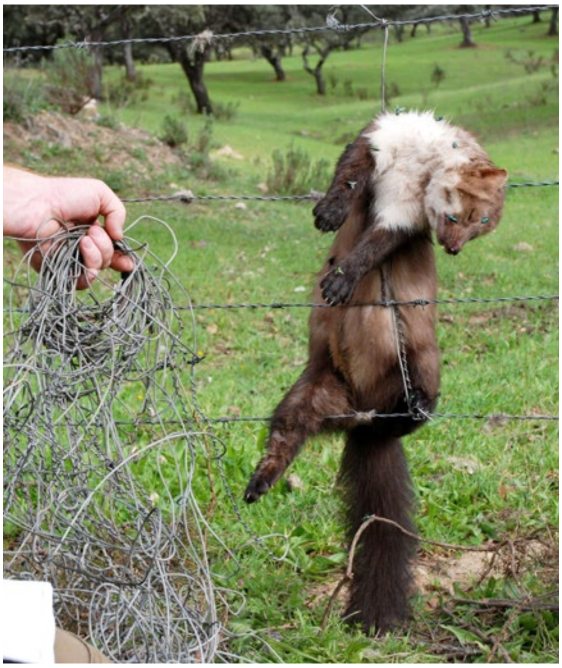


Photo 6.3 Marten captured and killed by a highly specialised hunting snare that was placed in a fence bordering the area of a hunting reserve .

Photo 6.4 Livestock protection snare placed in the wall of a sheep birthing pen to capture foxes.

By way of example, we will show a case that was registered in Andalusia and resulted in a conviction after the court ruled the facts as found. The intervention of law enforcement officers in this specific case could be applied to the investigation of other illegal wildlife trapping methods.

Night is falling in the little valley and a young female fox emerges from her hiding place at the top of a sandy slope, patiently burrowed under the roots of a rosemary bush. Hunger drives her to cross her territory, but she does so cautiously and stealthily, always alert to every noise and every smell to detect her eternal enemies – humans – before they detect her. The odour emanating from a rabbit burrow can be perceived in the air. Just fifty metres beyond the fence a family of rabbits lives in a rocky area. The fox can smell them. It is basically one last leap to reach the fence, and then she just has to crouch down and crawl through a small opening under the wire fence that she knows well. This is no small endeavour, because the narrow hole is flanked by rocks, but this poses no problem for a young fox that is well-practiced in crouching. To get under the wire fence the muzzle goes first, then the ears and then the front legs. The delicious rabbits are getting closer. However, the crossing under the wire fence is unexpectedly blocked. Her paws have bumped into something that seems to prevent the young fox from being able to go through the same crossing that she has been using for the past three months since settling in the little valley. Something is preventing her from moving on. Perhaps a bramble has gotten in her way, so the young fox pushes harder to reach the coveted burrow and her precious rabbits. But she cannot, she is trapped. Now she notices that something is grasping her neck, something thin and cold. Her cunning tells her that perhaps by retreating she can free her neck from the wire fence and finally gain access to the rabbits, because hunger is pressing and she is impatient to get there. Then, as she does every time, she gets stuck in a bush, she backs up in the firm conviction that she will be able to get away from the wire fence, which today is becoming especially complicated. But once again, just when she thought she was out, her neck is still trapped and she cannot get free. She pulls again with a little more energy, but to no avail; worse still, the claw trapping her neck has tightened even more. She finds it hard to breathe and starts to panic. She moves, becomes more and more agitated, jumps, turns, twists, but does not manage to get out. She feels a pain in her neck that gets stronger and stronger and starts to bleed. She can barely breathe, she is strangling herself, but she must keep fighting to escape. She does not know what is going on, she is puzzled because she sees no human enemies and the crossing of the wire fence is no different than any other night since she arrived in that territory. Something is wrong, even though she has taken every precaution to get to the rabbits. After resting for a few moments, she struggles again with all the strength she has left, but the more she does so, the tighter the cold grip that strangles her becomes. She is exhausted but even so her wild nature rebels and she puts up a fight against an invisible enemy that she cannot see. She bites desperately here and there, at branches, stones, everything she finds blocking her way. Like many other times, she scratches the ground, kicks and even tries to dig an escape tunnel, but it is no use, she is still trapped.

Hours have elapsed and the young fox is now exhausted, her energy spent. Her neck is raw, her claws practically broken from struggling, digging and trying to make her way through the wire fence. Her body and neck have become entangled in branches and fence wire due to her constant spinning around and jumping while she still had the energy. She feels pain in her mouth from biting at everything, trying to escape, but she is so exhausted that she no longer fights. She gives up. She is dehydrated and badly wounded. Hunger no longer matters, because she does not feel it.

But the sunrise draws near and the first light brings a new day to the valley. The sun rises behind the ravine, but the fox can barely see it. She does not move; she experiences shortness of breath, alternating a very fast heart rate, tachycardia, and suddenly a very slow rate, bradycardia. Her heart beats slower and slower. The morning rays touch the animal, warming her skin, which is full of dirt and dead leaves adhering to it after struggling on the ground. After a while the sun beats down stronger, but the animal cannot escape it to return to the coolness of her cave on the slope. Drained and overheated, she makes one last attempt to escape with what little breath she has left, but she remains stuck under the wire fence and gives up. Thirteen hours after trying to cross the fence that separated her from the rabbits, the young fox dies dehydrated, wounded and in severe shock. She will no longer move.

Just a couple of hours later a man stops his motorcycle on a nearby track. He looks around and decides to cautiously approach directly towards the wire fence. He carries a leather satchel. When he arrives, he looks with satisfaction at the carcass of the animal, takes a pack of cigarettes out of his shirt pocket to light one, and he smokes about two thirds of it; he throws the cigarette butt on the ground and steps on it with the heel of his shoe. He then takes some pliers out of the bag and crouches among the bushes until he finds a spot to insert them and cut the wire of the snare that has the fox firmly trapped by the neck. He pulls hard and takes the animal out of the bushes, completely entangled in dead leaves and wire. He looks at it carefully and then hurls it behind some thick bushes of heather and rockrose, out of sight of the track. He shakes off his hands and opens the bag again, this time pulling out a new steel wire made out of a bicycle brake cable and rubs it with leaves he plucks from the nearest rockrose. With great skill, in just a few seconds he has made a new snare, which he places with great care and expertise on the same wire fence, exactly in the same crossing through which fifteen hours earlier the fox that now lies dead behind the bushes tried to pass. He stands up and looks at the snare in place; he crouches down again and tinkers with it, slightly changing its inclination until he stands up again. He picks up all the tools and puts them back in the bag and heads for the motorcycle, which is parked on the track.

But today is full of unexpected events for everyone, and as he reaches the motorcycle, a voice speaks in a dry tone to the man with the shoulder bag, demanding him to stop. The voice comes from two agents coming out of the heather, who have been chasing the snarer for the past two weeks. They arrived when the fox was already dead, half an hour before the man on the motorcycle, and after unsuccessfully waiting for him on other occasions, today they were finally able to catch him in the act and are about to confront him. The man identifies himself to the agents as a gamekeeper, even though he is not wearing regulation clothing. When asked what he was doing at that moment, he seems nervous and surprised and replies that he was walking around the hunting reserve to see if there had been any poachers out during the night. The agents ask him about the snare, as well as five others located further down the ravine, and he categorically denies knowing anything about them. He says there are only wild boar snares placed by poachers, but no snares for vermin. The agents then ask him to accompany them to the place where minutes earlier he had been seen placing the snare and, visibly agitated, he replies that he knew nothing, that he had done nothing wrong, that he was unaware of the events the agents were talking about. One of the agents then goes behind the heather and rockroses and pulls out the carcass of the fox that had died hours before. Once again, the man takes another cigarette out of his shirt pocket and lights it, but this time he is trying to calm his anxiety, because he is restless, while he argues that he knows nothing about that fox, that it certainly has not died from a snare he has placed and that it must have died of old age, because in that hunting reserve the law is obeyed and there are no prohibited devices of any kind. He also claims that, although he is a perfectly good gamekeeper, he is alone to cover a huge territory and poachers and bad people enter the hunting reserve to place snares and poison, but he insists that he has been a good professional for many years and has never placed anything illegal; he maintains that he is a family man who has to earn his living and works from sunrise to sunset to support his children.

The other agent asks him to open his satchel and, already ostensibly nervous and defensive, he refuses outright. At the officer's insistence, the frightened man is forced to open it and the officer pulls out pliers, a coiled wire of new brake cable, as well as several pieces of stiff wire. However, when questioned, the man claims that he uses them to fix damage to the wire fence because poachers sometimes cause damage and cattle escape onto the road. "*What about the steel wire brake cable? This is not used for wire fences, but for making fox snares*," says the agent. "*It's not mine, I found it*," the man replies again. The agents do not ask further questions, sit down on a stone to issue a police report and seize the articles in the bag. The fox carcass is removed, sealed and placed in an official bag, which is sent to the forensic laboratory for confirmation of the cause of death. The agents then take note of the numerous fresh and old tobacco butts they found next to the snare, noting that they belong to the same brand that the man smokes and that they are extinguished and consumed in exactly the same way. The agents leave the site after a new and thorough crime scene investigation, during which they collect numerous pieces of evidence.

A few weeks later, the laboratory issues the report, which confirms that, although the carcass was hidden in some bushes, the injuries found on the animal and the carcass disposition were compatible with death by snare and that it was also possible to extract a fragment of the same snare from the animal's neck, indicating that the end of the cable had been cut with a sharp instrument.

In addition, the gamekeeper is known in the area to be very skilled and experienced in the use of predator control devices. The gamekeeper had noticed the presence of the young fox on the hunting reserve and had made preparations to eliminate it. The agents had been notified by an informant, who had overheard his intentions in a conversation at a bar, and as the story seemed credible to them, they decided to investigate it, obtaining the results that we already know.

Months later, the corresponding summons arrived from the court, announcing the date of the preliminary hearing. When this date arrived, the judge urged the parties to reach an agreement, a suggestion that was accepted by both the prosecutor and the defence before the trial. Result: the judge issued a final judgment of conviction. Case closed.

What traces did the agents collect and observe in their records and reports that contributed to reconstructing the facts with such reliability that it could not be refuted by the defence? Why did the judge not hesitate to accept the case? Let's take a closer look.

What we are about to explain involves both biology and police practice; both areas go hand in hand when it comes to solving crimes against biodiversity. If we are to be successful in investigating crimes against biodiversity, one cannot go without the other.

First of all, it should be remembered that the gamekeeper placed the snares in exactly the same location where he had detected the fox several weeks earlier. The gamekeeper's attitude was smart, as he let it get confident before eventually blocking the crossing. To ensure that the animal would cross through the selected passageway, he narrowed it using stones. The gamekeeper waited patiently for weeks for the animal to trust him and when he saw fit, he placed a masterfully handcrafted snare for it. This implies that the individual responsible necessarily has an excellent knowledge of the place, goes there regularly at various times of day and night, also knows the habits of wildlife in the area and in addition to all this, has mastered the making and use of trapping devices. These assumptions greatly limit the range of potential offenders, directing suspicion to a very small group of candidates, who are necessarily related to the management of the territory.

Agents will seldom be able to match the immense knowledge of the gamekeeper, to whom we should certainly take off our hats. But we must at least be able to recognise when wildlife crossings are being blocked and that this is precisely the location chosen to place snares. The agents in our example had already noticed signs revealing that a predator had been frequenting the fence crossing for some time, but in addition, they noticed signs of a deadly fight at the same site, by what they inferred were foxes that must have been captured months earlier by the same gamekeeper (photo 6.5 and 6.6). The agents had also detected old rusty snares in the vicinity, which the gamekeeper was discarding after the captures. In the field, they proved that the gamekeeper had been continuously conducting predator control activities at that location for which he was now being reported. In addition, the agents had informants (intelligence) who confirmed their investigations. The gamekeeper, therefore, was already being investigated, not only because of what the agents themselves had deduced on site, but also because of reports received.

Photo 6.5 A professional snare placed in a hunting fence whose passageway has been blocked using stones exhibits a lack of vegetation on the ground as a result of the fight put up by carnivores captured and killed in it .

Photo 6.6 A magnificent example of a snare that has captured a marten and the substrate under it completely altered and disturbed as a result of the animal's fight to free itself from the steel wire. These are visible signs that reveal that a snare has been in place and that it has yielded captures.

Once they learned that the gamekeeper had resumed the illegal activity, they decided to take action by setting up surveillance posts. Initially, they cautiously established two at a certain distance, but both had negative results. They did not want to get too close so as not to foil the operation, but in the absence of results they realised they needed to change the strategy. So, they decided to take a little more risk with a third post, this time very close to the snare. If it went well, they would come face to face with the suspect, but if it went badly, they would be discovered and the operation would fail. This time they left their vehicle about two miles away at about five in the morning, and walked to the post without lights, arriving there around dawn. They did not use colognes or aftershave that day and scrubbed their uniforms with some rockrose bushes when they left their car. They set their mobile phones to silent mode and hid watches and any metallic devices that might glow in the darkness.

They already knew in advance the gamekeeper's routine movements: what time he left home, the bar and the time he had breakfast in town, as well as his assigned days off work. The preliminary intelligence work allowed them to calculate the timing well, and so they did. In order to feign a diversionary manoeuvre that they considered essential, they requested the support and coverage of their colleagues, although we will not make further reference to this in order to ensure the confidentiality of the operation.

When they arrived at dawn, they found the freshly killed fox and their first reaction was to remove it immediately, but they were cautious and judiciously chose not to touch anything that might alert anybody of their presence. They decided to leave, but not before erasing their footprints, and hid in the bushes. They stationed themselves separately, blocking the accesses and setting a good visual perspective.

It was not necessary to wait for long, because just moments later they were alerted by the sound of the approaching motorcycle; the motorcycle stopped and a man got off it, whom they saw approaching from their hiding places. We already know the rest of the story.

All suffering in humans and animals is unnecessary. This goes without saying in modern Western society and therefore our legal system is responsible for ensuring that this is the case for people and animals of all species alike. At the beginning of this section we stated that, for the purposes of our police work, the unfortunate suffering of an animal leaves evidence that is extraordinarily useful in the investigation. In this case, the supreme guiding principle of criminal investigation, Locard's exchange principle, is applicable not only from the offender to the environment and vice versa, but also within the environment itself.

Let's recall again the unfortunate experience of the fox, whose long agony ended in death under the wire fence of the ravine. We saw that it had pushed forward and backward, strongly tugging with its neck to free itself from the snare. We also saw that it had rubbed its body against the ground and had been digging in the earth to find a way out. We discussed that it had torn its neck as a result of the violent friction with the steel wire that was strangling it and that it struggled among branches and dead leaves, staining its fur. In the course of its fight to the death against an enemy that the fox was unable to recognise, the animal pulled and pushed with its paws, trying to insert one of them between its neck and the snare, and in a desperate attempt, it snapped defensively at branches, the wire, the ground and anything else that happened to be there. Finally, we also found that it got stuck between the branches and trunks next to the snare and its anchoring to the substrate.

Well, everything described here leaves signs both on the carcass and its disposition, as well as in the place where the death occurred. The carcass will then be examined on a necropsy table by a complete and expert forensic team of biologists and veterinarians, taking all the time necessary and in comparatively comfortable working conditions. On the contrary, the agent has a limited working time and is alone or with a small number of colleagues. Therefore, the agent must pay more attention to a thorough and detailed inspection of the crime scene. His work involves searching for, detecting and documenting all this evidence of capture and death, whether or not carcasses have been found. This work, together with what the laboratory discovers from the carcass, is the best legal and forensic argument to guarantee the success of the case and thus justify the long hours of surveillance and the titanic efforts of the agents involved.

The injuries of a carcass killed by a snare or any other trap and its disposition are completely dependent on the manner of death.

On carcasses and their disposition

Regardless of whether the carcass we find is caught in the snare or trap that caused its death or not, it will show obvious signs of struggle. The post-mortem position will not be at all similar to the normal physiological position, but rather extreme, although different from those already seen in poisoning cases. It is common that the mouth be found wide open, as the animal tries to breathe better and counteract the lack of air due to strangulation (photo 6.7). It is also common to observe (but not always) eyeballs bulging, popping out of the eye sockets, resulting from the enormous effort the animal makes to free itself from the snare around its neck and from strangulation (photo 6.8). The eyes bulge because, by radically and violently obstructing at the neck the circulation of the veins that return from the head to the heart (the jugular vein), blood accumulates in the head and increases the pressure in the blood vessels surrounding the eyes; the blood continues to reach the head through the arteries, which are rigid and cannot be strangled and therefore large amounts of blood accumulate, increasing the pressure. In clinical practice this is explained by the Frank-Starling law. In addition, we have the effect of stress and panic, which abruptly tightens the facial muscles, further increasing the volume of the soft tissues around the eye socket and dislodging the eyes from the sockets by partially ejecting them outward. Exactly the same is true of the tongue for the same reason, although we will only see swollen tongues when carcasses are reasonably fresh (photo 6.9). This same phenomenon can be seen when someone is very angry or in a fit of rage. Some dogs of protruding-eyed breeds (Pekingese) may suffer severe eye bulging if they suffer outbreaks of acute aggressive behaviour, as an example.

Photo 6.7 An open mouth is one of the usual signs of death by strangulation.

Photo 6.8 Eyeballs often pop out of the eye sockets in death by snares.

Photos 6.9 A swollen tongue outside the mouth is another sign of strangulation that is clearly seen in fresh carcasses.

Signs of skin lacerations on the neck and bald patches on the skin resulting from the friction produced during the struggle against the braided steel wire are evident (photo 6.10).

Photo 6.10 Skin wounds are also typical of death by snare.

Broken claws showing the same substrate (sand or soil, mud, vegetation, etc.) can be seen, due to desperate digging in the ground (photo 6.11) or by friction against the steel wire, and teeth may also have been broken by biting the cable or adjacent branches (photo 6.12). The fur will appear dishevelled and not bristled, due to violent rolling, and the animal will also have scratches resulting from the fight, especially if the snare is anchored to a barbed wire fence (then there will be wounds and haemorrhages visible to the naked eye). It is common to observe in the carcass disposition that the animal has died in a position in which it clearly was trying to free itself from the snare with one or both forelimbs, and usually holding the neck bent in one or the other direction (photos 6.13). Overall, it is a very dramatic and violent disposition and shows slow agonising suffering. It is also evident how the animal has struggled to free itself until it became entangled among cables and wires (photo 6.14). Sometimes, as mentioned above, the animal tries to dig an escape tunnel, tearing the claws of its front legs.

Photo 6.11 The animals may appear with broken claws after trying to dig to escape.

Photo 6.12 The teeth also sometimes appear broken after biting the wire or other adjacent elements.

Photo 6.13 Carcass dispositions due to strangulation and to the effort of escaping aided by the front legs.

Photo 6.14 The carcass disposition is dramatic and reveals a slow agony.

In any case, it is essential for the agent to take note of all the details on the carcass disposition and record it photographically as explained in the section about photography. Once the carcass is placed in the plastic bag, frozen (if applicable) and sent to the laboratory, by the time it is thawed and placed on the necropsy table, all traces of the carcass disposition will have disappeared. As we can see, the role of the agent is absolutely vital in the recording of carcass dispositions. What the laboratory personnel can determine more easily than agents in the field are the external injuries in detail and, of course, the internal ones, since these will come to light when the corresponding necropsy is performed.

Signs in the field: the on-site substrate

What we discussed about carcass dispositions can also be applied to the terrain, since, as we say in forensic jargon, everything that happens leaves a trace and can be found out.

We must observe the site as if a real battle had been fought, as indeed it has been. Many agents colloquially refer to it as the battlefield or the wallowing ground (photo 6.5), because the ground is smooth and flattened and devoid of vegetation, which has been pulled up by the kicking of the trapped animal during its struggle.

Photo 6.15 A sign of possible snares in the area are the bald patches of vegetation that indicate the struggle of the trapped animal.

We will discover bites and teeth marks on branches (photos 6.16) and vegetation, as well as remnants of blood and fur in the anchoring substrate. It should be remembered that the animal is sometimes trapped in such a way that it is difficult for the investigating officer or technical personnel to extract the carcass (photo 6.17)

Photo 6.16 Bite marks on branches are also evidence left by animals trapped in a snare .

A very helpful contribution is to observe the entomofauna, specifically the blow fly family (see the corresponding chapter). If we see them landing on wires and structures associated with the snare, as clearly seen in photo 6.18, we can be sure that blood and remains of tissue and epithelial cells are also present, which in turn reveals that there is or has been a carcass there recently. The same is true if we observe fur, pieces of hide and the like. Even if we do not see the carcass, because it has been removed to eliminate evidence, we can certify that an illegal act has been committed at this location, resulting in the death of a wild animal. A genetic analysis of the fur will be able to identify the species.

Photo 6.17 The presence of blow flies shows that there is or has been a carcass nearby.

Photo 6.18 The presence of flies of the Califoridae Family shows that there is or has been a corpse nearby.

Finally, if the capture has been left at that location without being removed and has rotted on the ground, we will see that the vegetation on the ground has disappeared – what we call a cadaver decomposition island. Acids from the rotting carcass burn the grass and leave an easily recognisable bare patch. We will also observe the remains of larval cases from insects, although for this we must look for them very closely and carefully.

It would be interesting as well to look around for the remains of other captured animals, a sort of cemetery, in case this is a permanent site for the placement of snares and other traps. If we search well in the surroundings, we will probably find this, thus enabling us to prove the existence of ongoing criminal activities over time, which may aggravate the criminal penalty (photos 6.19).

We must insist once again on the importance of this specific section, since only the acting officer can study the crime scene.

It is important to mention here that in many cases snarers check their traps regularly, even every morning and every night. When this is the case, many of them prefer to kill the animal, as they usually find it trapped but still alive. By killing it, they prevent it from attracting the attention of people who are not involved in the crime. To kill it they may use a mallet (photo 6.20), a stick or cane (photo 6.21) a metal rod, a knife attached to the end of a long stick (photos 6.22) or even a firearm.

In the sections on cage traps and leghold traps we describe these devices and how they work.

Photo 6.20 Mallet used to finish off animals.

Photos 6.19 Cemeteries or animals hidden among vegetation often appear around trapping sites.

Photo 6.21 Stick used to kill trapped animals.

Photos 6.22 Various tools used to kill animals in traps.

An agent will note that up to this point we have only mentioned predatory species captured in snares, mainly foxes. In fact, we have mentioned the fox because it is the classic species most often persecuted through the use of this non-selective illegal device. However, we already know that snares lack eyes and brains, so they block the passage of any animal whose dimensions trigger it. A snare placed in Europe and neighbouring regions to capture foxes can also trap lynxes, bears, wolves, martens, otters, badgers, jackals, hyenas, dogs, deer, wild boars and even raptors, such as goshawks and imperial eagles (photo 6.23). We will refer to these snares as predator snares. Sometimes the maker can design them to be more selective and it is possible to find snares made with the exact measurements and placement to hunt mongooses, martens, large dogs and, of course, foxes. These are considered expert snares.

Photo 6.23 Imperial eagle trapped in a snare for carnivorous predators.

There are also snares for poaching and agents are required to be able to distinguish one type from the other, because the forensic, police and legal implications are diametrically opposed. Poaching snares are intended for species such as wild boar (sometimes also deer specifically) or for rabbits or hares (sometimes also rats). The materials, knots and placement methods are completely different in each type (see types of snares in previous sections), but we will not discuss that here. It is important to bear in mind that poaching snares do not necessarily have to be made by people directly linked to the management of the land, as was the case for predator snares. In many cases these snares are placed by poachers, i.e. individuals outside the hunting reserve, farm or operation, to capture edible wildlife for self-consumption or sale, but in no case for predator control (commonly known as "vermin control"). An experienced agent will always be able to recognise, based on police evidence (never on personal opinions), if these snares have been placed by outside poachers or by people directly related to the property. As we have said, the legal and even criminal consequences are very different and we must avoid charging an innocent person. We must determine each case based on existing expert criteria. First of all, the type of wire used reveals which species it is intended for and thus tells us who benefits from its placement. In other words, the placement of a predator snare only benefits the hunting reserve manager, since it eliminates predators that do not "harm" anyone else. Investigating this line provides revealing information that to date has not been rejected in court. In the case of poaching snares, i.e., directed at game species, the beneficiary can be either outsiders, someone from the hunting reserve or the manager himself. Clearing this up is more complex and has to be verified through an investigation.

Regarding the injuries sustained by species subject to poaching by snares, the following should be highlighted. It is less likely that we will find a wild boar captured in the snare. Although it happens from time to time, it is not common, and if it does happen, the animal will be found still alive but trapped in the snare, or freshly dead. A captured wild boar can literally tear its neck apart and this is obviously easy to identify by the acting officer. Its imposing physical capacity and power even lead it to severely lacerate its neck. The strength with which it struggles is such that it can even lift the fence to which it is anchored. Therefore, the way it is anchored to the substrate has relevant police implications that the agent must investigate. Generally speaking, agents find out about wild boars in snares because a passer-by has been alerted by the enormous disturbance caused by the struggling animal. However, long before that happens, the poacher will most likely have already removed the animal. There are actual professional wild boar poachers in Europe who are true masters in placing snares and in passing unnoticed to law enforcement officers. This is a significant risk to public health, since a considerable proportion of the captured animals sold are carriers of diseases that are dangerous to humans, mainly tuberculosis and trichinosis. Wild game is sold to rural hospitality establishments without any health controls.

Snare injuries on rabbits and hares are less visible. Unlike foxes and wild boars, rabbits do not struggle as much and once they are caught in the snare (usually copper-made), they give one or two small tugs and a few moments later they fall dead from cardiac shock. Consequently, the injuries are not very apparent externally, apart from some slight abrasion on the skin of the neck and ears. On the other hand, the forensic laboratory will find the corresponding injuries internally.

07. IDENTIFICATION OF DEATH BY CAGE TRAPS

For the purposes of legal concepts and definitions, a cage trap is any device with one or two entrances which has a mechanism that is triggered by the animal itself, lured by means of an attractant (live or dead) or when passing through, trapping it inside. Cage traps include varieties consisting of entry devices that prevent the animal's exit (photos 7.1) once they have been trapped inside (photos 7.2 and photo 7.3).

Photos 7.1 Different types of cage traps detected in the wild.

Photo 7.2 Cage traps are not selective and can trap endangered animals such as the Iberian lynx.

Photo 7.3 Marten trapped inside a cage trap.

Along with leghold traps, snares and poisons, cage traps are currently the most common prohibited trapping devices for the illegal eradication of generalist predators in Spain. Their use for poaching is minimal, i.e., they are generally used only to capture and subsequently eliminate predatory mammals. When other species, such as raptors or corvids, fall in cage traps, they will almost certainly be eliminated. They should not be confused with cage traps for wild boar and ungulates, characterised by very large sizes, or with those for corvids, which also have specific shapes. Both of these may be legal depending on the circumstances in some Spanish, European or African regions.

Cage traps come in various types and sizes, ranging from 50 cm to almost 2 m long. There is a large number of cage traps on the market, with one or two entrances, with a device for live or dead bait and with a guillotine or tilting closing system. Handcrafted cage traps can also be found.

The use of cage traps for predators may be occasionally and exceptionally allowed by governments, although in these cases the authorised person will be required to show the written permit to the law enforcement officers.

Due to their size and cumbersome nature, cage traps are easily detected during inspections by law enforcement officers (a certain number of them are seized every year in Spain). This, together with their high cost, means that their use is limited. They are mainly used in large hunting reserves, generally within a closed perimeter where inspections are infrequent.

Unlike other devices used to eliminate predators, cage traps are usually placed in a single location, since they are more difficult and inconvenient to transport. Consequently, they are what we might call fixed capture stations, which is an extraordinary advantage for our inspection and surveillance work.

As a result, when in the course of our work we come across one of these cage traps, first of all we will check whether or not there are captured animals inside and whether these are alive or, as may be the case, have died due to neglect. We must remember that, in terms of punishment, in addition to the corresponding fine for placing a cage trap (or any other prohibited device), we must consider the penalty for having captured a protected or endangered species, in which case the violation would have criminal consequences. Once the inside of the cage trap has been checked, we will observe whether it is activated, i.e., baited and ready for the automatic closing mechanism to be triggered when a predator enters, which should be written down in detail in our corresponding records.

One thing to keep in mind is that cage traps capture all types of predators, including diurnal and nocturnal raptors, depending on the bait used. Therefore, it is not uncommon for the cage traps to be uncovered, free of obstacles above so as to be more visible from the air. If they are covered with branches and bushes, they will go more unnoticed. In these cases, they provide more shade and cover from the elements (cold, wind and heat) to the animals captured inside them.

The explanations above about the placement of snares by people directly related to the management of the land can be equally extended to cage traps. Their use is strongly linked to land managers. Poachers or individuals outside a hunting reserve or livestock farm do not set cage traps for several reasons. Cage traps are large, heavy and cumbersome and cannot go unnoticed during transport, which of course requires a 4x4 vehicle or similar. They are costly and placing them on land belonging to others generates an unnecessary risk of loss. Besides, a cage placed in the countryside is difficult to camouflage. It is virtually unthinkable that a poacher would sneak onto someone else's land to eliminate predators whose meat is not consumed and whose sale does not generate economic benefits.

As a general rule, death in cage traps is actually not due to the cage itself, except for cases of so-called capture myopathy, which occurs relatively frequently in lynxes and wildcats. Rather, the death of the captured animal is caused by the individual who places and/or checks the traps.

Here, the circumstances are relatively diverse. Often, once the predator is captured and locked inside, it is abandoned and left to die of hunger, thirst and heat stroke. Once it has died, a few days or hours later, the carcass is removed and thrown into some bushes in the surroundings or eliminated by other means that we will not specify here. In these circumstances, the injuries on the carcass are easily identifiable and are characterised by the fact that the animal is extremely thin as a result of having spent many days without food and water. It is also common for the skin to show abnormal wear and tear, as well as bald patches on the fur, as a consequence of fighting and struggling against the bars of the cage. The same applies to claws and teeth, which can get broken for the same reason.

However, there are times when the offender needs to have the cage activated and at full capacity for as long as possible and cannot wait for the predator to die of starvation every time something is captured inside. In this case, the offender must kill the animal quickly, and here there are different alternatives, as we have seen over the years.

A significant proportion of the individuals responsible for the illegal placement and monitoring of cage traps choose to carry a weapon, often an air rifle. These guns are quieter than conventional .12 calibre cartridge weapons. They are generally not legal and preferably have a 5.5 mm calibre in many Mediterranean regions. When the keeper accesses the cage trap and verifies that there is a live capture inside, he gets out the gun (which may be hidden near the cage), loads it and inserts the muzzle between the bars. The animal usually bites the muzzle, and if it holds the muzzle inside its mouth with its teeth, the keeper pulls the trigger and fires. If not, he aims at its head, bringing the muzzle as close as possible to the predator's skull, and then fires. Sometimes it takes two shots or more, as the animal turns and moves inside the cage, causing the offender to miss the shot, or elements of cruelty and sadism may appear and the animal is slowly eliminated with multiple shots to produce unnecessary suffering. It is common to see tooth marks on the muzzle, although this detail is rarely checked by the acting agent when this type of weapon is seized. Once the capture is dead, it is removed and can be disposed of in the so-called "cemetery", as explained in the previous section on snares.

Wound trajectories found in animals put down inside cage traps are usually descending or oblique (see trajectory diagrams and photos on previous pages), but always downward. In shooting cases, the forensic study of the projectile trajectories in the carcass will allow us to determine not only the distance, but even the angle of the shot, which can be used to find out the height of the offender.

The other most frequent option is also bloodier. The keeper carries in the vehicle or hides in the bushes next to the cage a long metal spike, like construction rebar, the tip of which has been sharpened with a lathe and sometimes bears a finishing piece welded to it. It can be more or less elaborate, including a handle, or just the bare, sharpened iron rod. In Andalusia, this spike is locally called "*muerte*" or "*jinco*" by its regular users (see photos in the previous section on snares). When a capture has been found in the cage, the keeper approaches it with the *jinco* and inserts it between the bars of the cage to deliver one or more repeated thrusts to the head and thorax until the animal is dead. Once dead, he removes it and throws it into the cemetery. Similar to gunshot trajectories, spike trajectories in carcasses provide important information about the offender during forensic examination.

Although the animal may be killed using other methods, some truly cruel, these are the most common.

If the keeper is a cautious person or is aware that agents make regular appearances in that area, he may dispose of his dead captures by dumping them elsewhere, avoiding creating cemeteries next to the cage, which may attract too much attention. They can also be dumped on the road, faking roadkill.

From a forensic point of view, the laboratory can examine the animal's injuries and, in the case of gunshots, it can verify whether they were fired under these circumstances or from a distance, while the animal was free. We will not detail how this is done here, as these are purely forensic, rather than police, methods.

A mistake frequently made by agents in Spain is to overlook the importance of the tools used to finish off or kill animals, such as the aforementioned mallets, clubs and spikes. Except in rare cases, agents have either failed to recognise this important artefact or have underestimated its legal/police/forensic relevance and have not seized it, losing it for the case. It must be strongly emphasised that, from a legal point of view, this element is part of the prohibited trapping device and, therefore, must be seized and inspected. On the rare occasions when this was the case and the work was done correctly, it was possible to obtain DNA from its tip and match it to the species to which it belonged, resulting in the corresponding conviction of the offender. This detail is important and is a sign of a job well done.

In this section we would like to warn of a new variant of cage traps that has recently appeared in several areas of the Mediterranean Basin. They are simple PVC pipes, up to 20 cm in diameter. They are placed with a certain inclination and have bait at one end that is closed, so that they allow the animal (usually a fox or a mongoose) to enter, but not to retreat and get out (photo 7.4). The animal dies of starvation and stress. In some cases, as in the photograph here, the pipe has a small orifice through which the offender inserts the spike to stab the captured animal's neck or head and kill it. It is possible to know if these pipes are being used illegally based on the signs left by the captured animals (photo 7.5).

Photo 7.4 Some traps consist of simple PVC pipes.

Photo 7.5 Some animals leave signs on pipes used as traps.

08. IDENTIFICATION OF DEATH BY LEGHOLD TRAPS

This chapter does not discuss the different types of leghold traps, since, as we have already mentioned at the beginning, the variety that can be found in and around Spain is truly overwhelming. We have detailed the most common types in another chapter of this manual. For instance, in Andalusia alone, up to 18 different types have been confiscated in nature, manufactured in many different periods and originating from many different regions. German, British, French and Moroccan traps, as well as traps from practically all regions of Spain, have been found in the wild. An inventory of the various types of traps and snares found throughout Europe would exceed the total volume of this manual. We strongly recommend that professionals study in detail the most common traps and snares used in their respective countries or regions and learn about their use, construction and operation.

Here we will discuss the most typical injuries that can be seen in the field, which are the ones agents may normally encounter.

It is necessary to mention that investigating leghold trap placements involves greater difficulty than, for example, that of snares. The reason is simple. Snare making is a purely handmade activity and, consequently, there are offenders' signatures both in its production and placement. On the other hand, leghold traps are factory-made, so it is not possible to find offenders' signatures on them. In these cases, the investigator has to go to great lengths to find placement patterns to conclusively link them to the offender. For this purpose, it is appropriate to know the methods of placing a leghold trap, the most convenient locations and even its orientation. Similarly, it is important to detail the elements associated with the trap, i.e., whether it has weights, whether branches have been used to guide the animal, whether the offender has swept the ground in one way or another, whether he has impregnated the traps with specific odours, whether they are baited or any other detail. While the proper placement of a snare requires some expertise, a leghold trap requires even more experience and knowledge. Although all leghold traps from a given manufacturer are identical, no two people will be able to place them in the same way (photo 8.1). As a precaution, we will not go into more detail here, but let this serve as a warning to urge investigators to pay special attention to all these fundamental aspects.

Photo 8.1 Leghold trap ready to use.

On many occasions, the jaws of a leghold trap cause serious injuries, which are generally concentrated in the extremities of the animals (photo 8.2), especially in the extremities especially in the case of carnivorous mammals. Fractures with traces of blood are common, whether the animal survived or bled to death. Sometimes leghold traps can act on vital areas such as the head or neck and the animal either dies instantly or after a prolonged agony like the badger pictured here (photo 8.3).

Photo 8.2 Injuries from leghold traps are observed especially in the extremities.

Photo 8.3 Badger caught in a leghold trap.

It is possible, and even frequent, for the animal to manage to free itself from the trap, even if to do so it has to self-amputate and sacrifice the limb that has been trapped. In these cases, the animal may survive the trauma and it is possible to see lynxes, wolves, foxes, bears or jackals that have managed to readjust to life in the wild missing one limb. If it is a carnivore that has not died instantly, its teeth show considerable damage as a consequence of biting the metal ring (photos 8.4) and even its claws, which get damaged when trying to release the trapped limb from the metal (photo 8.5).

When leghold traps or other jaw traps are the cause of the crime, both live and dead animals show a blackish colour on their injured limbs, indicating that the tissue is already dead or necrotic. If we look closely, we can even distinguish signs of the trap teeth in the bones of carnivorous mammals trapped in toothed devices. This is important from a police and forensic point of view in order to link the capture to a particular trap with or without teeth.

Photo 8.5 The claws show damage due to the struggle to get free.

Toothless leghold traps cause injuries that are more difficult to identify, because they are non-specific (they lack exclusive distinctive signs). The severity of each injury depends on variables such as the type of leghold trap, whether it is old (has lost strength) or manipulated (to increase strength) and which limb has been trapped. It is difficult to assess the degree of injuries on site, although the naked eye can sometimes detect skin abrasions in the area of contact with the trap metal. On numerous occasions there are considerable lacerations and open fractures that are typical of this prohibited device (photos 8.6). However, it may occur that there are no ex-

Photos 8.4 Mouth injuries are frequent in animals that try to free themselves from leghold traps.

ternal injuries at all (photo 8.7) and it is then necessary to perform a necropsy to observe injuries that are not visible externally, such as bruises or major muscle haemorrhages. In these cases, the ultimate cause of death is usually linked to some stress-related cardiac condition.

Photos 8.6 Some of the injuries caused by leghold traps.

Photos 8.7 Sometimes traps do not cause external injuries.

This is especially frequent in trapped rabbits, which may be ravaged inside but have hardly any external wounds. This type of capture makes it possible to sell rabbits without wounds that could cause rejection when they are sold in public establishments Diagram 8.1. This explains why many professional rabbit trappers reduce the power of traps either by inserting a stopper or by bending the long-spring. Traps used to capture small birds act in a similar way.

In many cases what we find in the wild are the remains of animal bones, sometimes even groups of bones and carcasses of the victims that have been set aside and grouped together after being captured in the leg-hold traps. In these cases, it is not easy to determine with the naked eye whether the death was caused by a leghold trap or not. A detailed study of each bone is required in the laboratory, after an adequate cleaning process (photo 8.10).

Diagram 8.1 Picture of a rabbit caught in a leghold trap

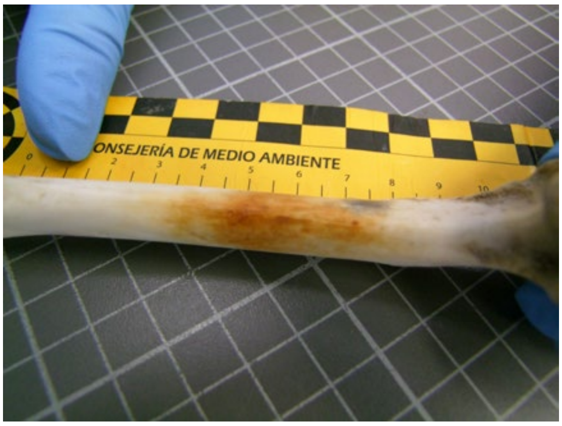


Photo 8.8 Bone analysed in the laboratory where injuries due to the effect of leghold traps can be seen.

Mammals are not the only victims of leghold traps; birds can also be trapped in them when they are placed at a certain height, such as on poles or perches (photos 8.9). This is very common in countries such as the United Kingdom or Portugal or locally in other countries such as Spain. If the bird manages to escape from the leghold trap, it may lose part or all of the trapped limb. There are cases in which, after such loss, the bird can adapt and continue its normal development (photo 8.10). As indicated above, it is normal to see necrotic tissue in the stump area (photo 8.11). In these circumstances, the laboratory has to demonstrate that the stump is really the result of the action of a leghold trap, for which purpose the affected bone is cleaned and all the details related to the study of these injuries are investigated (photo 8.12), even with the aid of a microscope.

Photos 8.9 Leghold traps can be placed on perches to capture birds.

Photos 8.10 Some birds are found to have missing limbs.

When leghold traps are found, it is very important to inspect them in detail. Blood or fur remnants may indicate whether they have been used and what species of animal may have been the victim of the capture. In this context, DNA analysis of the remains is useful, as it allows the identification of the animal species and the results can be produced as evidence in a subsequent trial for possession of illegal trapping devices, which is a crime against wildlife. We can also encounter blood on the substrate where leghold traps have been placed (photo 8.13). We have already achieved significant success in this regard. Indications on how to obtain and submit such samples to the laboratory are given in the chapter on labelling and packaging of samples.

Photo 8.13 Leghold traps can leave evidence such as traces of blood in adjacent areas.

Photo 8.11 Necrotic tissue after losing a limb as a result of a leghold trap.

Photo 8.12 Bone cleaned for forensic analysis.

09. IDENTIFICATION OF DEATH BY ELECTROCUTION

Power lines are perhaps the infrastructures with the greatest impact on birdlife. Sometimes they have a positive effect, as many species use them as perches and nesting sites when natural elements are lacking. In exchange, power lines have introduced a significant mortality factor into the environment. This problem is especially serious in the case of medium and large birds such as raptors, which are generally scarce in number and many of them seriously endangered. Thus, dangerous power lines are a constant drain for the populations of some protected species globally, reducing the effectiveness of the resources allocated to their conservation and the restoration of their habitats. Hundreds of thousands of birds die every year in Europe as a result. In Spain alone, according to a report by the Spanish Ministry for Ecological Transition and Demographic Challenge (MITECO)[12] power lines cause the death of at least 33,000 raptors per year (taking into account that only data from 11 of the 17 Spanish autonomous communities and this group of species were analysed), generating a cost of around EUR 141 million, estimated according to the MORA (Environmental Liability Supply Model) system[13].

In this chapter we will discuss how injuries caused by electrocution in birds can be recognised by agents in the natural environment. We can all recognise an electrocuted animal when it is found at the foot of a power line with burned talons and wings, but the injuries are not always so obvious. All possible injuries, both obvious and not so obvious, will be discussed in this chapter, explaining how they occur.

As mentioned above, electrocution or collision is one of the factors that causes the highest number of deaths in some specific species. It can reduce the populations of certain raptors, including the Iberian and eastern imperial eagles, Bonelli's eagle, osprey, white-tailed eagle, golden eagle, Egyptian vulture, kite, great bustard, different species of vulture, etc. In general, the greater the wingspan and the greater the inexperience (young specimens lacking experience in flying and hunting), the greater the risk of electrocution. Environmental conditions also influence the risk of electrocution, with mortality being higher in rainy, windy or snowy weather.

In this chapter we will provide answers to several frequently asked questions that may arise in an investigation process in these cases.

Do all electrocuted birds die instantly?

No. In fact, not even the vast majority. According to data for Andalusia, immediate death occurs in approximately 75-80% of cases, but not in almost a quarter of them. About 10% died from the trauma caused in the fall, although many of them were probably already fatally injured. Another 10% or so made it to the ground alive, but died later due to dehydration, predation or as a result of the severity of the injuries caused by the electric shock.

Do all electrocuted birds show obvious signs of electric shock?

In this case, using data from Andalusia, about 5% of the birds showed signs affecting more than 80% of the body, giving an appearance of almost total charring. Most of these were large birds. Some 80% showed less dramatic signs, but still visible to an experienced individual, and approximately 15% showed external signs that were practically unnoticeable or barely visible.

[12] Soria, Mª, Guil, Francisco. First general approach to the impact caused by the electrocution of birds of prey - Incidence on birds and associated economic impact. June 2017.

[13] MAGRAMA, 2016. MORA (Modelo de Oferta de Responsabilidad Ambiental - Environmental Liability Supply Model). At http://eportal.magrama.gob.es/mora/login.action

Are all electrocutions caused by high-speed electric shocks?

No. In fact, there are two main types. The first are slow incidents, characterised by the birds' high resistance to the flow of the current and therefore an accumulation of energy is created. The most noticeable injuries occur in these cases. The others are rapid incidents, featuring no or low resistance by the bird to the flow of the current and the animal's body experiences a fulminating shock. In these cases, injuries tend to be internal and less apparent, with heart failure being the most prominent. However, as we will see below, there is a wide variety among them due to intrinsic and environmental factors.

Is the electrocution of a bird a crime?

This is one of the most recurrent questions even among professionals related in some way to the investigation of environmental crimes. The answer is not categorical, since there are a series of legal, technical and environmental variables that make it impossible to give a single global straight answer for all cases within Europe.

Whether or not the electrocution of a bird on a power line is unlawful is determined primarily by the legislation in each region and/or country. Secondly, as is the case in some Mediterranean countries, it may depend on the specific legal status of each particular power line and may even depend on the user of the electricity channelled by the line or on the owner of the line. Thirdly, it may depend, and in fact in many cases it does, on the maintenance conditions of the poles kept by the operator. In addition, depending on the country, it may depend on the species killed by electric shock.

On another level, even if the electrocution of a buzzard, for example, is considered an unlawful circumstance in a particular case, this may simply be considered an administrative offence rather than a crime.

In any case, at EU level this type of mortality falls within the framework of Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.

The existing complexity within the different European countries and also in the different regions therein increases if we take into account that in a great deal of the electrocution cases that result in legal proceedings, the companies, individuals or perpetrators reported will submit allegations. Logically, the resolution of most of these legal disputes is beyond the control of the agents and technicians, since they are settled in court, but it will lead to considerable forensic, police and expert work for these professionals to deal with. In these circumstances we are required to have a basic knowledge of the phenomenon of bird electrocution and how power lines are categorised according to their danger level. As this is not the subject of this manual, we encourage you to read the existing published manuals. It is also necessary for professionals, technicians and agents to have a minimum understanding of the injuries caused by electrocution and how they occur. This chapter discusses precisely this.

Agents need to bear in mind that we have recently found numerous cases in which criminals poisoned or shot birds and then left them under a power line to simulate death by electrocution. Agents must be technically prepared to correctly identify these cases.

Why do birds get electrocuted?

Electric poles provide perches for hunting, resting, feeding, territorial defence or nesting. Raptors in particular use power line structures to bask in the sun, seek shade and get a sense of air currents.

When a bird is merely perched on a cable, there is no risk of electrocution. This is because the electric current chooses the path that offers the least resistance. Let's explain this: Birds (and people) are very resistant to the flow of electricity, i.e., they are poor conductors. On the other hand, the cable on which a bird perches conducts electricity very well (hence their purpose) and the electric current flows through it instead of through the bird, because it conducts electricity millions of times better than the living tissues of the bird. The bird also receives some electricity, but the intensity is minimal and harmless. Almost all of the electricity flows through the cable without impacting the bird, so there are no electrical accidents. The problem arises when the animal acts as a conductor between one cable and another, or between a cable and the ground. In that case, the electricity has no choice and must necessarily pass through the bird, so that electrocution occurs when thousands of volts run through it. This connection between cables can occur in several ways. When the bird touches two cables or a cable and some grounded element at the same time, e.g. when it lands on the crossarm and touches one of the energised phases or some other electrically charged structure.

The large wingspan of a raptor makes it easy for it to touch two cables when it spreads its wings to soar or land on a pole, but this contact between cables can also occur through its droppings – the ejected liquid can even fall up to 2 meters, a distance which is more than enough to connect the wire on which it is resting with the one immediately below (photo 9.1).

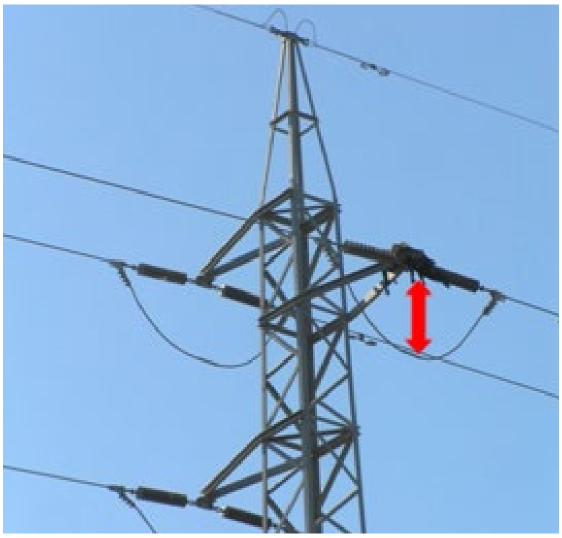


Photo 9.1 There are multiple possibilities of electrocution on an electric pole.

How do the typical burns on talons, legs and wings occur in electrocuted birds?

As we have already mentioned, birds are resistant to the electric current and, like humans, have parts in their bodies that are more resistant than others. The greater the resistance of a tissue to the flow of the current, the greater the transformation of electrical energy into heat. Simply put, the current, when finding resistance in its path, accumulates in that area that is reluctant to the passage of electricity and unfortunately for the bird, it does so in the form of heat, reaching very high temperatures. In some cases, the accumulated heat is such that the bird can cause a fire when it falls and burns on trees and vegetation under the pole. If this occurs, the bird will be found burned (photos 9.2), not because of the electrocution, but because of the fire that the bird itself has caused.

Photos 9.2 Electrocution can generate fires that end up burning the affected birds.

Interestingly, the most resistant parts of a bird to the flow of electric current are the talons, legs (the skin is very resistant), feathers, bones and tendons, so these are the parts of the bird that we always find literally scorched, which is very easy to distinguish on site (photos 9.3) because they usually appear at the foot of a power line.

Photos 9.3 Signs of electrocution are usually very evident on legs and feathers.

Sometimes this event is so severe that it can lead to bone fractures (photo 9.4) and even amputations in extreme cases. On many occasions it is thought that these fractures occur when falling, but this is not always the case; as we have said, they can be caused by electrocution itself.

Photo 9.4 Electrocution can cause major injuries, such as bone fractures.

What happens when it rains?

We know that when it rains birds get electrocuted more easily. When it rains, water reduces the resistance to electricity, which generates a greater amount of electric current through the animal's body. Electricity enters a wet body more easily, where it encounters internal tissues and organs that are much less resistant to the flow of electricity than skin and feathers. Among these organs the heart must be highlighted. The passage of electricity causes cardiac arrest and death ensues on the spot. In these cases, there is no heat accumulation and we will not see the obvious burns explained above. It is possible, however, to see wet or damp feathers on the carcass.

Moreover, when it rains, as the skin and feathers become less resistant, a low voltage current, which in a dry setting is totally harmless, can become as deadly as a high voltage current.

Based on all this, we now understand why we do not always see burns on talons, legs or wings. But electrocuted birds can also appear without obvious signs of burns in the absence of rain. Why does this happen? Can we detect any signs apart from typical burns? Absolutely. We will try to explain this in the following section and we will show pictures of these electrocution signs that we usually call "atypical".

Why are burn injuries not always evident on electrocuted birds even when it is not raining?

When the voltage of a power line is low, we are unlikely to see obvious burns. Sometimes a small circular injury can be observed that may go unnoticed or be mistaken for autolysis, especially when the carcass is decayed or skeletonised.

When the voltage is high, in the absence of rain it is also possible that the bird does not suffer the obvious burns shown in the pictures above. As we have seen, skin, feathers, bones and tendons have a high resistance and tend to heat up before transmitting the current. Evidently, other parts of the birds are less resistant to the passage of current: the nerves, responsible for transmitting electrical signals, as well as the muscles and the blood vessels, with their high content of electrolytes and water, both of which are very good conductors of electricity due to their high salt content.

Keeping in mind this difference in resistance between tissues, let's see the situations in which we will not find clear electrocution injuries on a bird, even in high-voltage power lines:

- If the bird has a wound on its talons or something has happened to alter the natural resistance of the talon, the electric current finds a passage and uses the blood vessels for transmission (we have already seen that blood is not very resistant, so it is very conductive to the flow of current). Along the way it leaves signs of coagulation and necrosis in these blood vessels. In these cases, we will notice externally how a line of congestion ascends along the toes (photo 9.5).

  For this reason, when a bird is collected fresh and no electrocution injuries are clearly visible, the laboratory cuts the toes of the talons lengthwise, looking for these signs of the flow of electricity in some of them (photo 9.6).

Photo 9.5 Electrocution usually results in ascending congestion in the legs.

- When electricity reaches muscles or nerves, neither of which are very resistant tissues, the high voltage produces muscle spasms (which are not convulsions as in poisoning cases) and the bird is literally projected from the electrical source, so the exposure is so short that there is no time to accumulate heat or produce obvious burns. In these cases, we will only see traumatic injuries from the fall. It is easy to distinguish the stiff talons and stretched body (muscular tetany), (photo 9.7) as observed in bird carcasses with poisoning disposition (they are similar, but not the same).

Photo 9.6 In the laboratory it is possible to examine the animal to find signs of electrocution.

Photo 9.7 Sometimes there are no evident signs of electrocution, but there are other signs such as muscular tetany.

Therefore, when we see a dead bird with a typical stiff posture near a power line, we may contemplate electrocution rather than poisoning, even if we do not see typical electrocution injuries. The laboratory will identify exactly which of the two factors (or both) caused the animal's death.

- Sometimes the electric current produces disarray in the muscle cells of the animal's body. This current alters the properties of the muscle (a phenomenon called electroporation), instantly turning the muscle into a flaccid mush. The bird falls and death is actually due to trauma, with no obvious signs of burns. On site we see the softened tissues of the legs, with a whitish colour and a viscous appearance, as if the muscle had been cooked (photo 9.8). This explains the inability to stand upright on the cables, lose balance and fall to the ground.

Photo 9.8 Another effect that electrocution can leave behind is soft and viscous tissues.

Let's keep these notions as elements of judgement on site, because they always shed light on the reconstruction of the facts. We must emphasise, again, that any injuries will be thoroughly studied with the necessary resources once in the laboratory. Any doubts that the agent may have on site in front of a carcass are easy to clear up in the laboratory, provided that the carcass has not been handled excessively.

To conclude this section, we must point out that no two electrocutions are the same. There is a long list of factors that determine the immense range of circumstances, especially the size of the bird, its flesh, the intensity of the electric shock, the trajectory of the shock, the degree of injuries caused, the ambient humidity, the impact of the fall, the degree of reflexes in the fall, the existence of predators in the surroundings, the vegetation under the pole, etc. As a result, it is possible to find some birds completely burned and others apparently unharmed. Not infrequently, if the injured animal receives assistance in time, it may survive and even be released, like the Bonelli's eagle shown in the photo 9.9.

Photo 9.9 Bonelli's eagle that survived electrocution.

10. SIGNS OF DEATH BY COLLISION

Collisions against wind turbines

In general terms we can say that this cause of death is the most unknown and underestimated of all. Although there is not much data at EU level, it must be said that the data collected refers only to a few of the cases that are detected and, consequently, those that give rise to legal or criminal proceedings. In fact, in order to increase detection rates, searches are currently being conducted with specialised canine units in some areas of Europe.

From a forensic point of view, this cause of death in general does not pose major problems for identification, given the location where the bodies are found and the type of injuries observed. In laboratories, the most frequent cases analysed are related to soaring birds and other large birds or those that are on long-haul flights (migratory birds), such as raptors or storks. Deaths of passerines, bats, insects, etc. are also very frequent.

There are two types of collisions. The first type are collisions produced by the middle-distal end of the blades. These collisions leave very dramatic and striking injuries, virtually unmistakable both on site and in the laboratory. The collision almost always results in the death of the animal.

The second type are those caused by the part of the blade that is closest to the rotor or tower. In this case, injuries are not so noticeable and the animal may even survive the impact. In these cases, the lower magnitude of the impact is explained simply by the laws of physics, since the moment of inertia and, therefore, the collision power, is much lower if the bird is hit by the proximal end than by the distal end of the rotating blade (photo 10.1). Since in this case the injuries may not kill the animal on the spot, it is very difficult to assess the real scale of the problem and to carry out a detailed study of the exact injuries caused. For this reason, in the rest of this chapter we will only refer to fatal injuries caused by the middle-distal ends of the blades.

Photo 10.1 Cinereous vulture showing the effects of a collision.

Be that as it may, the collision does indeed occur, either due to a distraction or to the inability to prevent the impact because of the wind. In fact, after reviewing the data of birds that have been sent to the CAD laboratory in Andalusia over the last five years, it is confirmed that the griffon vulture is undoubtedly the most affected species, although there are also cases of death by this type of collision in other species such as cinereous vulture, Egyptian vulture, short-toed snake eagle, osprey, black stork, lesser kestrel, common kestrel and Iberian imperial eagle.

After a collision, the bird carcasses usually appear under the wind turbine, showing the typical injuries of severe trauma: contusions, bruises and fractures that can lead to the amputation of a wing (photos 10.2) even splitting it into several fragments (photos 10.3 and 10.4).

Contusions and bruises are not easy to distinguish on a bird in the wild due to the feather cover, but amputations, which are very frequent, are easily distinguishable. Sometimes the different parts of the carcass can be found scattered around.

Photos 10.2 In many cases, collisions with wind turbines cause amputations of wings and damage to other parts of the body.

Photo 10.3 Cinereous vulture that has been severed by a blade.

In several carcasses of victims of these collisions, poisons and other toxic substances have been detected in samples taken during necropsies. These toxic substances undoubtedly prompted the collision by causing a loss of reflexes (toxic substances directly impair the nervous system). Therefore, these carcasses are an important source of information on the presence of poisons and other toxic substances in areas more or less close to the collision site.

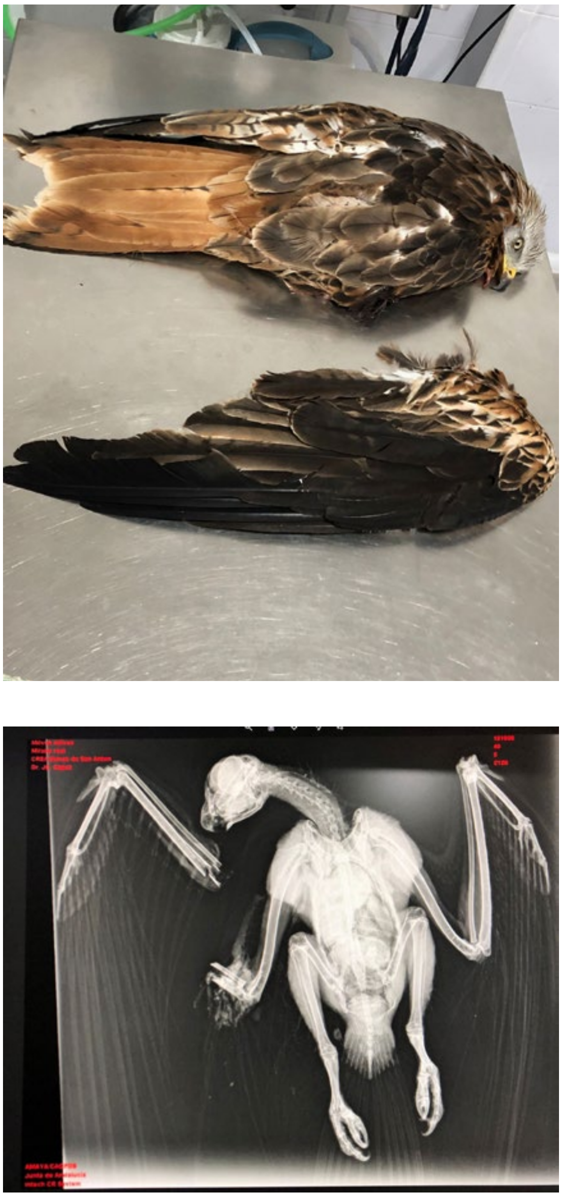


Photo 10.4 Red kite with wing amputations.

It should be highlighted that this section refers to carcasses of species that are analysed in a laboratory. Collisions of small birds or bats against wind turbines are countless, but their carcasses do not normally reach forensic laboratories. In most cases they are scavenged by other species and their detection rate is very low.

Collisions with vehicles

For many endangered species, collision with vehicles is such a frequent cause of death that it may even be a factor of local extinction for populations of some carnivorous mammals, such as bears, wolves and lynxes, or some nocturnal raptors, such as little owls and barn owls. Focusing on birds, estimates of annual mortality due to road accidents in some European countries range from 350 000 to 27 million birds[14].

In general terms and intuitively we assume that an animal has been killed in a road accident when we find its carcass around a road, and this is usually, but not always, the case. Although fortunately this is rare, in the research work carried out in Spain we found that some specimens, including lynxes and badgers, had died from other causes, such as gunshots (for raptors) or leghold traps (carnivores), etc. and their carcasses had later been intentionally placed on the road to simulate roadkill. We can suggest that probably as much as 5% of the animals that we find by a road may be criminally manipulated. Once again, the obvious explanation does not always correspond to reality and discovering the truth is a challenge to the skills of the agents.

In this case, the final explanation lies in the findings of the necropsy report issued by the forensic laboratory, but this does not prevent us from being able to gain some insights on the ground.

As a general rule, roadkill that is not completely mangled (in which case little can be observed) should show some injuries that reveal the type of death. However, we would like to stress once more that the animal may have died from ruptured internal organs and can still appear intact in outward appearance.

In most cases, roadkill mammals have visible open wounds or fractures, with more or less abundant haemorrhaging, both in open wounds and in natural orifices (muzzle and ears). Bald patches on the skin, caused by the impact against the abrasive surface of the asphalt, are frequent. We can see damage to the jaw and teeth and in the case of felines (domestic cats, wildcats and lynxes) it is common for the claws to be broken or chipped at the ends. In the case of felines, the necropsy will most likely show a full stomach, even though we may not be able to appreciate this on site. In birds, the most frequent sign is finding abundant closed fractures (without wound) through touch.

On the crime scene, we must look for traces of fluids – blood, urine, faeces – that may have been left by the animal either through the wounds or as a result of sphincter relaxation whether on the asphalt or on the shoulder. The finding of this biological material reveals that the death occurred at that location and that the carcass was not moved from another point, should death have occurred somewhere else.

[14] Johannes Erritzoe, Tomasz D. Mazgajski, and Łukasz Rejt “Bird Casualties on European Roads — A Review,” Acta Ornithologica 38(2), 77-93, (1 December 2003)

11. INVESTIGATION PROCESSES, FROM COUNTRYSIDE TO COURT. DUTIES OF THE DIFFERENT PROFESSIONALS

In the European Union it is now possible to find excellent environmental police and forensic teams and specialised laboratories. This is undoubtedly one of the greatest achievements in biodiversity conservation in recent years and we must continue to move in this direction. Moreover, these professionals are needed, as highlighted by the latest SOCTA (Serious and Organized Crime Threat Assessment) reports of 2017 and 2021, which have resulted in the EU Council recognising environmental crime as a threat posed by serious and organised criminal activities.

However, it is common to find investigations and cases that began brilliantly but do not achieve the desired success in the courts of justice as often as we might wish for. How is this possible?

This has several readings and justifications, which we will discuss below. One of the most relevant reasons is the lack of a steady, sustained response from the opening of the case to its culmination in the judicial phase.

We have already seen that many specialists from different academic, scientific, police, legal and administrative disciplines are involved in the police investigation of a crime against wildlife. The most difficult challenge in obtaining a conviction is not the removal of the carcass or the crime scene investigation by the agents, and not even the forensic or the final judicial phases. The most difficult challenge is the essential task of providing this long process with a sense of continuity from the moment the crime is discovered until the offender is summoned by the courts, and this is where the vast majority of cases opened throughout Europe, from Portugal to the Balkans, fail. It is absolutely useless to have the best canine units specialised in the early detection of poison in the natural environment, the best team of agents and environmental police or the best lawyers specialised in these crimes if all the links are not perfectly coordinated and there is no chain uniting them. Unfortunately, there are many examples of cases that have been lost in court due to poor or non-existent coordination.

This is currently the greatest challenge and the main obstacle to be overcome by governments in their efforts to fight environmental crimes.

In an investigation, the role of each professional involved in this long chain must be perfectly clear and tasks must be carried out in accordance with the competencies established by law in each European country. However, in many European regions there is currently confusion between the different roles in an investigation of biodiversity crime, especially at police and forensic level.

This confusion can even be seen in the terminology we use in our daily work. Not surprisingly, we often use the terms “police” and “forensic” interchangeably, given that both are closely related as they refer to procedures used in solving illegal acts.

This raises the need to underpin fundamental concepts in our professional work, some of which are new, while others are already known but sometimes used inaccurately in documents and reports. Throughout this environmental police manual, we intend to clarify each and every one of them.

First of all, we will mention the concept of “police work” and its implications in terms of competence. As is well known, European criminal law and other regulations define police work as the task that the public authorities grant to certain officers specifically commissioned for this purpose, known as law enforcement officers. In Europe these include individuals belonging to the Italian Carabinieri, to the Portuguese SEPNA-GNR, Spanish Environmental Agents or the Civil Guard and officers from the French Gendarmerie. All these professionals are tasked with reporting to the commissioning authorities any alleged crimes and infractions, in addition to providing evidence about what, how, when, where and why the act happened through a logical-sequential process called police investigation. To this end, agents are or should be trained in schools and academies and, for the performance of their duties, the public authorities provide them with a wide variety of auxiliary tools. The law also establishes that only officials commissioned or authorised for this purpose may perform the duties and powers reserved to law enforcement officers, but not officials who are not vested with this legal status or who have not been formally and officially commissioned for this purpose. As an example, a biologist or a lawyer cannot remove the carcass of a protected species if he or she is not qualified to do so according to the public authorities of his or her country. Police work can only be carried out by law enforcement officers (in our particular case, this would ideally mean environmental police).

Forensic work is very similar to police work because it shares the same purpose, but there are important differences. While police work is carried out by agents, forensic work is carried out by technicians and consists of processing and analysing the materials and traces obtained during the police work. The material provided by the agents receives the technical name of samples or evidence from the moment it is delivered to the forensic expert. However, forensic work is not the same as police work, since forensic work is the application of strictly scientific procedures and, according to standard international regulations, can only be carried out by qualified technical personnel and/or professionals with advanced academic degrees in pure sciences (e.g. chemistry, physics or biology) or applied sciences (veterinary medicine, human medicine, engineering, etc.). The forensic expert is a technician with an advanced academic degree in a scientific discipline who has received specific training to carry out a specific task and who processes and/or examines samples submitted by law enforcement officers as part of a police investigation.

Therefore, forensic work is performed by a technician who has been trained at a university and accredited by an established team for this purpose, who applies the scientific method and scientific principles to solve legal problems and who puts science at the service of law enforcement. As in the previous case, a law enforcement officer that is not academically qualified, has no specific formal training and is not appointed by the public authorities for this purpose cannot undertake forensic work, because it would be invalidated as a matter of law in judicial proceedings as it lacks legal guarantee, notwithstanding the legal actions that could be filed against him by the defence or the respective professional association.

In summary, police work can only be carried out by a law enforcement officer or an individual specifically authorised/commissioned for it and forensic work can only be carried out by forensic technicians commissioned by the public authorities and courts, accredited by a university or engineering degree in one of the scientific disciplines involved.

It is important that concepts and procedures are clear; otherwise the cases and investigations opened end up in failure, either due to inaccuracies in the records and police reports, errors in the chain of custody, erroneous professional powers or any other weaknesses, which will undoubtedly be exploited with great skill by the defence attorneys as befits the normal performance of their important work. Let us also remember that the role of the defence is established in the legal system and its purpose is to guarantee the legal rights of citizens.

Investigation phases of biodiversity-related crimes

Having said all this, we can now break down the different phases in the investigation of biodiversity-related crimes. This is a chain whose links are interconnected. It is no use if one link is solid and the next is not, because at the end of the day this means that the procedure fails.

Let us use a specific example to illustrate the investigation phases, e.g. a poisoning case of a red kite in any random European country.

Police phase of the investigation

The first phase of the investigation, as we mentioned, is the police phase.

This phase starts from the beginning, i.e., from the moment the crime is known to have been committed. In our case, this is a phone call from a private individual to the environmental police reporting the existence of a raptor carcass out in the countryside. After hearing the details, a team of agents moves to the site following the indications of the anonymous informant. Once there, they comb the area until they find a carcass in the indicated spot and ascertain that it is specifically a red kite, which is catalogued as endangered in the relevant country. After finding the carcass, the agents proceed to conduct the crime scene investigation (CSI), which they carry out with the utmost care, taking numerous samples and filling out the corresponding reports.

This implies that there is already an ongoing investigation and based on the findings, strongly pointing towards poisoning, the carcass is delivered to the forensic laboratory for diagnostic testing to confirm the cause of death. In parallel, the police team has already started the first inquiries, questioning witnesses and visiting nearby livestock farms in search of suspects.

At some point the investigation cannot continue and goes into stand-by mode because it is pending confirmation of the cause of death by poisoning, or by natural causes, which puts an end to the case, or under other non-natural circumstances, in which case it is necessary to rethink the procedure in a different way. The case now depends on a different phase.

Laboratory phase

The samples collected in the police phase are now in the possession of forensic laboratory specialists. After performing certain tests (perfectly explained in the following chapters), they come to the conclusion that the kite has indeed died from ingesting poisoned bait. The laboratory completes the corresponding necropsy and toxicology reports and sends them back to the police force in order to reactivate the open investigation. For the time being, the laboratory phase ends here.

The police phase is reactivated upon receiving these results and based on them, they decide to dig deeper. The laboratory proves that the animal died from ingesting poisoned bait, but this information alone is insufficient to resume the investigation. The investigation team now decides to get more answers and to this end the case enters the next phase:

Forensic or analytical phase

This phase can be carried out either by the laboratory itself, if it is qualified to do so, or by a duly accredited third party. In this particular case, the environmental police refer the case to an additional forensic expert for further analysis to find an answer to the questions raised. The results of the forensic phase are completed three weeks later, with the preparation of another technical report. This report provides answers to the acting officers, starting with the fact that the animal did not die in the same place where it was found dead and produces a probability map in which it determines with a high probability (greater than 60%), the area of land where the poison was placed and in which areas there is less likelihood of the crime having been committed. In other words, it is providing the environmental police with an area in which to focus the subsequent actions of the police phase. The forensic report also determines that, given the nature and properties of the toxic substance, it is highly probable that the source of the poison came from a livestock farm linked to sheep or, to a lesser extent, pigs, and that it has a *dehesa*-pasture-crop habitat, excluding large wooded areas. This report concludes the forensic phase, which, as we have said, can be carried out in the same forensic laboratory or in a different one.

That is, with the information provided in the forensic phase, the police phase resumes again, this time focusing on a specific area. As a result of the agents' subsequent inquiries, they identify an alleged offender or suspect, named John Doe.

The environmental police now have a suspect, supported by a complete body of documentation, consisting of the reports and carcass removal records generated in the two previous phases. Convinced that they now know who, how, when and why the investigated crime was committed and have sufficient evidence to prove it before the judge, the agents proceed to prepare a new accusation report against John Doe, which is sent to the court.

It should be noted that another reason for the low rates of police success in solving biodiversity crimes lies precisely in the overall lack of forensic analysts in Europe to carry out this type of work. This is undoubtedly a bottleneck that blocks and prevents cases from properly passing from one phase to another. It is common that when the reports reach the courts of justice, where suspects are tried and if appropriate convicted, the language and conclusions in those reports are not correctly adapted to the terminology that should be used or are not explained in a way that legal specialists can understand.

Judicial phase

The police phase has been completed and the case now enters a new and final phase, the judicial phase (or administrative phase, if we are dealing with administrative infractions). This is the final phase of the entire process. Although this phase is not the subject of this manual, it must be said that it is extremely complex and involves a number of actors: prosecutors, private prosecution lawyers (if any), attorneys, NGOs (acting as private prosecution), defence lawyers, the defendant, etc. and, of course, all the witnesses, police, forensic experts and specialists called to testify at the public hearing that will end the entire process. By then, several years may have passed since the day the anonymous call was received. The outcome of the verdict in this case is the least important matter, since at this point all the actors mentioned above have done their job and what happens in the court is beyond their control and their competency. In a state governed by the rule of law, the case is decided in the courts of justice.

As we can see, this whole process is extremely long and costly in terms of time and material and economic resources. The likelihood that some element will fail is very high, because there are many phases and many different individuals involved. As mentioned at the beginning of this section, it is no use if some phases are masterfully performed when others have significant weaknesses.

We know from experience that good teamwork and proper coordination among all the phases is the best tool.

Below is a description of the procedures involved in the investigation of biodiversity crimes:

Crime scene investigation: Field investigation and forensic investigation division

"... There is no perfect crime, only eyes that do not see properly." This forensic dogma draws attention to the fact that the ability to solve crimes against wildlife actually depends on two fundamental factors: how good the offender is at hiding himself and his actions, and how good the people are whose objective is to discover and prosecute what the offender has done. When confronted with an expert professional criminal, the chances of the police neutralising him are slim, but this can be reversed by turning the game around, that is, by being better than him. We can show thousands of examples of this over the years, but they all boil down to the fact that, at the beginning, when we start working, it is surprisingly easy to solve crimes. Over time, as criminals become more aware that police activity can be an inconvenience to their activities, their methods become more subtle, their movements more difficult to detect and their deeds almost imperceptible. This is what in forensics is called forensic awareness, turning crime investigation in certain regions into a kind of cat-and-mouse chase game, in a world where the mice are getting smarter and better equipped.

In general, we have learned over the years that professional criminals will always be far ahead of us. These are extraordinarily intelligent people and we can consider that neutralising them and achieving their conviction is an exceptional accomplishment from a police point of view. But we have also learned something else during this time. Tenacity and continuous effort pay off in the long run, and even the smartest people make mistakes. The key to success is knowing how to be in the right place at the right time. In the end, sooner or later, mistakes end up happening.

No one can deny that the element in the police phase that determines the success of the investigation of crimes against biodiversity is precisely the CSI. The success of the overwhelming majority of cases depends on this and we can assert that if the CSI is carried out correctly, the most difficult part of the whole procedure has been completed. The CSI requires amazing observation and knowledge integration skills, extreme caution, a rigorous approach and, above all else, extremely high doses of patience and time.

For all these reasons, our main advice to professionals in this field is to never throw in the towel. No crime is perfect. If we are faced with a clever criminal, the agent will eventually develop the right strategy to capture him, but we must be aware that the key will be perseverance and patience. Over the years, we have certainly witnessed the capture of many extraordinarily sly offenders who we never thought would be arrested.

Every criminal investigation revolves around a fundamental element for the agent's work: clues, evidence or proof. Although these terms have different legal and police meanings in the criminal justice system of different countries, in order to simplify we will use a single term that is valid for all European countries: evidence, even if this word may have different legal connotations in the legal system of each country.

Evidence is the reliable demonstration by the agent that the results of the investigation are truthful, and obtaining it is the fundamental purpose of the forensic investigation division, the environmental police and the investigators. In other words: the pieces of evidence are the building blocks of the investigation of a specific case and without evidence there is no case and no possible investigation. Every criminal act must be proven and this is done with evidence. It can be said, therefore, that the purpose of crime investigation is to accumulate evidence that proves the identity of a culprit in a case, that pinpoints him at the crime scene at a given time and that links him to the crime. Ultimately, any police investigation related to wildlife crime aims to accumulate evidence (photo 11.1).

Photo 11.1 Andalusia's UFOA team searching for evidence in a potential poisoning case.

We must remember that according to the different European criminal justice systems, environmental police officers cannot judge, but only provide the evidence and bring the facts to the attention of the judicial authorities or the investigating judge, who are the only authorities competent for issuing the possible administrative penalty.

All in all, the evidence must always be clear and unequivocal, in order to leave no room for doubt and to facilitate as much as possible the work of prosecutors, magistrates or investigating judges of infringement proceedings, who have the responsibility to continue with the case in the judicial or administrative phase – for administrative infractions – in which agents do not take part directly. Therefore, the more detailed, clear and complete the work carried out in the police investigation phase or police phase is, the greater the guarantee that our procedure will be successful and its duration in time will be short. On the other hand, it should never be forgotten that law enforcement officers must ensure that legal procedures are followed impeccably to the letter, clearly supported by the Constitution of each European country. The outcome of the investigations will determine the ruling or judgement of the judge, who may even hand down prison sentences or impose heavy penalties that are not always easy for the average citizen to bear. In conclusion, it is always better to have three guilty people unpunished than one innocent person unjustly prosecuted.

Work phases in field investigations or forensic investigation division

Forensic investigation is a sequential process, with different phases that vary depending on the type of crime being investigated. The most challenging crimes are usually wildlife poisoning and shootings. These crimes are technically complex (although not impossible) to solve and due to their peculiarities, they are very rarely solved immediately. In addition, the investigation involves an added difficulty: since these are highly mobile animals with extensive home ranges, it is not always possible to know the exact location where the criminal acts took place. Even though we find the carcass of a cinereous vulture at a specific location, it may have been shot or ingested the poisoned bait hundreds of yards or even several miles away from the carcass location. For all these reasons, investigations can often take months or even years to complete. Some cases of wildlife poisoning have been solved and closed up to five years after the police started the investigation.

Consequently, in relevant cases of crimes against wildlife, our advice is to request the collaboration of agents and technicians experienced in this special type of crime.

Textbooks that teach criminology and investigation to police forces in European academies detail three fundamental sub-phases within the police phase:

a) Crime scene investigation (CSI)
b) Follow-up police investigation
c) Forensic tests

According to the National Coordination Commission of the Spanish Judicial Police (CNCPJ), the CSI is the set of observations and technical police operations carried out at a crime scene for practical purposes of the investigation. It is carried out to verify the facts of the crime, identify the perpetrator(s), prove their guilt and provide the basis for the investigation.

Undoubtedly, the most important phase of all of them is the first, the CSI, as is even established in the criminal regulations of European countries. This is the phase in which the evidence and samples are taken for analysis. The crime scene investigation is the foundation of the entire process and if it is performed incorrectly the whole process is flawed.

Not a single experienced judicial police officer would call into question that at least 80% of every case investigated is solved during this all-important phase. In addition, any steps we fail to take during the crime scene investigation are generally irreversible, because if we return to the investigated location later, whatever we may be looking for has quite possibly disappeared intentionally or by simple deterioration. In other words, it is during the crime scene investigation that we discover the pieces of the puzzle (evidence), which we will have to assemble during the next two phases and, if we have not collected all of them, we will not obtain the complete picture.

The CSI must meet two essential conditions: it must be clean and thorough. The site must be examined without contaminating it with elements of our own that could lead to confusion, and all the elements of the site must be observed and analysed. In forensic science, a precept establishes that a good CSI always includes samples that are not relevant to the case and that these may account for up to 30% of the total number of samples collected for analysis by the investigators.

Most of the investigation failures in Europe to date have undoubtedly been linked to a poorly conducted CSI. We will never cease to insist on the importance of this part of the investigation and the need to undertake it properly.

The two subsequent phases focus on the detailed analysis and interpretation of the samples collected during the CSI and are based on our inductive-deductive capacity, as well as on the laboratory procedures and technological resources at our disposal.

For cases of poisoning in wildlife, there is another particular series of phases. As already discussed, the use of poison is not usually an isolated event in time. On the contrary, unfortunately, those who use poison do so with relative regularity. This is a so-called recurrent criminal behaviour. The frequency of poison baiting depends on many factors, which must be considered in each case in order to clear up the facts correctly. In the criminal justice system of several European countries, recurrent criminal behaviours are referred to as continuing offences.

From this perspective, two fundamental phases can be considered in the police investigation of cases of wildlife poisoning:

a) Identification of the exact geographical origin of the poison
b) Identification of the offender(s)

The first phase can be extraordinarily long and may even take several years. It should be remembered that it is common for kites, vultures or large eagles to ingest poisoned bait at one location and die in a different place, which may be up to several miles away depending on the type of poison used, the type of bait, the amount ingested, the species that ingests it and other environmental variables. It is not uncommon to fail to make progress and get stuck in the first phase, as has happened on numerous occasions.

On the other hand, once the source of the poison is well identified, the identification of the offender is by far easier, knowing how and what to look for and with sufficient patience and observation. It should be emphasised here that, as a general rule, poisoning is recurrent (a recurrent criminal behaviour), so all we need to do is wait, accumulate evidence and act at the right moment.

Most frequent errors and distortions in police investigation

Cumulative experience has led to a high degree of specialisation in the investigation of illegal acts against the environment and wildlife in particular, which has given rise to important successes in both administrative and criminal proceedings. However, this journey would not have been possible without having made mistakes and sometimes major gaffes. In this sense, mistakes should not be considered only as negative aspects of our work; on the contrary, they are an essential part of learning and, thanks to them, we move steadily in the right direction.

The investigation of crimes against wildlife is by no means an easy task; on the contrary, it requires enormous doses of patience, observational skills, many hours of work, day and night, and a bulletproof iron will. For all these reasons, it is important to know what mistakes we make most frequently, so as not to throw away all the work done in a particular investigation, which can sometimes entail several years of our time.

1. The carcass syndrome

This is the most frequent and most blatant of the mistakes made in the investigation of crimes against wildlife. This syndrome implies that we pay much more attention to the carcass itself than to the evidence, which is really the essential element.

When we arrive at the crime scene, the area around the carcass whose death we are investigating may be too crowded with people to take a close look at it, especially if it is a seriously endangered or uncommon species (lynx, vultures, wolves, bears, eagles). When we have little experience, it is inevitable to take out our mobile phones and take pictures and even selfies and this is the moment when we start to ruin the whole procedure.

By the time we want to start the CSI, the entire scene is already contaminated and there may be confusion about whether certain evidence such as fingerprints, cigarette butts or other elements belongs to the investigation team or to someone related to the events. The evidence obtained is thus subject to doubt, and in addition to the difficulties inherent to our investigation, we must now add uncertainty in the midst of a veritable chaos of ruined evidence.

In these cases, we do not take into account the fact that the place where the carcass is found is generally not the place where the crime was committed. The animal may have ingested poisoned bait or been shot at another location and may just have fallen there by chance. Besides, the carcass is not going anywhere away from the scene, so there is no reason to rush to its removal unless other external circumstances make it advisable. Therefore, it is well worth waiting a few more minutes, performing a CSI correctly, and not competing with colleagues as if it were a race to see who arrives first at the scene.

2. The bait syndrome

The opposite is true with poisoned bait. We often limit ourselves to simply collecting bait, forgetting that this is the place where the crime was committed and, therefore, where the probability of finding exchanges (and relevant evidence) is much higher. The place where the bait is located was chosen by the poisoner personally and therefore has the characteristics he is looking for. If we are able to find a thread or feature that is common to all the locations and recognise the key motives, we may be able to link this information to a specific suspect. In addition, it is possible that exchanges with value as evidence may be found around the bait. We have plenty of examples of this, as explained below. In short, the study of the location chosen to place the bait can lead us to the offender directly or indirectly.

3. Contamination of the scene during CSI or during removal of bait and/or carcasses

A lack of organisation renders many pieces of evidence useless and causes the signs left by the true offender to be erased by superimposing our own. During crime scene inspections we must always ensure the cleanliness of the procedure and establish protocols for a gradual approach to the bait, carcass or sample to be taken. It is highly recommended to refrain from smoking or eating at that time and place or performing any action that may leave potentially contaminating exchanges; in fact, these actions are prohibited in the standard operating procedures of the judicial police for agents involved in the investigation of murders and violent crimes against persons.

4. Incomplete crime scene investigations

If we perform a CSI with preconceptions and predefined suspects, it is common to focus the sample collection in the wrong direction, leaving out the real evidence. Therefore, during CSI we must act with an open mind to all kinds of possibilities. The subsequent follow-up police investigation will reveal to us in due course the direction in which our investigation should proceed, but not beforehand. As in the previous cases, there are many examples of this type of error. They are regularly committed during CSI in poisoning cases, for example, assuming that the cause of the poisoning is livestock protection when in fact it responds to hunting motivations and vice versa. A CSI must be approached without preconceptions and with a completely open mind. The cause of death we may be thinking about at the beginning may change within a few minutes.

5. Wrong location of the crime scene on a map

Although this is increasingly rare, coordinates or references of the exact location of the carcass removal may be taken incorrectly, resulting in the opening of proceedings or reports on the wrong individuals. Fortunately, this type of error is corrected by analysing the report thoroughly, before outside third parties may be affected. In order to avoid this error, we must be very careful when using maps and satellite images, reading hunting reserve signs and other references in the field and using the GPS in the appropriate time zone for each country.

6. Red herrings

In those places where environmental police pressure is higher, the offender leaves red herrings to avoid being identified and we have to detect them during the CSI. Offenders tend to act in a very specific manner, eliminating all evidence of their actions. This is what we called forensic awareness at the beginning of this chapter, and this tampering with the evidence can be done before, during or after committing the crime. Thus, for example, we have found poisoned animals that had been placed under a power line to simulate electrocution, or carnivores killed by snares and leghold traps that had been thrown onto the road later to simulate a vehicle collision death.

In these cases, it is essential to have minimum forensic knowledge to recognise the causes of death on site, which is our aim in much of this manual.

7. Procedural and protocol errors

These two terms refer to the need for all samples and evidence to be collected in full compliance with the law. It is of no use if the evidence has been obtained outside the boundaries of the law. Such evidence would be declared invalid in the criminal or administrative proceedings and, possibly, with it, the entire results of our investigation. Fortunately, examples are scarce and those that do exist usually refer to trespassing on private property without proper accreditation or justification. Protocol errors include transferring samples improperly labelled or in containers of inadequate material for each type of sample, leading the samples to deteriorate and be rendered useless upon arrival at the laboratory. It should also be highlighted that some samples are sent without the associated documentation, which renders them completely impossible to process.

8. Coordination errors

The lack of coordination between different agents, or even between different police forces in those regions where several of them exist and share identical legal functions, causes mutual interference that may lead to undesired results. On occasion, two different law enforcement agencies, both unaware of the duplicity, have been known to investigate, for example, the same poisoning case. Biased sampling, contaminated CSIs and invalidated procedures were always the consequences of all these errors, which of course never led to conclusive evidence. As much as we insist on the importance and necessity of the coordination of police forces, we can never stress it enough. Until this happens, we are doomed to fail in this and other conservation programs.

In conclusion, errors and distortions are easily avoided by understanding how we have to work, doing so with adequate advance planning and organisation and acting in a well-coordinated manner among the different agents and police forces involved when sharing the same investigated case. Open-mindedness, total cleanliness during CSI, avoiding contaminating samples during the investigation and maximum compliance with the law when sampling are equally decisive.

Summary of the most common types of evidence and clues to be considered in investigation procedures

It is impossible to make a complete list of all the elements that can be considered evidence from a police and forensic point of view and, therefore, that may be collected as samples during the CSI.

In practice, all we need to know is that when an offence or crime against wildlife is committed, the offender leaves traces according to the concept known as Locard's exchange principle. In other words, the offender will leave elements of his own at the crime scene and in exchange he will take elements of the environment with him. For instance, an individual placing poisoned bait may leave a shoe print when bending down to place the bait and may get mud on the soles of his shoes or on his trousers. This principle is the basis of police investigation and holds that when a crime is committed the offender and the environment exchange elements, whether physical or other types, which, if properly investigated, can give him away.

Thus, making a list of the elements that can be exchanged by someone who places poison in the countryside, shoots an endangered species or plunders an endangered bird's nest would be virtually endless. The range of clues is so extensive that it is hardly worth attempting an exhaustive breakdown. However, we can mention a number of elements that are exchanged quite often and are now common in many cases investigated to date. By studying these frequent elements, it has been possible to discern facts, identify offenders and bring them to justice; it has also made it possible to open numerous administrative infringement proceedings.

Therefore, the key lies in collecting absolutely all the elements we find on site during the CSI phase, irrespective of what may be related to the crime and what may not. When in doubt, it is better to collect the sample because, to our despair, we have regretted often enough not having picked up that cigarette butt or that plastic bag that we remembered was very close to the poisoned bait or the dead bird. Needless to say, when we returned to the site a few days later, those clues had disappeared.

Everything that is collected during the crime scene investigation is called a sample or evidence. Samples, as detailed in other sections of this manual, should be properly collected according to their nature. As we have said, having collected all possible evidence, some samples will be irrelevant to the case under investigation, as will be verified afterwards during the follow-up police investigation phase. The useless samples are called discarded exhibits, but they will not be destroyed in any case until the entire procedure is solved. On the other hand, those samples that are directly or indirectly related to the offender or that explain the facts are called evidence. Therefore, all evidence collected are samples, but not vice versa.

In other words, evidence is a concrete sample with probative value – it explains a particular wrongdoing, links unequivocally or quite certainly to a specific offender or pinpoints him at the crime scene when the offence was committed. A clue is a sample that points towards the offender but it is inconclusive and, therefore, harbours a certain degree of doubt. Therefore, good evidence is always better than a clue, but it is important to remember that a large number of clues can be considered as proof if they are well substantiated. On these occasions they are called circumstantial evidence.

In short, evidence (or proof, depending on the criminal justice system of each country) is the objective and raison d'être of our work, and all our efforts must be focused on collecting, interpreting and accumulating it. Once we have accumulated enough evidence to identify the offender and pinpoint him at the place and time of the crime, the police phase of the crime investigation is complete.

It would be inconceivable to include in this manual a complete list of all the potential samples to be collected during the CSI, as we have already mentioned, but we can stress the importance of those that most frequently become incriminating evidence in crimes against wildlife. It should be emphasised that every case we investigate is different and that we will find different pieces of evidence in cases that are apparently similar. What really matters is to discern which ones are relevant, what we can do with them and what we can find out from their study and analysis.

The following are typical samples that have given successful results in professional practice in Spain as well as in other police forces in neighbouring countries.

To begin with, it is necessary first to be able to distinguish the basic concepts of potential and incontrovertible evidence/clues. Potential evidence is evidence of unknown origin that has been collected at the crime scene and must be subsequently compared with a known sample for proper identification. Once correctly identified, this evidence is referred to as incontrovertible evidence, i.e., it is not in doubt. The best example of this is a fingerprint collected on site without knowing to whom it belongs. In this case, since we do not know to whom it belongs and it is in doubt, it is potential evidence. However, when the duly identified suspect puts his fingerprint on a piece of paper at a police station and it is obvious that the fingerprint belongs to him, then we call it incontrovertible evidence.

1. Biological samples

Biological samples are those samples that are not manufactured and have an animal (including human) or plant origin. They are natural elements, including those of human origin (such as traces of DNA, for example). In some circumstances, their processing requires sophisticated technological resources, which fortunately are becoming increasingly available in some forensic laboratories specialised in fauna.

It goes without saying that in the CSI phase we must always be alert to find and collect all possible clues that may later become evidence, including, among many others, the following:

First of all, the carcass itself is relevant. We will pay special attention to the carcass disposition and the possible existence of post-mortem manipulations (see the corresponding chapter in this manual).

a) Feathers and fur. Bird feathers and mammal hairs fall off easily and become attached to surfaces or people with whom they have come into contact. Numerous cases have been solved in which the incriminating evidence was feathers or down of endangered species. In one of the cases, there was down on seized nets (photo 11.2); in another case, feathers of birds plundered from nests were found at the suspect's home, which was searched after obtaining the corresponding entry and search warrant issued by the judicial authorities (photos 11.3). In this case, despite the failure to find the plundered birds, a conviction for plundering of golden eagle, eagle owl and red kite was handed down. In Spain, cases of lynx deaths have also been solved thanks to the fur found during the CSI inside the suspect's vehicle, and the same can be said for imperial eagles, wild boars, and many other species. In a recent lynx case that ended in conviction, it was even possible to identify which individual of the species it came from, thanks to detailed genetic analysis in the laboratory.

Photo 11.2 Down and feathers stuck to a seized net.

Photos 11.3 Feathers seized during the search of a home.

During CSIs we must collect feathers and fur for species identification by the forensic laboratory and for DNA extraction and identification. The finding of fur in snares, leghold traps or cage traps also makes it possible to determine whether these prohibited devices have been used or not.

b) Pellets. Some 300 European bird species produce pellets as a result of their digestive processes, containing remains of the animal's recent meals and also toxic substances. Searching for and collecting them at the crime scene can lead to surprising results, as the following true case in Spain illustrates.

A few years ago in the spring an adult cinereous vulture was providentially found still in agony after ingesting poisoned bait, although its blood test failed to reveal the type of poison it had ingested. Since the bird was alive and there were no other possible samples, we thought that we might be able to find toxic substances in the pellets collected under the bird's perch if intoxication had induced vomiting. At the site we found pellets and sent them to the laboratory for toxicological analysis. The analysis revealed the existence of high quantities of chlorfenvinphos, leading to a subsequent police investigation that discovered the source of the poison and prompted infringement proceedings. Thanks to the legal proceedings initiated as a result of the information provided by a simple pellet, the defendant now actively collaborates with the government in the conservation of wildlife and currently manages a midden for cinereous vultures with a hide for photography. The vulture miraculously recovered, was released at the site equipped with a GPS transmitter and has since then safely visited the same farm where it was poisoned some time ago.

c) Fingerprints. The study and classification of fingerprints is known in criminology as dactylography and there is no need to stress its importance in a police investigation. There are numerous cases and accumulated experience in this regard in crimes against biodiversity and it is a common tool in investigations today related to poisoning and professional poaching. The most common surfaces on which fingerprints are collected are usually soda cans, cigarette packages, wrappers, poison containers or packages and pieces of paper (photos 11.4). We must always collect those surfaces where this potential evidence may have been left imprinted and send them adequately labelled and referenced to the judicial police laboratory for identification and verification in the database. In addition to the analysis of the fingerprint itself, we must that the contents of the containers also be analysed if they are likely to contain poisons. Only in those cases in which the surface cannot be transported due to its size or other causes may fingerprints be developed for transfer to the laboratory.

Photos 11.4 Different samples from which suspects' fingerprints can be collected.

In this section it is necessary to mention that fingerprint collection is regulated by different laws depending on the country. This manual urges investigators to scrupulously adhere to the established provisions for each case, region and police force.

In the wild, the most practicable techniques include black and white magnetic pigments, as well as fluorescent pigments and the conventional black and white ones (photo 11.5).

Photo 11.5 Use of pigments in dactylography tests.

d) DNA. This is the genetic material contained in cells through which every living organism can be individually identified. Like fingerprints, this tool, which is fundamental in forensic science, has become part of the standard protocols for relevant cases in Europe today. On our team in particular it is a fundamental tool that we use on a daily basis thanks to which we have been very successful in the investigation of crimes. When investigating biodiversity crimes, two sources of DNA are investigated: Human DNA from the suspect and animal DNA from the species and specimens whose death we are trying to solve.

The analysis of genetic material is an excellent tool to determine with certainty the exact origin of the meat used as poisoned bait, linking it to the alleged offender, to identify the species whose feathers or hairs have been found in the possession of a suspect, to identify the blood of a suspected poacher found in his car and a thousand other circumstances. DNA can also reveal exchanges on objects handled by the suspect (cans, cigarette butts, snares, leghold traps, weapons, etc.) and directly on tissues or fluids (hair, sweat, blood, skin, etc.). As in the above cases, we must collect these samples according to the protocols explained in this manual, label them and send them to the laboratory for analysis and interpretation.

As is the case with fingerprints, each European country has its own specific regulations, which investigators must strictly adhere to.

e) Blood. Blood. It contains the DNA of its owner, making it possible to identify not only the species, but also the individual, and leaves virtually indelible traces despite repeated washing. We have already gathered experience in its use as police evidence in wildlife conservation.

Many poachers have been arrested and charged thanks to traces of blood on their bodies, as well as on tools, car seats and other places likely to harbour captured animals. On other occasions, blood traces help to explain the true cause of death of the animal, ruling out other possibilities and helping us properly focus the police investigation (photo 11.6).

Photo 11.6 Blood traces left by a run-over lynx.

In order to solve poaching cases, a very useful tip that often yields positive results is to look for traces of blood on the outer profile of the suspect's forearm and elbow, making him roll up the sleeves of his shirt if necessary. On that part of the arm, blood tends to accumulate and coagulate, and does not disappear completely by washing hands after butchering the illegally slaughtered animal. In addition, this area of the arm usually escapes the person's ordinary field of vision, so that the stains persist for a long time (photo 11.7).

Photo 11.7 Traces of blood are pieces of evidence that sometimes remain stuck to the body.

In order to confirm dubious stains, hydrogen peroxide can be used, generating the well-known and characteristic foam in the event of a positive blood reaction, or luminol may also be used, but it is more restricted to forensic investigation forces. Forensic light sources are another essential tool that is now commonly used. Although high quality light sources are ridiculously costly, it is possible to use other UV light sources that show traces of blood and biological fluids reasonably well. It should be remembered that a proper use of this method entails combining glasses with filters and lights of different wavelengths (photo 11.8).

Photo 11.8 UV light analysis equipment.

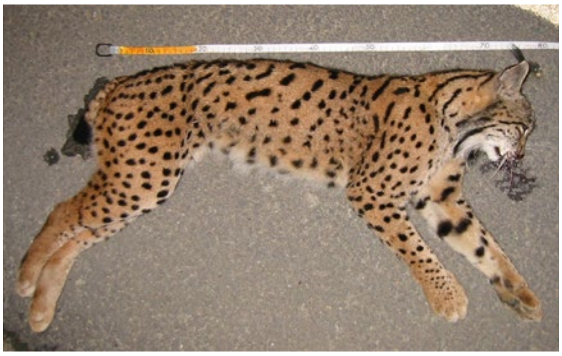
f) Type of species killed by poisoning. When investigating poisoning cases, we must be very careful to detect all affected species. Finding birds (vultures or eagles) with large home ranges that travel long distances in a few minutes is an entirely different matter to finding carcasses of small animals such as insects, reptiles (large and small lizards) or mammals (especially dormice, mice or shrews), which are very susceptible to the use of poisons and which appear in the worst cases next to the bait or carcass. This type of finding clearly reveals that the poison was placed nearby and it is highly unlikely, if not impossible, for them to have ingested the poison far away but to die at the site where they are found, due to their reduced mobility and daily ranges of action.

g) Cadaver fauna. The information provided by cadaver fauna is decisive and can directly contribute to identifying the perpetrator of crimes committed against wildlife.

At present, these studies have become a regular part of the forensic analyses carried out by Andalusia's CAD and, as a result, numerous convictions have been handed down in which the role of forensic entomology was decisive. We are not going to elaborate further on this, since there is an extraordinary chapter in this manual devoted exclusively to it, which has been prepared by an international authority.

h) Apparent evidence of cause of death. Regarding this, we have already analysed in detail those aspects to be taken into consideration. Having a rough idea, based on reliable signs, of the actual cause of death when faced with the carcass of a wild animal is a great help in police investigations, contributing to get the most out of the CSI. Although we have to wait for the reports issued by the forensic laboratory for an exact confirmation, we can work in the field with some hypotheses that help improve the quality of the investigation, without, however, ruling out other alternatives. Agents must be familiar with these signs, which are sometimes highly accurate. For example, a feline found dead near a road with broken and chipped claws reveals that its death was caused by vehicle collision and rules out the possibility that it may have been killed by a snare, a leghold trap or a cage trap and then thrown onto the road to hide the true cause of death (photo 11.9). It is common in mammals that have been run over to find urine and/or faeces in their anus, on or next to the carcass in case of roadkill, due to sudden relaxation of the sphincters after the collision (photos 11.10). These are unmistakable signs that the animal died at the place where the carcass was found.

Photo 11.9 It is necessary to assess all the signs, such as the broken claws of this dead feline on a road.



Photos 11.10 The presence of fluids next to a carcass may be evidence that there has been no post-mortem manipulation.

2. Non-biological samples

Non-biological samples include manufactured objects found at the crime scene that may have probative value. They may be valuable in their own right, such as a pack of cigarettes or a cigarette butt of the same brand smoked by the suspect, found next to poisoned bait, or because they are the physical medium for a biological sample such as DNA or fingerprints. Naturally, there are thousands of non-biological objects and samples that may be important, but we will discuss here only those that have proven to be the most relevant in the experience gathered to date.

a) Bullet shells (ballistics). Their relevance in cases of poaching and shooting of endangered species is crucial. The ballistics laboratory is capable of analysing fired projectiles and cartridges, matching them with incontrovertible weapons and filling out the corresponding reports. In addition to the information that these elements themselves provide, they can also contain fingerprints and DNA, which increases their value in the forensic investigation as inculpatory evidence (photo 11.11). The finding of certain ammunition can provide information on some illegal activities to which they are directly linked, such as the use of .22 calibre cartridges, among others. We must pay special attention to these aspects in our investigations.

Photo 11.11 Bullet shells are an important source of information.

In the past we have already solved important cases by matching ammunition and weapons. However, we must remember that in many neighbouring countries, access to weapons databases is reserved to certain police forces and it is essential to count on their help and collaboration. Likewise, in some cases it is necessary to match questioned samples with the offender's (incontrovertible) weapons, but often this will require judicial authorisation, according to the national legislation of some of our neighbouring countries.

b) Soil and soil debris. The characteristics of the land where the investigated events took place may be unique or peculiar, having elements such as pollen, fertilizers or minerals that may pinpoint the offender in a certain place. The vehicle floor mat or the soles of the suspect's shoes are good places to look for and collect samples for comparison with samples collected at the scene. We can also check their presence in boots and other elements.

The mere observation of the ground or place where snares or leghold traps have been placed can be revealing – post-capture wallows are the spaces under the snares or traps where there are obvious signs of the animal having struggled and agonised to death. These spots, characterised by overturned soil resulting from the trapped animal's struggle, are very easy to identify because of the contrast between the fresh soil (wetter, looser and uncovered) and the pre-existing soil (dry, compact and with vegetation). Even if we do not find the carcass because it has been hidden, we may find signs called "cadaver decomposition islands", in addition to pupae or moults of cadaver fauna and other signs indicating that there a decomposing body was there (foto11.12). The vegetation may be very altered and branches cut off, with obvious signs of dragging, which may be clearly evident if the victim of the snare or leghold trap is a wild boar, for example. All these indications are essential and must be recorded, properly photographed and sampled if necessary.

Photo 11.12 Under the carcass there may be evidence which is useful for the investigation, such as pupae, remains of fluids and other substances.

c) Objects. The list of different objects that can provide information themselves or as surfaces for biological samples is enormous: labels, cigarette butts, cans, cigarette packs, cattle ear tags, plastic bags, glass jars, gloves, backpacks, flashlights, food scraps, clothing, sacks, mobile phones, ropes, bird rings, ammunition boxes, etc. Gloves used by cautious poisoners to place the bait are sometimes left in the vicinity. DNA can be found on the inside of the glove from finger perspiration and traces of the substance used on the outside of the glove, as has happened in many cases (photo 11.13).

Photo 11.13 Gloves used in the placement of poisoned bait.

Cigarette butts that are found can be decisive in pinpointing offenders at the crime scene in two ways: through the DNA they carry and through matching with the brand consumed by the suspect (photos 11.14).

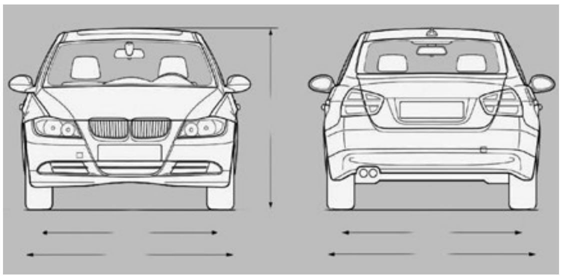
We may also encounter the tools used by poachers for trespassing on properties, such as a pair of shears. The judicial police laboratory can compare the tool with the objects found and may request comparative studies of tools and objects or infer criminal activities through their study. In 2007, a suspected poacher was identified in Andalusia thanks to a match between the shears found inside his vehicle and some broken chain links on a gate for entry into a hunting reserve. The judicial police laboratory found a link between the two elements and, therefore, connected these to the owner of the vehicle (photo 11.15).

Photos 11.14 Tobacco residues can expose a lot of information about the offender.

Photo 11.15 Object comparisons can be decisive in determining the offender, such as this pair of shears found in a vehicle and the chains that were cut with it.

c) Vehicle tracks. Moulds can be extracted from vehicle tracks or photographs can be taken using scales (photos 11.16). The camera must be kept fully perpendicular to the tracks and maximum resolution used when photos are taken. We must measure the track width and the distance between axles, which is the distance between the midpoints of opposing tracks of the same axle (Diagram 11.1). Each vehicle make and model on the market has its own characteristics and measurements, which are easy to trace during the police investigation phase.

Diagram 11.1 It is necessary to take complete measurements of the dimensions of vehicle tracks



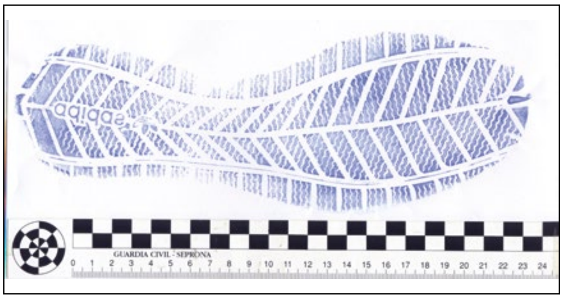
Police forces have complete databases of the different tyre and vehicle makes, and can ask for an analysis by the judicial police laboratory, which in turn will request the appropriate report on the type of tyre, make and model of vehicle.

Photos 11.16 Footprints found at the scene of a possible crime against wildlife.

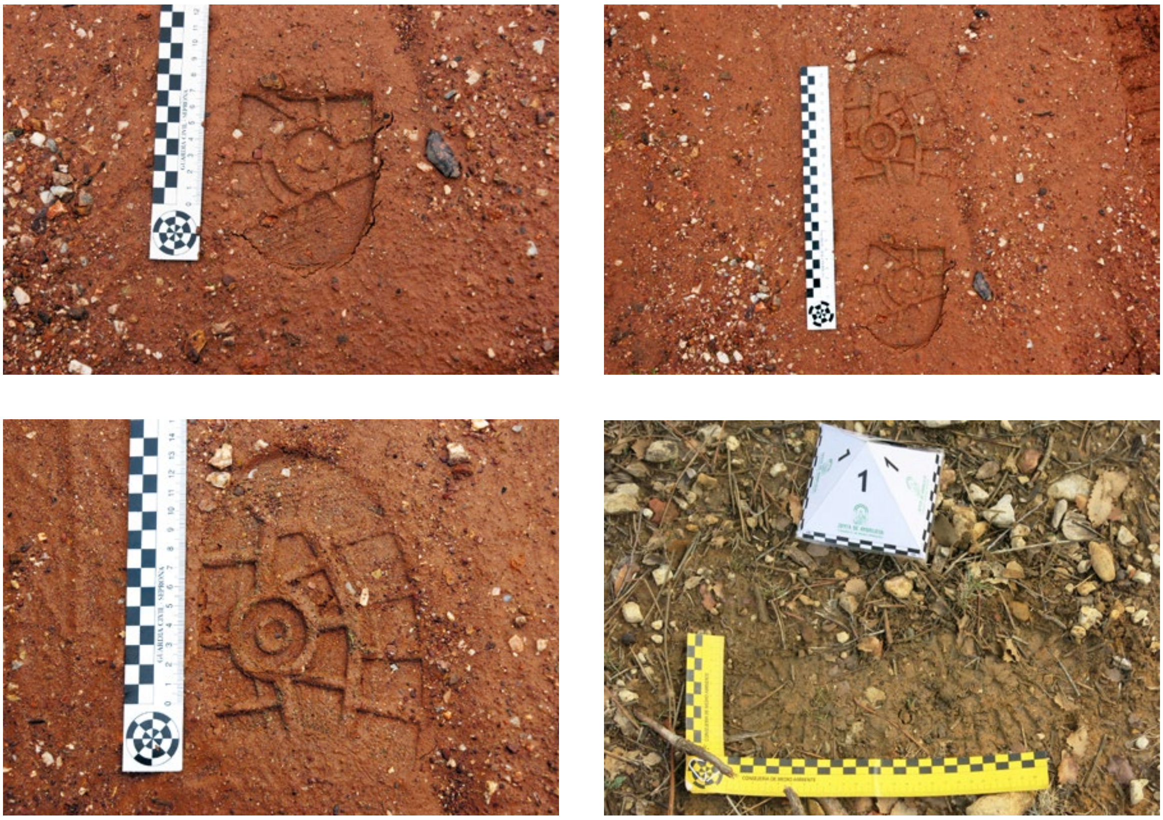
Let us recall here that one of the largest firm administrative penalties imposed to date in Europe for infractions against wildlife, amounting to EUR 200,000, relied on this type of proof. Here, following a poisoning case, the inculpatory evidence that most strongly justified the court's decision was precisely the vehicle tracks, which associated and pinpointed the suspect to the place and time of the events.

d) Footprints. As with vehicle tracks, moulds can be extracted and digital photographs can be taken using scales. When photographs are taken, the lens must be held fully perpendicular to the footprint and the highest possible resolution must be used for further processing in the laboratory. A general photograph of the footprint and several detailed photographs of the heel and midsole must be taken (diagram 11.1) (photos 11.17). If we have a suspect, it is possible to make a paper print of his footwear according to the following protocol:

Esquema 11.2 It is possible to obtain moulds or paper prints from footprints



- The shoe sole is cleaned to remove impurities.
- The entire sole is gently inked with a sponge.
- The suspect must step on a sheet of paper as if he were walking, and the entire profile of the sole must be marked, heel first and toe last.



Photos 11.17 Footprints found at the scene of a possible wildlife crime.

- It is advisable to use A-3 paper and to take the print on a padded surface, so that the whole profile is well marked.

General data on the suspect's footwear (brand, model and size) must also be provided, along with general and detailed photographs of the soles, always using a scale (photos 11.18).

As with tyre tracks, judicial police forces have databases of the different brands on the domestic and international market, so the corresponding expert report may be requested to pinpoint a specific person at the crime scene. The procedures are the same as for vehicle tracks and fingerprints.

Photos 11.18 The use of scales is essential when collecting footprint information.

Murphy's law and the whims of chance

Chance can also play an important role in the investigation of crimes against wildlife and in fact it often does so for the worse. Anything that can go wrong, will do. If one particular sample is more important than others because of its relevance, it will surely be deteriorated and, similarly, if we want a particular carcass to yield a certain toxicological result, it is highly likely that it will not.

However, sometimes Murphy's law and chance are on our side and allow us important strokes of luck in our investigations.

Any team working today has multiple such stories to tell and here we can include some of them. In one case investigated in Spain, a griffon vulture vomited the bait that had poisoned it before dying. The offender had forgotten to remove the label from the meat establishment where it had been purchased, so that the vomit with the label contained sufficient clues to open the corresponding investigations; through the timely police investigation of the commercial chain, the discovery led to the actual perpetrator (photo 11.19).

Photo11.19 Meat product label that made it possible to determine the origin of a piece of poisoned bait.

On another occasion, agents had been trying unsuccessfully for almost three years to find out the origin of a series of repeated poisoning cases in griffon vultures in a specific Andalusian district. There were no clear leads to open an investigation and, consequently, nothing could be done about it. Finally, on a routine patrol the carcass of another griffon vulture was unexpectedly found, which, as in the case above, had vomited its last meal before dying of poisoning. In this case the animal regurgitated a cattle ear tag (photo 11.20), revealing the number plate and data of the exact place where it had been poisoned; as a result of pure chance, the case was solved and, with it, a repeated series of poisonings that had ended the lives of a hundred griffon vultures and almost forty cinereous vultures over a period of fourteen years came to a close.

Photo 11.20 Cattle ear tag found on a poisoned vulture that led to the offender.

In the course of the CSI in another wildlife poisoning case, a law enforcement officer found an empty sack and traces of poison and dead insects hidden under some stones, along with poisoned bait. It had apparently been used to transport an entire batch of aldicarb-impregnated pieces of bait; when the last one of them was placed, the offender disposed of the sack by hiding it. The sack belonged to a brand of cattle feed that is not common in the area. During the inspection of the nearby livestock farms, it was found that only one of them regularly purchased this specific brand and stored in its facilities large quantities of sacks identical in terms of brand and manufacturing batch to the one found in connection with the pieces of bait (photos 11.21). As a

Photos 11.21 Some objects can lead a crime to be solved by searching for their origin, such as this sack used to carry poisoned bait.

result, the farm manager became the prime suspect among all the potential suspects. The suspect was brought before the courts and the hunting reserve was closed for a period of time established by the technical services of the Autonomous Department.

As a general rule, Murphy's law does not work in our favour, but, as we can see, luck sometimes changes sides.

12. OTHER ASPECTS TO BE CONSIDERED IN INVESTIGATION PROCEDURES

1. Inspections in warehouses and tool sheds

There is a Spanish saying that goes, “if you want to kill a snake you need to cut off its head”. Another way of saying the same thing is that if you want to defeat an army, neutralise its command centre or its supply centre.

This is also true in our specific case, especially for certain crimes like poisoning and shooting. Regular poisoners are well aware of the fact that the compounds they use for killing are highly dangerous and that very small amounts can wipe out hundreds of specimens, but also the people nearby or even their own families.

For this reason, poisoners very rarely store toxic substances inside their homes because this can pose a serious health risk. These compounds are therefore usually kept in rooms or small sheds in spaces other than living quarters. As a general rule, these are small storage areas for farm tools or materials for use on the property such as tractors, machinery, livestock harnesses, work tools or similar items. The same could be said for weapons and ammunition, although these are more often stored inside the home.

For the same precautionary reasons, these premises are not used (in the vast majority of cases) for sleeping but rather, as mentioned before, are secondary spaces used for material storage. Since they are not places of residence, these premises are obviously not protected by the law in terms of the inviolability of the home. The legislation in European countries is clear in this regard: in order to perform an inspection inside a private home, an entry and search warrant must be issued by the judicial authorities. In these cases, however, this is not necessary, given that these spaces are not residences. Obviously, each country has specific regulations in this regard, which must be strictly obeyed. It must be recalled that the police are tasked with enforcing the law, and not just the laws on biodiversity protection, but all laws. However, we would like to stress how vitally important it is in our work to be able to act on criminals’ centres of operations, which is no doubt what these premises are.

It is also highly useful to bring in canine units, where available, in inspections of these premises. Closely observing the suspect’s attitude, if this person is the owner or manager of a warehouse in which poison or other unlawfully possessed items are found, is advised. If they are trying to conceal something, their attitude, gestures and body language sometimes give them away, so it is a good idea to have one member of the team monitor this person’s behaviour (photo 12.1). Suspect surveillance work is essential in the investigation The checks may be repeated, entering the warehouse as often as needed until what we suspect to be hidden is found. Monitoring suspects will also prevent them from distracting us in an effort to eliminate evidence such as poisoned bait or poison stored somewhere. We must bear in mind that we are in an unfamiliar place, whereas the suspect knows it quite well.

Photo 12.1 Suspect surveillance work is essential in the investigation.

Inspections must be conducted without preconceived ideas, thoroughly searching every corner, hidden spaces (including ceilings), cupboards, boxes, etc. (photos 12.2). We must be aware of the fact that most times the toxic compounds are not stored in their original packaging (photo 12.3). For example, snares are rolled up and hung for storage, or stretched and dismantled, resembling conventional domestic-use wire (photo 12.4).

Sometimes important evidence has gone undetected right before our eyes, simply because we did not recognise what we were seeing at the time and by the time we returned to gather it, it had obviously already been eliminated.

One final effective recommendation is to employ large teams to conduct inspections, making more eyes available and benefitting from the inspection work and its deterrent impact to the utmost.

Photo 12.4 Snares may be stored as simple wires for use in legal activities.

Photos 12.2 The inspection must cover every area of the premises.

Photos 12.3 Many poisons are stored in non-original containers.

2. Vehicle inspections

Once again, in this regard, the valid regulations in each country must be applied. In some countries, it is possible for the environmental police to inspect vehicle interiors, while in others it is not.

Vehicles do not count as residences from a legal perspective, except for campers and the sleeping cabin of large trucks and motor homes. Therefore, they can and should be inspected if necessary, where allowed by law. Pay special attention to glove compartments, underneath floor mats, spare tyre wells, tool boxes, the boot and any other hollow spaces. Also check the contents of any containers that hold products other than what they were originally intended for, besides other traces such as gloves used for laying poisons, cartridge cases and other evidence. In investigations or services related to poaching, keep an eye out for traces of blood or hidden spaces that could conceal weapons or wild game.

Everything that applies to four-wheeled vehicles must also be taken into account for motorcycles.

We have often found traces of feathers or fur of endangered species whose death was under investigation, or bags used to move carcasses. Subsequent DNA tests proved their connection to the events and the suspects were convicted.

As mentioned above, if canine units are available, they must also be used for inspections inside vehicles (photos 12.5).

Photo 12.4 bis Canine unit dog.

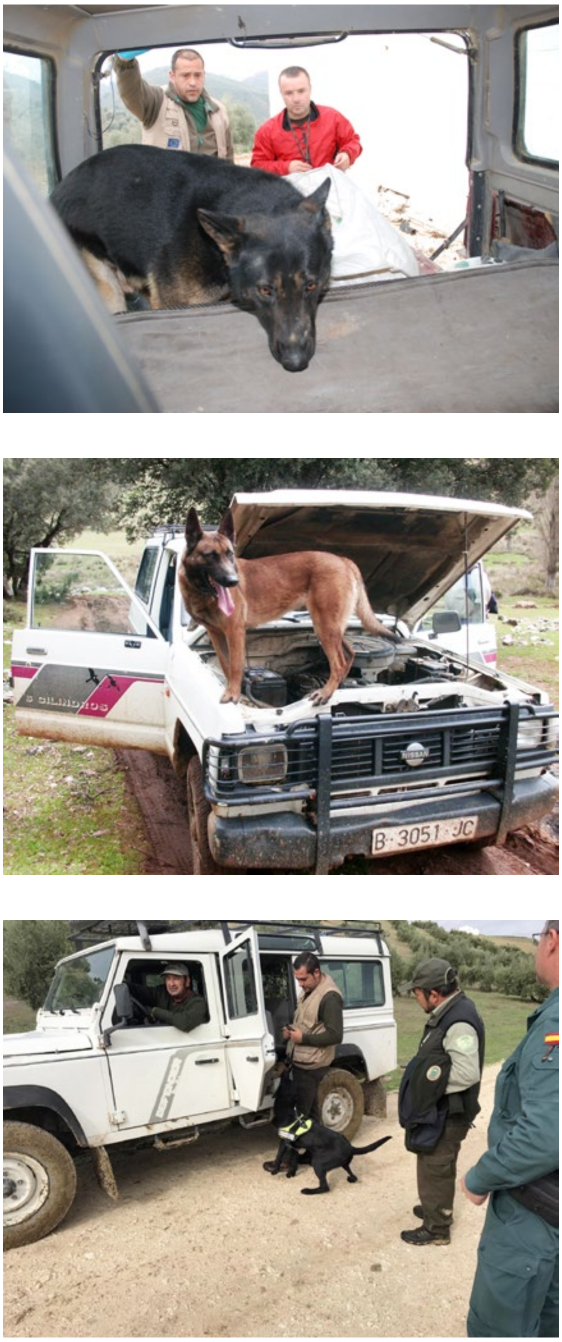


Photo 12.5 Canine units are highly useful tools in inspections.

3. Searches of homes

We have mentioned this before. This police action is extremely aggressive on individuals' intimacy and European laws are usually highly restrictive when it comes to granting judicial permission to enter a home and inspect it, less than one for every two years of work. However, during this time more than 5,000 tool sheds were inspected in Andalusia alone (photos 12.6).

As we can, searches of homes are as powerful a tool as they are difficult to achieve.

When investigators feel that the circumstances warrant a search to be necessary in their investigations, they must carefully defend and justify their position in order for the judicial authorities to consider granting their permission.

4. Telephone tapping

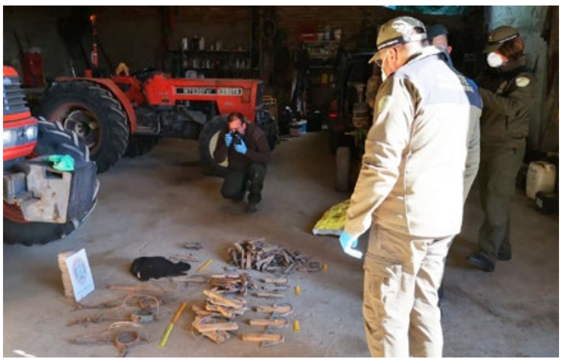
As in the previous case, in and around Spain taps are only allowed by court order given that they infringe on individual rights and freedoms recognised in countries' constitutions. Experience has shown that they generate large amounts of extra work because all the conversations must be transcribed on paper so that they can be submitted to the courts. On the other hand, the results have been excellent when this tool was used for diverse types of crimes against fauna, leading to guilty verdicts for the suspects.

Requesting and receiving authorisation is legally complex but not impossible. In Andalusia, permission has only been granted in cases related to organised crime and, in other cases investigated in Spain, for unlawful use of poison.

5. Enclosures and fences

When crimes or offences in natural environments are investigated, ownership and enclosure of the space are fundamental issues. We need to bear in mind whether the events under investigation took place in an






Photos 12.6 Inspections in farmhouses and rural facilities.

open space or, on the contrary, in enclosed, fenced-off areas, (photo 12.7) whether on public land or on private property. As an example, the appearance of poisoned bait along with the carcasses of diverse species, in addition to snares, traps and cage traps has vastly different implications if they are found in open spaces accessible to the public than if they are found inside a hermetically sealed and fenced-off hunting reserve, where third-party access to the property is quite restricted. The implications for the police are also quite different.

Photo 12.7 Many crimes are committed inside fenced properties.

Photos 12.8 The use of prohibited methods is often not limited to just one, but rather a combination of several methods.

Once again, national and regional regulations must be taken into account.

6. Simultaneous use of several prohibited methods or several biodiversity crimes by the same perpetrator

It is common to find a combined or simultaneous use of several prohibited methods: poison, snares, traps, cages and shooting (photos 12.8). These are systematic wildlife hunting campaigns. When, in the course of an investigation related to one crime, such as the death of a bear by shooting, we find evidence that other crimes against biodiversity have been committed, then this is what is known as a multiple offender.

In this case there is evidence of a clear, unequivocal intention to commit an offence or crime, and there are criteria of proportionality defined in virtually all the specific legislation of European countries. These special cases must be promptly reported to the public authorities and the courts.

In every case, these individuals have committed crimes consistently over time.

7. Use of social media

Until recently, this seemed like something out of science fiction, but the fact is that, virtually overnight, this has become one of the most common environments for investigations.

It is now common to find news of people bragging about committing crimes against biodiversity (or the environment) over the Internet. These people obviously make it extremely easy because they not only confess to committing the crime, but they also disclose it.

Although this is a matter of criminal profiling, which is not the subject of this manual[15], we will say here that, in our experience, the crimes most often published on social media are related to shooting protected and endangered fauna, poaching big and small game species and disturbing protected species during reproduction.

The social networks that are most often used and searched for this are Facebook and YouTube.

Tracking of unlawful activities on social media is expected to increase in the future in line with social trends. In-depth investigations of these cases are usually conducted by police units dedicated to cybercrime, although in Spain, cases affecting the environment are also led directly by the Civil Guard's Service for the Protection of Nature.

The investigation of environmental crimes committed by organised groups or associations, generally related to large-scale trafficking of species or waste on an international level, deserves special mention here. In these cases, investigators need to search the areas of the Internet in which criminals usually operate, such as the Dark Web. These are highly complex procedures and therefore investigations of this type of crime must be conducted exclusively by specialised units that are properly equipped for these purposes.

8. Mobile telephones

This is a similar case to the previous one. However, there are important differences in comparison because mobile phones are personal devices and, as such, inspections are restricted to occasions on which a court order has been issued authorising the confiscation and analysis of the device. Once again, the specific regulations of each country regulate the entire procedure.

In Andalusia, several cases have now been investigated in which the grounds for investigation were videos or photographs found on the mobile telephones of various individuals arrested and investigated. In all cases, these were police assignments occurring in recent years. Once again, the images showed unlawful activities related to a number of crimes: shooting and poaching, as well as threats and unlawful possession and use of weapons.

In all the cases, these investigations are led by judicial authorities and are strictly confidential in nature.

These investigations will undoubtedly grow in relevance and are expected to increase in number considerably in the future.

9. Advertisements in the press and specific social or commercial networks

This section is closely linked to the topic of cybercrime. In the recent past, certain regions have experienced an increase in crimes against biodiversity prompted by advertisements in the print media and, increasingly, in digital channels. Of particular note here is the trading of endangered species, i.e. unlawful trafficking of species. This may refer to birds of prey, turtles, ivory, finches, coral, sharks, whole or partial, live or stuffed animals or any product or by-product that cannot be legally bought or sold. Current demand for certain species or products has recently triggered an increase in the number of advertisements.

It is quite easy to track and investigate these cases, so the results obtained in this field are very good.

[15] In terms of the motivation for environmental criminality, please see *Estudio sobre el origen y las motivaciones de la criminalidad ambiental*. LIFE Guardianes de la Naturaleza. SEO/BirdLife y *Sociedade Portuguesa para o Estudo das Aves*. Madrid y Lisboa. 2020 en www.guardianes.seo.org

10. Intelligence applied to investigation

This topic will not be discussed in detail here, since it is not the aim of this manual. However, it is important to note that this is one of the best tools for investigation, prevention and deterrence of crimes against biodiversity.

Intelligence is nothing more than information that is suitably processed and filtered to achieve a certain objective. The information itself has no value. Only after it is filtered and analysed does its value increase exponentially. There are several types of intelligence, based on its sources, the most important of which for our purposes are HUMINT, intelligence based on information received directly from people, OSINT, which is gathered from open sources such as the media (the previous section is a clear example of this), and IMINT, gathered from images, to name a few. Based on the purpose for which the intelligence was gathered, it may be categorised as military, commercial or, in our case, criminal.

Intelligence is broken down into three levels: strategic, basic and operational. In our specific case, we can simplify this by defining strategic intelligence as that which is required for long-term tracking and monitoring of crimes, trends over time, detection of new behaviour and *modus operandi*, or anything needed for monitoring crimes and criminals on a broad geographic and time scale. It may even predict trends or, in the case of poisoning, warn us about the appearance of new compounds, no matter how recent, the disappearance of others, etc. Basic intelligence is the set of documents and data generated during investigations, which acts as a reference base for present and future investigations; and operational intelligence is that developed to solve a particular crime. A recent case carried out by the Autonomous Government of Andalusia in conjunction with the Civil Guard, in relation to the fatal shooting of a bearded vulture, offers an example of this. When it comes to looking for suspects, thanks to its strategic intel, the Autonomous Government of Andalusia has a good basic knowledge about individuals who could, potentially, be involved in the events, based on different zones, as a result of nearly two decades of consistently gathering information in the field. In this specific case, the Government prepared a cycle of basic intel from its records to narrow the conclusions reached above and, at the same time, started a round of operational intel to gain in-depth knowledge in the field that would lead to information on people matching the responses to the questions of who, how, when, why and where this bearded vulture was shot. To perform this work, the Autonomous Government of Andalusia has a team of people dedicated to intelligence. After all the strategic, basic and operational intel is received, an analyst filters, selects, validates and interprets the findings, coming up with specific intelligence on the alleged crime concerned. All of this information, along with the names of the suspects that emerged in the intelligence cycle and other related data is indicated, specifying the degree of reliability, in the intelligence report sent to the Civil Guard so that this organisation can, in turn, use the contents as deemed appropriate in its investigations for the purposes of delivering the perpetrator to the judicial authorities. From this explanation we can see that, through this tool, it is possible to start from scratch and provide the judicial authorities with a list of suspects, in order of likelihood, on which the rest of the investigation can be developed. Needless to say, this resource is highly valuable.

Over the past few years, regional teams in Spain have specialised in gathering intelligence in several specific branches and sources, as well as creating a nationwide environmental intelligence office, the National Central Office (OCN, Spanish acronym) of the Civil Guard. We should point out that, in the near future, investigation of crimes against biodiversity will be inconceivable without this essential tool.

Examples of information gathering (HUMINT)

One essential part of any police investigation is information. However, in the example of the poisoning episodes, which could serve as a reference for other crimes, certain highly useful guidelines are included here that often provide interesting outcomes.

Information may be gathered from diverse sources: Public authorities, testimonies, documents, informers, etc. Some of the different sources for gathering information that may be used to help clarify the facts are listed below:

- Interviews with other local agents, field rangers, stockbreeders and owners of neighbouring properties.
- Statements by possible witnesses and victims of domestic animal poisoning in the vicinity, even from previous cases.
- Gathering information about cases seen at veterinary clinics in the area.
- Gathering information about livestock poisoning cases in the area at agricultural offices.
- Gathering information from police stations in the area where the events occurred, to see if other reports have been filed for related cases.
- General study of problematic issues existing in the area.
- Gathering information from the environmental authorities about records of cases occurring and/or reports or claims submitted in relation to damage caused by predators.
- If the events are recent, conducting a search of any suspects' vehicles; if any bait, eggs, etc. are confiscated, send them to the laboratory for analysis.
- If fresh bait (sausages or the like) was used to place the poison, inquire at nearby butchers about buyers who are suspects.
- Find out whether any pesticide treatments have been carried out recently on the property.
- If the toxic product used is known or suspected, make inquiries at the nearest establishments selling plant protection products. However, to facilitate the investigation, regional delegates of retailers that use the same active substance as the poison found can also be contacted. They can provide information about the establishments to which they have been distributed.

Examples of information gathering (IMINT)

In this case we are referring to gathering images that have value as criminal evidence, obtained through the use of technological devices. The main examples are:

- Conventional cameras for photographing suspects and their activities
- Camera traps placed at the site of the events (primary scene) or at the entrances to it (secondary scene)
- Cameras attached to drones operated by police agents
- Satellite images (mainly Google Earth) and downstream applications like the European Union's Earth Observation Programme (Copernicus), which is coordinated and managed by the Commission.

The use of IMINT is a common tool in solving crimes against fauna. It is worth noting the significant progress made by the RSPB's Crime Unit in the United Kingdom through the use of camera traps.

The use of drones was recently added to CSIs, providing the perfect complement to the use of canine units. In addition to having a spectacular deterrent effect, these devices provide images of incalculable value for investigations (photos 12.9).

Photos 12.9 Drones have become a highly valuable tool for gathering information.

The collection of images of this kind is strictly regulated in each country's legal system, meaning that agents must be perfectly aware of the extent to which these resources may be used. The regulations are even stricter when it comes to drones.

Another type of intelligence is that gathered from GSM transmitters, satellites, VHF devices and beacons

At present, much of the information about crimes against fauna is gathered from data furnished by the transmitters worn by thousands of specimens of endangered wildlife, which are tagged throughout Europe within the framework of widespread conservation programmes. We would have no information at all about many specimens that have died from criminal activities if it weren't for the data gathered through the use of these trackers, worn as collars on mammals or on the thorax or pelvis on birds. The relevant species in this regard are: Griffon, cinereous, Egyptian, Rüpell's and bearded vultures, northern bald ibis, Bonelli's eagles, ospreys, golden and imperial eagles, red kite, marbled teal, whimbrel, bears, wolves, lynx and wildcats. There are certainly more species involved, although their participation in police investigations has, up to now, been less relevant in comparison.

Whenever the carcass of one of these specimens is found, the information provided by the trackers is used regularly as part of the police investigation, bringing highly valuable data to light in clarifying the cause of death and, where appropriate, assigning the resulting liability (photo 12.10).

Today's trackers are equipped with high-precision devices that can provide exact locations and also information about the specimen's movements. This is made possible by an accelerometer, which is a component of the transmitter that tracks movement on three axes. This device is essential for discovering the exact place and time that a bird was shot, for example, along its route on the map.

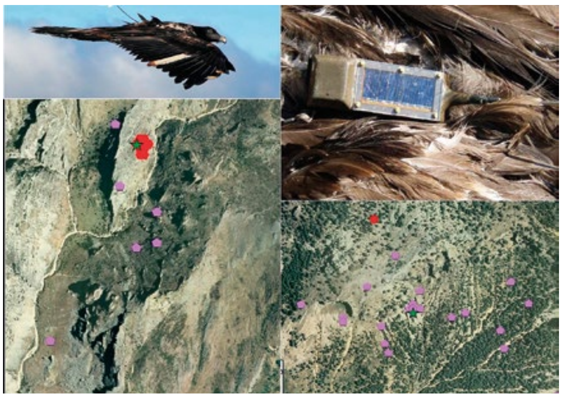


Photo 12.10 Tagging protected and endangered species makes them sentinels for possible criminal activity.

We can confirm that the number of cases solved by the police and judicial authorities thanks to information provided by trackers is extremely high, and if we had to explain all the examples here, we would need another volume just for this purpose.

The case of beacons is somewhat different: while GPS, GSM VHF trackers are placed on animal specimens, beacons are placed either on people (not, however, for the types of crimes discussed in this manual) or on vehicles. This latter is common under certain circumstances. However, it should be noted that the use of beacons requires prior judicial authorisation in most neighbouring countries, so any information gathered without judicial authorisation is automatically nullified in court.

11. Offender's signature: case study

While it is not the aim of this manual, this criminology tool has now become one of the best weapons in fighting against these crimes. The offender's signature must not be confused with *modus operandi*, given that these are diametrically opposed concepts in forensic science. Although they are of the utmost importance in investigations, they are not the subject matter of this manual.

The offender's signature can be found on anything made by the criminal, such as a snare placed in the field or poisoned bait, and even on things not made by this person but merely placed in a certain way, such as traps. Applied police experience has used these methods to identify the perpetrator and, even more importantly, link that person to the crime or offence committed when no evidence could be found by other means.

The information provided in this regard is essential, but is rarely given the importance it deserves within the context of Europe.

As an example, we should look for these marks on snares at the two ends of the wire, the means of anchoring and the slipknot (photo 12.11). Poisoned bait is a hand-made element which is therefore prone to exhibit traits indicative of the person that made it. Pay special attention to the sublayer type, size, cutting method, the way in which the poison is placed, how it is transported, etc., and any other parameter that may be determined by the criminal. Bear in mind that, if this person commits these crimes relatively often, the offender's signature will be better defined and clearer.

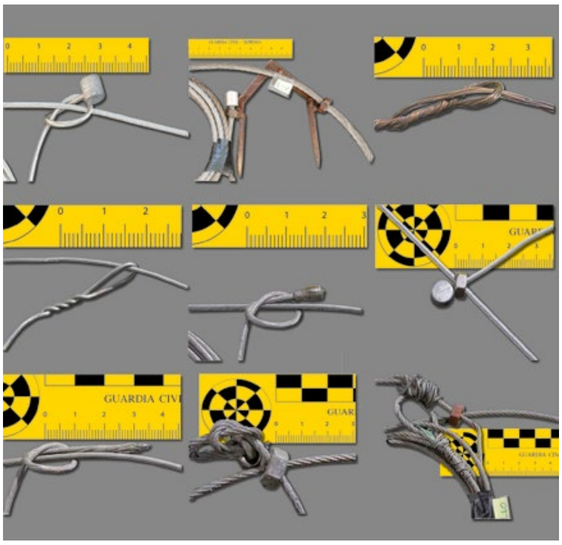


Photo 12.11 The different ways of preparing snares offer valuable information about the perpetrator.

The following series of photos (photos 12.12) shows the example of an actual case that illustrates how a specific perpetrator can be identified and linked to a crime. The discovery of dead foxes inside a hunting reserve led to the culprits thanks to the offender's signature.

The events occurred as follows:

In the course of an inspection by SEPRONA agents after receiving a report, a tree was detected from which eleven foxes had been hung. The apparent cause of death was a snare for predators, and the carcasses had been moved to this site in a feed sack of a certain brand, which was found on the ground below the carcasses. Some of the bodies had even been strung up on the same wire that killed them. We can see that the snare bears highly characteristic marks of the offender, with a nut used for the slipknot, which is unusual in the typical snares of the region. During the CSI conducted in the vicinity, the agents found a significant number of snares set and enabled in the gaps of a stone wall leading to an inhabited house; these snares bore a design identical to the ones found on the hung-up foxes. At the house, the keepers were found, notified of the events and summoned to inspect the tool shed adjacent to the dwelling. Inside the shed, numerous snares identical to the others, prepared and ready for use, were found, along with abundant amounts of cable and nuts for creating new snares and numerous empty sacks of the same brand of feed found under the carcasses. In addition, traps and other prohibited devices, as well as unlawfully trapped carnivorous animal furs. The two pieces of evidence found and duly explained in the police report, sacks and signature snares with materials for constructing them, were allowed by the judge, who filed the corresponding criminal proceedings.

12. Criminal record and background

Just as doctors need to know their patients' medical history to correctly diagnose their illnesses and prescribe an appropriate treatment, we also need to consider the background

Photo 12.12 In this series of photographs we can see the sequence of events that led to the finding of the perpetrator of a crime against wildlife.

of suspects, hunting grounds or farmland and the surrounding areas. As an example, knowing and studying previous poisoning cases can offer us reliable clues as to whether the poison is linked to the illegal control of predators, livestock or personal revenge. For example, the use of poison in relation to hunting activities usually takes place immediately before and after the start and finish of the official season, and also tends to coincide with the days prior to the release and restocking of partridges. On the other hand, livestock poison tends to coincide with mating seasons, which may vary depending on the regions we work in, but often accumulate around the Christmas and summer holidays to meet market demand, regardless of other local events or festivities. In each country these cycles vary depending on market demand.

To conduct a background study we locate previous cases on a map or aerial photograph, checking to see whether there is a pattern that relates them and, with the current episodes taking place (whether poisoning, poaching, looting, etc.), we try to discern whether these links in time and space match the commuting routes, access or home of potential suspects, comparing all this information with direct statements taken in the natural environment. This entire procedure is known as geographic profiling of the criminal, which is an exciting field but goes beyond the scope of this manual.

Along with the information gathered in the CSI, a thorough, detailed study of previous cases can provide sufficient information to create a good body of clues and, possibly, even some inculpatory evidence.

13. Investigation using forensic psychology methods, criminal profiling and criminal analysis

This is another of the more recent tools available for investigating crimes against biodiversity. In our experience, it has shown to be incredibly effective and also increases the investigation capabilities, reaching limits that were unheard-of even a few years ago.

However, as mentioned elsewhere in this manual, specialised analysts are needed to apply these methods and, at the present time, the number of specialised professionals of this kind in Europe can be counted on one hand. The role of a criminal analyst must not be confused with that of an intelligence analyst, as these are completely different concepts. And the function of criminal analysis must not be confused with that of expert opinions, although there are more similarities in this case.

We must stress the need to increase the number of specialised experts available, given their extraordinary effectiveness in solving crimes.

Within the framework of LIFE Nature Guardians, the largest international study was conducted on the motivation for environmental criminality[16], which may be used as a reference for application in specific cases.

14. Overall assessment of proof and clues

The explanations given up to now serve merely as an orientation about the infinite possibilities offered in the area of field investigation. What truly matters is for each investigator to explore their own possibilities in the field and to understand the resources, procedures and mechanisms available to them. We must insist that no two cases are the same, each one has unique characteristics and it is these features that we must take the greatest advantage of in order to solve the crime and accurately reconstruct the events. We must not make the mistake of accepting one clue and disregarding the rest, as sometimes happens, because if the evidence provided is not allowed or is dismissed for some reason, we may lose the

[16] Guardianes de la naturaleza | Contra el crimen ambiental | ESTUDIO SOBRE EL ORIGEN Y LAS MOTIVACIONES DE LA CRIMINALIDAD AMBIENTAL (ES, PT) (seo.org)

case. On the contrary, the strength of our investigations lies in the number of clues, pieces evidence and items of proof we can furnish. A good way of verifying if we have identified the right person is by looking at whether all the proof or clues point unequivocally in the same direction. If they do, we can be certain of our conclusions. If, on the other hand, something does not match up, we must continue with our investigations. In the end, the judicial or administrative authorities are the competent bodies tasked with allowing the investigations or making the appropriate decisions.

As a final reflection, it should be emphasised that, despite all the methods deployed, the technological progress and ultra-specialised resources available, to properly investigate these crimes, sometimes all that is needed is a strong dose of willpower and little more. A lack of sophisticated resources cannot be used as an excuse to fail to do the work. We could give some excellent examples of guilty verdicts for poison use achieve with little more than a tape measure, an ordinary camera, a pen and a notebook. Experience has shown us that the path is made by walking and while we may not have all the necessary resources to start with, we end up getting them over time. We insist, the main enemy is not the criminal, or even the poison or traps, or the lack of resources, but rather frustration.

13. RECORDS AND DOCUMENTARY PROCEDURES IN THE INVESTIGATION OF BIODIVERSITY CRIMES

There is a Spanish proverb that says “a short pencil is better than a long memory”. In ordinary life this saying is wise, but in the field of investigation of crimes against biodiversity it takes on crucial importance.

All investigations are based on analysing criminal acts. These acts, in turn, constitute the starting point for any proceedings. The first real contact we have with the facts takes place in the CSI, and this contact is recorded in a set of documents including forms, records and reports prepared by agents. This body of documents is absolutely crucial to the success of the case. As the saying goes, if it is not written down, it does not exist. All evidence, every finding, must be perfectly documented in writing because the success of the case depends entirely on the quality invested in preparing this documentation.

It is easy to understand now that the preparation of records and technical and supplementary reports is one of the most important phases after the discovery of an alleged environmental crime or offence, given that this is where the events that occurred are detailed. These documents are added to the file comprising the investigation, which means that the success or failure of any ensuing administrative and criminal proceedings relies on the precision and quality of their contents. Hence the importance of ensuring that all records and reports contain clear, unequivocal and detailed information that does not give rise to any doubts for any parties involved in subsequent phases of the proceedings. There are numerous examples from the past of cases that have failed simply because the documents and records were full of errors or inaccuracies, or did not contain enough information. We can decisively state that if the case is not well documented, there is no case. Without proper documentation there is no investigation and if there is no investigation, crimes go unpunished and unsolved.

We need to bear in mind that the laboratory technicians are not present when the carcass is being removed or when the samples they receive are taken, so the information provided in the records are a fundamental tool for diagnosis in many cases. Photographs, details about the conditions of the carcass, the entomofauna and the temperature at the site are all points that will doubtless be useful to the forensic laboratory.

Later on, based on the documents, the courts of justice will decide whether the person suspected of committing a crime is innocent or deserves to be convicted. Therefore, it should not be surprising that we consider this chapter to be so important. No court or judge will convict a suspect if there are insufficient grounds to do so; i.e. if the presumption of truth can be decisively disproven. All of this relies on the documents.

In fact, the structure and contents of the body of documents comprising records, forms and documents that the agents must fill out when removing the carcass or at the scene of the criminal acts under investigation depends on each individual country or region. Each police force in Europe has its own forms, so there is little to add in this regard. What we will focus on is the fact that no investigation is possible unless that body of documents is filled out thoroughly and in a highly detailed manner.

As a general rule, the documents that agents must fill out from the moment at which they appear at the crime scene are the following[17]:

- Carcass removal records
- Records of forensic samples and police evidence taken
- Records or forms for samples sent to the laboratory
- Chain of custody form

[17] Within the framework of the LIFE VENENO NO project, two protocols for police action were drawn up, containing additional information about taking samples and templates for records and other documents for use by law enforcement officers in the event of crimes against fauna. They are available at the website www.venenono.org under the section Fondo Documental/Legislación y estrategias.

- Additional technical report forms
- Others: Each specific case gives rise to different documents.

The investigation case file comprises all these documents that are prepared by the law enforcement officers, in addition to any others generated at later stages of the investigation, which are prepared by experts or other government officials, the accused, laboratories and other parties and emerge during the course of the investigation.

The documents drawn up during the CSI at the scene must contain sufficient details of the work done so that anyone reading them will have an exact idea of what was found, who found it, how it was found, what exactly was done with each item of evidence found, how they were handled, where, how and by whom they were sent, by whom they were received, at which laboratory, how they were handled and analysed, what was done with them after the analysis, how the results reached the investigators and absolutely every detail, no matter how small, that might help understand the steps taken during the investigation.

The records must indicate the identification number or name of the acting officers and, where applicable, witnesses' details. They must also contain the number, identification, time, coordinates and seal type and number for each sample taken. There must also be a section for "other facts to be highlighted", where any items deemed to be of interest can be added. Any detailed information must be shown in the form, in a supplementary report or in the enquiries.

In many cases, the information to be highlighted is so important that the agent will need to draw up additional technical reports. These police reports must contain:

a) A cover sheet with relevant information: report no., acting officers, time, date and place of the events and alleged offender or suspect (if there is one).

b) Explanatory text with a summary of detailed information from the finding of the samples to the initial results of the investigation. In this section, all the details of the records and the form can be described, as well as any information gathered during the days before and after the samples were found: witness statements, previous cases of unlawful use of prohibited predator control methods, events observed and verified, other actions taken and anything else that may be useful at a later stage of the investigation.

c) Appendixes. Sketches, diagrams and maps and, of course, a thorough photographic report, are essential, and will be discussed in a separate chapter below. The aim of the photographic report is to narrate with images what has already been explained with words. Each photograph must have an identification number for reference to the explanatory text. There must also be a section with maps showing the locations of each sample (bait, carcasses and other types of biological or other samples), boundaries of properties and operations (for livestock, hunting, etc.) and any other point of interest (photo 13.1).

As mentioned above, each police force, country and region has its own templates, which likely contain all the points indicated here.

Photo 13.1 All the relevant information of the case must be established in records, which must always be accompanied by photographs.

For example, in the event of poisoning episodes, gathering certain specific details in the field is especially important:

1. The bait/carcasses are found inside a hunting reserve, private property or a livestock farm.
2. They were found within the boundaries of the property.
3. The bait/carcasses were located in the vicinity of inhabited country houses or developments.
4. The poisoned animals or bait are found outside the official hunting season and during the mating season of the main small game hunting species.
5. Number of pieces of bait found.
6. Dead species found and number.
7. Amount of poison used.
8. Detailed description of the bait used.
9. Apparent risk of poisoning for endangered species present in the area.
10. The bait was discovered at an important time or phase of human activity (when livestock are giving birth, when wild game is released, etc.).
11. Location of bait/carcasses in relation to facilities on the property or reserve, such as hunting facilities, partridge feed and water troughs, cairns or rabbit burrows; whether they are found near other predator trapping elements, etc.; livestock facilities like sheepfolds, water troughs for livestock, etc.
12. How was the case discovered?
13. Were the carcasses/bait found inside the hunting reserve unbeknownst to the owner of the property?
14. Who owns the land?
15. Protection status of the area where the samples were found, if it is a protected space.
16. Quantitative and qualitative impact on the health and safety of humans and their assets (finding near recreational areas, reservoirs, poison added to food consumed by humans, public paths and general areas of human transit).
17. The estate is fenced off and it is not easy for third parties to gain access.
18. Notice of discovery of bait/carcasses by private individuals who are not owners of operations.
19. The bait/carcasses were found thanks to an anonymous phone call.
20. History of use of poison and illegal methods.
21. Report by the environmental law enforcement officers.
22. Appearance of carcasses that have been buried, concealed or tampered with in order to mislead or cover up the death.
23. Whether or not the operation has a security or surveillance system.

Other items deemed relevant.

The agents may add any other points they consider to be appropriate. These are just a few examples. The professionals in each region are likely to have a thorough knowledge of the criminal cases in their regions and the variables that should be indicated. The agents are recommended to have ready-made records or forms in simple checklist format, so that nothing is left to memory and all the agent has to do is to fill out the sections as simply as possible. This ensures that nothing is forgotten when taking notes, preventing relevant details that could be crucial to the police or judicial resolution of the case from slipping one's mind.

By way of illustration, two record forms are attached here, which are currently used for official purposes in Andalusia and could prove helpful to others. First, the carcass removal record for electrocuted birds and secondly, the protocol applicable to alleged cases of poisoning.

14. POLICE PHOTOGRAPHY

Just as it is true that anything that is not in writing, properly stated in the records drawn up in the CSI, does not exist for legal and judicial purposes, it can also be asserted that anything that is not photographed can and will be denied and questioned by a good defence team during court proceedings. The moral here is clear: a thorough police photography report must be created. It is often said that a good CSI will give us up to an 80% chance of success in solving a case, and it could also be said that there is no good CSI without a correctly prepared photo report to support it.

While they are not quite the same thing, police photography is quite similar to forensic photography, and both fall under the category of the discipline known as scientific photography.

Police photography is photography done directly by law enforcement officers or by their assistants for the general purpose of providing proof of the traces brought to light during the CSI.

While achieving this goal may seem like a simple task, it actually entails some difficulty and, at present, it is still one of the pending matters in police work throughout all the forces across Europe and its neighbouring countries. For this reason, we will focus here on establishing the criteria that govern the creation of a good police photography report. These reports are tremendously useful for forensic laboratories, so that they can correctly contextualise the samples received at the laboratory. We must bear in mind that the forensic experts in the laboratory work blindly, in some way, because the records and photographic report are the only information available to them for interpreting the findings of the autopsy. Besides this, police photography seeks two specific objectives: a) to show the judge the findings of the CSI and subsequent investigation, and especially, b) to contextualise them. While the first objective is usually achieved in the reports normally drawn up, the second one is not. Properly contextualising an image means proving that the traces photographed are present there –and only there– and thus, the police photographic report bears witness to this. Where needed or by court order (which has occurred several times now), it is possible to go back and examine exactly the same site based on the images. In real life, this is not always possible. An assessment of the photographic quality of the police reports issued by the Autonomous Government of Andalusia and used in criminal and administrative proceedings between 2010 and 2016 revealed that slightly less than 40% of the police photographic reports prepared by law enforcement officers met basic standards. It is highly interesting to note that, from 2016 on, the reports received have improved greatly in quality thanks to the specific training given to the officers in this regard.

Police photography is the graphic support that helps establish and prove: who, when, where, how and why a crime against biodiversity was committed. For this very reason, all the photographs included in official reports must meet certain technical conditions, which are known as the ten commandments of police photography:

1. Good double perspective (close-up and panoramic)
2. Well framed
3. Properly focused
4. Proper georeferencing
5. Good numerical and size reference
6. Good angle
7. Good light
8. Good practices
9. Proper procedure
10. Proper speed and aperture

Good double perspective

All police-related photographic reports must show two essential perspectives: the close-up appearance of the traces found (photos 14.1

and 14.2). Reports that do not meet this condition are not properly done and may not only be brought into question during a trial but may even prompt it to be dismissed. Situations have arisen in the past in which the counsel for the defence argued that the photograph of poisoned bait had not been taken on the property under his custody but rather somewhere else. A good panoramic shot completely eliminates this risk.

Photos 14.1 Close-up photos of the evidence and spatial context thereof in panoramic view.

Close-up images must show the traces (bait, carcass, snare, trap, etc.) in their entirety and, if they are large, photos must be taken of each part. The purpose of this is to highlight the unique features or intrinsic characteristics of that specific piece of evidence, distinguishing it. The photographs must also meet the conditions of the other rules, especially as regards the good numerical and size reference, as we shall see below.

Perspective or "spatial context" images must be taken from diverse points and orientations (east-west, north-south, etc.) and their function is to prove that the evidence belongs to that exact site, unequivocally, and none other.

Photos 14.2 Example of panoramic photos of the scene.

As mentioned above, both images –context and close-up– are necessary and essential.

Well framed

While the current trend in artistic photography dictates placing the subject of the photo off-centre according to the so-called "rule of thirds", in police work, the subject to be photographed must be centred so as to capture the greatest amount of detail and best possible focus, as well as focusing the attention of the judge or lawyer making decisions based on the photographic report. There are some exceptions to this rule when the agent is trying to create a composition that encompasses a number of structures or subjects. However, close-up shots must always be properly framed. Poorly framed photos like the example here (photo 14.3).

Photo 14.3 Example of a poorly framed photo, which must be avoided in reports.

Properly focused

This might seem like something that goes without saying, but it is not uncommon to find photographic reports containing unfocused photographs. Foto 13.6 A and 13.6 B Unfocused photos must be avoided It is better to leave out images that are not perfectly focused because they give the impression that the agent lacks expertise or, worse yet, professional capacity, and may be used as an argument by the defence. Partially out-of-focus images may only be used when it is impossible to retake them and their documentary value makes up for this shortcoming, which should be indicated in the corresponding photo caption in the photographic report.

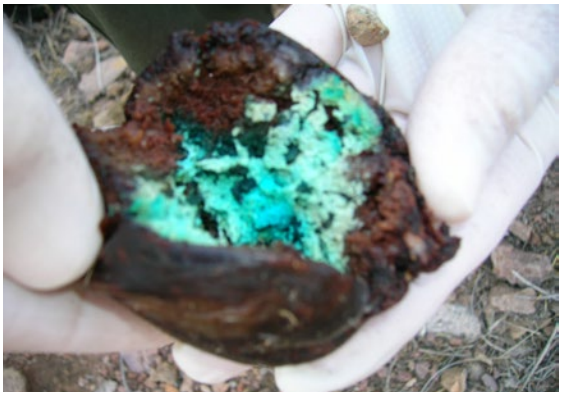


Photo 14.4 Unfocused photos must be avoided.

Experience has shown that photos are usually out of focus for two specific reasons. The first is that we get too close to the object when taking close-up shots of poisoned bait, for example, or a wound on a carcass. The solution is quite simple. Most cameras have a button or an option that can be selected on the digital screen to indicate "macro" mode. This is usually depicted by a small flower icon. Remember to activate this option when you want to take close-up detail shots, zooming out as much as possible and moving the camera toward the object until you see a completely sharp image. This will give you quality photographs just a few centimetres away from the object.

The other reason why our photos come out unfocused is when the object to be photographed is near the camera, small in size and there is nothing in the background. Under these circumstances, the camera's focus sensor cannot accurately find the object because it is so small, so it forgets the object and focuses only on the background. This often happens when agents are trying to photograph details of a snare planted in the field. The solution here is also simple: put your hand or a piece of cardboard behind the snare to create a background that the focus sensor can recognise (photos 14.5).

Let us not confuse the terms “unfocused” and “blurry”. We will discuss the meaning of the term “blurry” in photography below.

Proper georeferencing

Photographs taken for police work to be included in a photographic report must always be georeferenced. The georeferencing details may be indicated in the photo caption and also in the body of the report. When close-up photographs are taken outdoors, we recommend placing the GPS near the physical evidence being photographed (photos 14.6). We must

Photos 14.5 Because the background or small size of the object to be photographed may lead the photo to be out of focus, place a hand behind it to make it easier to focus.

always position the GPS as described in the Proper Procedure section. Often, the camera itself shows the coordinates of the site where the photograph was taken, which is preferable.

Photos 14.6 It is advisable to include the GPS in the photographs.

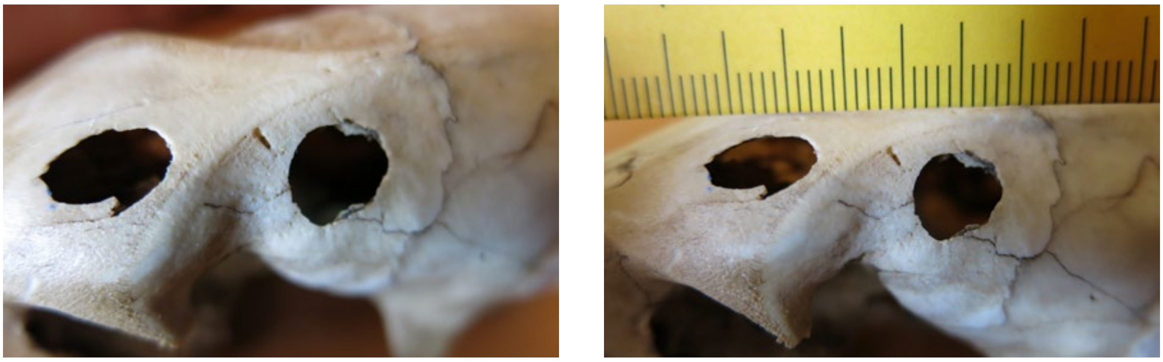
Good numerical, size and compass references

These are some of the most common shortcomings committed in police photographic reports throughout Europe by both inexperienced agents and those with years of experience and numerous solved cases to their names.

This section refers to photographs taken of evidence found during the CSI.

The traces found must be photographed in detail, as we have seen in the relevant section above. Furthermore, it is absolutely essential for judges, lawyers and forensic and other experts to be able to measure the size of the traces and the related features since this is a highly relevant diagnostic element. To do this, we must place a metric scale next to the evidence (photos 14.7), as described in the Proper Procedure section. As we can see, in one of the photos here (photos 14.8), it is completely impossible to discern whether the orifices shown are one millimetre or one metre in width. This image has no forensic or police value whatsoever and should be discarded. On the contrary, the other photo perfectly reflects the size of the orifices thanks to the simple placement of a metric scale. The same could be said of the other photo enclosed (photo 14.9) in terms of the size of the gunshot residue cloud. We can only estimate the distance of the gunshot by placing a metric scale for reference. When the traces are small in size, we should place a millimetre scale ruler next to the sample (photos 14.10). Where the sample is larger in size, the side of the scale with black and white markings should be used. The black and white scale is marked with segments measuring 1 cm (10 mm) (or ten cm, used for large-sized objects), (photo 14.11) and its purpose is to

Photos 14.7 It must be possible to measure the size of the piece of evidence in the photograph, and metric scales are used for this purpose.



Photos 14.8 Image with and without metric scales.

Photo 14.9 Metric scale used to measure the gunshot residue cloud.

Photo 14.11 In large-sized samples we can use the scale with black and white markings.

Photos 14.10 In small-sized samples, the scale marked in millimetres should be placed next to the sample.

enable forensic laboratory technicians and forensic experts in police laboratories to scale the samples on the computer screen (photos 14.12). The viewfinder helps agents to correctly focus the lens when taking photographs (if the lens is manual) and is also used by experts to correctly focus images on a computer (photo 14.13).

Pieces of evidence must also be correctly numbered in the photograph and this numbering must match that used in the body of the reports and records (photos 14.14).

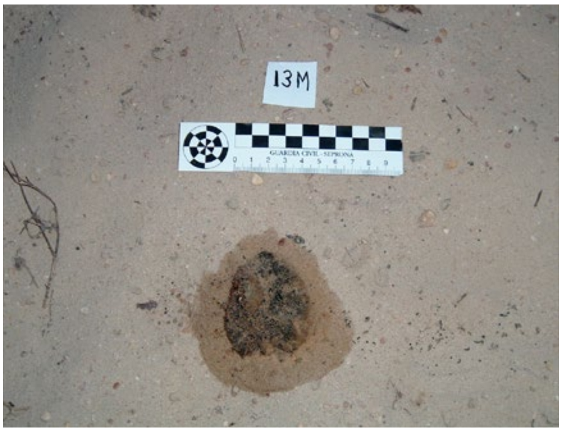
Photos 14.12 Using scales with different samples.

Sometimes, for a number of reasons, agents are not equipped with metric scales and number markers, or not in sufficient quantities or numerical order. Let's imagine, for example, that the number of clues to be gathered in a CSI is 56, but we only have up to number 40. While it is preferable to avoid situations like this, number markers can be created by hand, writing numbers on pieces of paper with a pen or marker, or familiar standard-sized objects can be used for the purposes of referencing the size of photographed samples (photo 14.15). In Spain at least, this solution has been allowed by the courts, which have even handed down guilty verdicts in cases in which the scales used were hastily written scraps of paper (photos 14.16). Anything is valid, as long as we always use some kind of scale.

Photo 14.13 The viewfinder enables us to correctly perform this operation.

Photos 14.14 Evidence must be correctly numbered.

Photo 14.15 In the absence of metric scales, any object that makes it possible to establish comparisons can be used .



Photos 14.16 Number markers can also be made by hand.

It is preferable, though not essential, for photographs to be contextualised using compass markers, i.e. markers that indicate the sample's position in relation to the geographic North Pole (photo 14.17).

Photo 14.17 Compass marker used in the investigation of the dead of a red kite.

See the section below on the use of flash for certain types of scales and markers.

Good angle

Sometimes, although not always, to take useful photographs of certain types of evidence, it is necessary to place the camera perfectly perpendicular to the surface of the sample to be photographed. This must be done to prevent aberrations caused by the angle, which can lead to erroneous measurements in the laboratory. This mistake is often made, for example, when taking photos of footprints or tyre tracks. There must be the same distance between the camera lens and all the points of the piece of evidence, and this is only achieved if the camera is completely perpendicular; in other words, it must form a 90-degree angle to the surface photographed (photos 14.18). For police photography that aims to highlight details of objects, the zenith angle is used, meaning perpendicular or exactly vertical to the sample to be photographed. This is the most commonly used angle in police photography because it is the one that best reflects the contours of the object, without distortions or aberrations. This ideal is very rarely achieved in reality.

Photos 14.18 The angle from which the photo is taken is important.

Good light

This is quite likely the most difficult category in photography in general and in police photography in particular, and it is certainly one of the most complex conditions for any agent, even those with expertise in the matter. Not in vain, it is said that photography is writing with light and, like any art form, not everyone is equally skilled, nor are all the cameras normally used for this type of work the same.

We usually set our cameras to automatic modes (P or AUTO), which meet our general needs. However, there are times when automatic mode by itself is insufficient to handle the ambient light conditions available or does not reflect the image as we would like to capture it. In these cases, it is advisable to use one of the alternative modes that all cameras are equipped with, which are referred to as TV, AP, S or A, depending on the brand. This is what we affectionately refer to informally as "photography for the eager".

One highly practical solution when working in low light is to increase the ISO setting. ISO is the sensitivity of the imaginary film, what used to be known as ASA on the conventional film rolls of the past. In general, the cameras we use most often have options for adjusting the ISO, although it can also be adjusted automatically if the sensor detects low light. However, it is preferable to be familiar with this concept so that we are the ones choosing the parameters, rather than the camera of its own free will. What we need to bear in mind is that at low ISO speeds, the image is better quality, whereas, if it is very high, the photo will appear grainy, although this is not a problem in police photography.

In sum, we should discard any images that are overexposed (too bright) or underexposed (too dark). It is possible to modify the light levels of a photograph using any of the numerous digital editing programmes that come with the camera when purchased or others that are by now classics in advanced photography (Lightroom®, Photoshop®, etc.). Some agents have recently started shooting their photos in professional RAW format instead of the standard compressed JPG format. This allows for many more options for improving image quality, although it considerably increases the size of the images, going from about 3 MB for a JPG to nearly 30 MB in RAW formats (RAW, NEF, etc.). RAW formats also require the use of more powerful computers and advanced software, which are not always available but offer excellent results.

Good practices

Photographic reports not only bring to light the evidence found in inspections, but they may also spotlight other aspects related to the agents' working methods. On occasion, in cases tried in Spain, a collateral effect of these reports has been that they showed certain practices that the counsel for the defence used to file appeals, pleadings or even motions for dismissal in some cases. Other times, the images contained in reports depicted incorrect practices or merely attitudes that could be improved. Again, it must be noted that tremendous progress has been made in this field and now is the time to offer these notes for the purpose of achieving perfection in the work we do.

This is not the place to go into detail on this matter, but suffice it to recall that when photos are taken for reports, records or statements, the agents shown at work should avoid wearing sunglasses. Likewise, special care should be taken to avoid being photographed smoking, eating or drinking, posing next to carcasses or samples, or displaying irregularities in uniformity. While these photographs are perfectly acceptable for private, personal use, they must not be included in official reports. Similarly, technicians and agents appearing in photos should be wearing latex/nitrile gloves (photo 14.19), masks and any other items that guarantee the cleanliness of well-known sampling procedures and CSI performance.

Photo 14.19 We must wear proper attire and be well equipped when taking photographs.

Proper procedure

This condition is in reference to following proper procedures when taking the photographs themselves. The mistakes made in this regard are actually widespread in police practice worldwide, for all crimes and in all countries. It is a universal shortcoming.

When we take photographs of poisoned bait, carcasses or any other type of evidence, the metric scales, number markers and GPS are often placed so that they physically touch the items we are photographing (photos 14.20). This can, and in fact does, alter and contaminate the samples (cross-contamination), which has unfortunately been the case on occasion.

Photos 14.20 Sometimes the metric scales touch or are placed too close to the samples, which could alter them.

We must stress the need to be meticulous and conscientious here, which is of the utmost importance in police and forensic work (photo 14.21).

Photo 14.21 An environmental agent wearing gloves and holding a container of alleged poison, keeping the sample away from his face to avoid DNA contamination. The other agent takes notes of the finding in the corresponding records. The image captures all the actions, which are included in the photographic report prepared during the CSI.

Proper speed and aperture

Shutter speed and aperture are basic concepts in photography that all good photographers must master; however, they are usually beyond most field agents' knowledge. Combining these two parameters is crucial in creating sharp images with good light and, as a general rule, cameras fortunately have automated settings for these combinations.

When we take photos at a high shutter speed (the speed setting is indicated on the camera with the letter S) of 1/1000 or more, or 1/2000, we are able to freeze the image of a subject moving at high speed, such as the blades of a helicopter in the air. Working at low speeds gives us the opposite effect, so that the subject appears still and the background has a dynamic movement effect. This technique in known as “panning”. Speed is expressed in fractions, e.g. 1/1000, which means that the camera captures light (and images) during a fraction of time that is 1/1000, or one thousandth of a second, which is a very fast, almost instantaneous, speed. The cameras used by some agents can even take shots at up to 1/4000, which is must faster than what is needed in police work. On the other hand, a slow speed would be 1/60, or one sixtieth of a second, which means a longer time with the diaphragm open and the camera capturing the image. The slower the speed, the more likely it is that the photo will come out blurry, but the faster the speed, the more ambient light we need.

The concept of aperture is different (usually represented on cameras with the symbol “f”). This “f” is the diaphragm, which opens or closes at our will. A good lens may have an open “f”, f=2.8, and a closed “f”, f=22. All of this may seem complicated, but we merely need to remember that an open “f” is a small number (2) and a closed “f” is a high value (22).

If we use a wide aperture, we let more light in, thus enabling us to work at lower speeds, so that we can take photos in darker places. If we exceed a certain limit and the speed is too low, then we’ll need to use a tripod so that the photo does not come out “blurry”. As mentioned above, “blurry” is not the same thing as “unfocused”. The first concept is related to a speed that is too low, whereas the second is the result of incorrectly measuring the focus distance. They are two separate concepts.

The problem with working with open “f” (open diaphragm) settings is that we lack depth of field, i.e., only the plane we focus on will be sharp. If we use a closed “f”, the camera will need more ambient light to work properly and the speed will be slower, giving the camera more time to capture that extra bit of light it needs to take a good photo. However, as we have seen, this may bring the speed down so low that the photo comes out blurry unless we use a tripod or, as is often the case, we rest the camera carefully on a rock or vehicle. Despite these disadvantages, what can we achieve by working with a closed “f”? The answer is related to what is known in photography as "depth of field", which means that a closed "f" will give us a photo in which the entire field of view is in focus and sharp: not just the foreground, but also the background (photos 14.22).

Photos 14.22 The diaphragm aperture allows us to take photos with a more or less focused and sharp field of view.

As we can see, what enables us to take good photos is the right combination of speed (s) and aperture (f) for each case and circumstance. To simplify, as a general rule, the less ambient light we have, the slower the speed we'll need to use, although this forces us to steady the camera to prevent the image from blurring or to use a flash (photos 14.23). A high speed enables us to capture movement and makes it unnecessary to use a tripod, but better ambient light conditions are required.

Photos 14.23 Using the correct speed and aperture settings gives us clearer photos that provide clearer information.

To create a portrait-type photo that focuses on the subject and softens the background (a very nice effect for human faces, flowers, etc.), we need to open the diaphragm and use an open "f" that requires little light and enables us to work at more comfortable speeds (1/125 and up). If, on the other hand, what we want is to take a photo in which both the foreground and the background are in focus, i.e. we want depth of field, then we need to close the "f", even though this forces us to work at lower speeds (1/60, 1/125 or even lower) and steady the camera or use a tripod.

When working completely in manual mode (mode "M" on most cameras), we need to select both the speed "s" and aperture "f" ourselves. This may be a slow process that takes up time we do not usually have during inspections in the field. Professional photographers always work in "M" mode, whereas amateurs never, or almost never, do.

However, at least in the world of photography, the vast majority of cameras used in the field today have two additional options of interest. Some amateurs refer to them as “the magic button”. We can set the speed we want depending on what we need to photograph, and the camera will decide for us which “f” setting is the most appropriate. This is known as shutter priority mode, represented by the letter “S” on the camera. We also have the opposite option, where we can prioritise and select the aperture “f” setting. Then the camera will adjust itself to the correct speed; this is known as aperture priority, symbolised by an “A” or “Tv” on the camera.

To summarise, among numerous other options, cameras usually offer certain completely automatic modes, which choose the “s”, “f” and ISO settings, and even the flash, for us. They are usually indicated as AUTO or P. There is also the intimidating manual mode, or “M” setting, for the “brave”, in addition to the shutter priority “S” mode and the aperture priority “A” and “Tv” modes seen above.

All of this seems complicated and more intimidating than it is in reality. Just take a few minutes to read through this text with camera in hand and take some test shots. The combinations of “s” and “f” are so varied and the possibilities so infinite that this is precisely what makes photography one of the most fascinating art forms and hobbies, sparking passions around the world. At any rate, today’s cameras do much of the thinking for us if we set them to do so, performing automatic calculations, but it is important to remember that, in this case, they are in charge, not us.

Use of mobile telephone cameras

In recent years, use of these devices has become widespread and some of them are even equipped with GPS and cameras. In fact, the cameras built into some mobile phones are exceptional quality, sometimes even better than conventional cameras. The solution lies in knowing exactly which features our mobile phone offers and using them whenever possible, making use of the normal camera only for photos that exceed the features of the mobile phone. Many of the photographs shown in this manual were taken with a mobile telephone, and they are of exceptional quality. There is no technical disadvantage whatsoever to using a mobile phone with a camera for police work, as long as all the precautions mentioned in this chapter are applied.

Photographs of original chemical compound containers

During the course of inspections, it is common for agents to find chemical products suspected of being used to poison wildlife, for example. Many of these products are kept in their original containers (primary packaging), or in others (secondary packaging), the latter of which may amount to an administrative offence. Nowadays, agents either send the entire container to the laboratory for its contents to be analysed at the toxicology laboratory, or they take samples of a smaller volume to be sent for analysis. Sometimes the agents do not confiscate the original containers, merely taking photographs of them, which are included in the records and reports. This practice is perfectly valid, but the problem arises when taking these photographs. More often than should happen, the photographs taken by the agents of the containers are too general or are taken from too far away, making it difficult to discern the exact composition of the seized compounds. The information contained on the packaging label is vitally important to the laboratory for several reasons: for example, if an original container has been tampered with or contains some other compound, which must be penalised. Other times, identifying the compound type using chromatography equipment can be like looking for a needle in a haystack, so the chemical composition information may be very helpful as guidance for the analyst.

In sum, it is especially necessary for the agent to take detailed photographs of the chemical composition of the labels on the original packaging of chemical compounds found in tool sheds (see attached photos) (photos 14.24). Remember that, to do this, we need to set the camera to macro mode and even use a flash.

Use of flash

This is undoubtedly the question that technicians and agents ask most often when using cameras as part of their professional activities, and also the question for which we usually have the fewest answers.

Let's take a look at the use of the built-in flash on cameras, technically known as the *fill flash*.

Needless to say, when shooting photographs at low speed (for example, below 1/60), we need to use the built-in flash so that the camera can choose the highest speed to prevent the photo from coming out blurry. The flash enables the camera to work at greater speed,

Photos 14.24 Photographing the chemical composition of confiscated substances is a necessary part of the investigation and laboratory analysis.

i.e. from 1/60 and up, thus ensuring a sharp image. In automatic mode, cameras even use the device automatically, without needing to activate it.

All we are saying here is that a flash should be used in low light. However, in addition to the well-known classic, conventional use, a flash offers agents a broad range of highly useful tools that we rarely take advantage of. The clearest example arises when photographing hard-to-see objects that we want to spotlight in a photographic report and, in this regard, perhaps the most interesting example is that of snares planted in the field.

Snares often go unnoticed at first glance. An experienced agent may locate 50-100% more snares placed in the field than someone lacking experience. This same argument is also valid for photographs. Reports often contain images of snares with or without metric scales next to them in which the snare is barely visible because it blends in with the background. We must bear in mind that the main recipients of these reports are legal experts with little or no knowledge about these devices, so we need to make their work easier. One highly useful bit of advice is to activate the flash when taking photos of snares (or other inconspicuous metal objects), because the light given off is reflected in the metal, making it stand out against the background. The photos here illustrate this phenomenon well (photos 14.25).

As mentioned above, using a flash increases the reflections on the objects we want to spotlight, but unfortunately, also on those we do not want to spotlight. When taking close-up or detailed photos, the flash creates reflections that render certain important features hard to make out, such as metric scales or laminated plastic numbers. For this reason, the scales used in police work have a matte finish, to prevent unwanted reflections. A laminated plastic scale is easier to clean and disinfect but causes more problems with flash reflections.

Photos 14.25 Using a flash can help create a sharper image and better definition of the object photographed.

Another important use of the flash is to avoid backlighting. When agents need to take photos against the light, they should certainly use a flash to achieve greater detail and sharpness.

The most important precaution to be taken here is to avoid bringing the flash too close to the object we are trying to photograph. Too much light can burn out or overexpose the details of a piece of poisoned bait or even a snare, rendering the image useless.

Digital photography has numerous advantages, one of which is that the cost does not increase depending on the number of photos we take. Therefore, let's apply the golden rule of photography: be generous, the more shots taken, the better. Take photos with and without flash during inspections in the field, then simply choose the ones we like best.

Remember that the flash is there too and can help us with our work.

Conclusions

As we have seen throughout this chapter, police photography is one facet of scientific photography. It is closely related to forensic photography, but they are not the same thing. We have also seen that the photographic report is vitally important and essential, and it must be done properly, following the guidelines detailed above.

Two types of parameters must be applied in every photograph: photographic parameters (focus, light, speed and aperture) and context (metric scale, numbering, compass orientation).

The ability to prepare quality police photographic reports must not be out of agents' reach, given that this is a fundamental aspect of routine work and one part of the CSI. However, progress must be made in this field to refine the technique.

Increasingly, teams assign certain agents exclusively the task of taking photographs during inspections. This is an ideal practice because it ensures a perfect report. At any rate, we must reiterate the importance of having good reports for the police investigation as support in solving the case. On the contrary, poor reports have even managed to jeopardise the entire proceedings. Remember that photography work must not only look good, but its true purpose is to be useful.

15. LABELLING, PACKAGING AND LABORATORY SHIPMENT CONDITIONS

During a thorough examination of the site of the criminal acts by the acting officers, clues are found and photographed, then they must be gathered, labelled and packed to be taken to the laboratory.

Based on the international standards developed by Technical Committee 272 (International Standards ISO/TC 272), this chapter describes in detail how to collect evidence, label it and refer to it in the records and the chain of custody. We will discuss the best way to package each type of sample, focusing on how to correctly do this, given that this is essential for ensuring that evidence reaches the laboratory intact, is not contaminated when gathered or during transport, and that legal provisions are complied with in the packaging and transport process.

Obviously, everyone knows that samples must always be accompanied by the corresponding records and chain of custody. By correctly sending the documentation, it is possible to monitor who has been in charge of the samples at all times. The chain of custody ensures that the sample analysed at the laboratory, which will later be reported on, is the same as that which was collected in the field. "Breaking" or manipulating the chain of custody is a very serious act that inevitably leads to the dismissal of the piece of evidence, rendering all the work done by agents, lab technicians, etc., useless. A breach of the chain of custody may even entail legal repercussions for the agent in some cases.

Gathering evidence (samples)

This chapter applies to samples, traces and clues related to any kind of crime against wildlife. However, biological samples are the ones that have the highest rate of deterioration and for this reason will be discussed in greatest detail so as to ensure that they are processed correctly. As mentioned before, in general, forensic laboratories must make tremendous efforts to find answers to the questions that the agents need to resolve in the course of their police investigations. It is not uncommon for forensic laboratory staff to be put to the test, almost on a daily basis, in order to provide the expected results, and these technicians must renew and update their knowledge at a dizzying pace. The laboratory must go to great lengths, but to do this, the police officers must provide them with suitable samples, which obviously must be collected, packaged and sent correctly so that they can be analysed to the utmost extent. This chapter seeks to explain the proper ways of doing this.

Looking at our crime scene, we can see the number markers we have planted. Now that we have photographed the details, it is time to collect the samples.

Regardless of the sample concerned, it is important to follow some simple general rules that are applicable to any kind of sample found:

- Handle samples only as strictly necessary. Unnecessary handling often arises from curiosity, which could seriously compromise the expert analyses done in the forensic laboratory. Certain entities not related to the police forces offer courses, some of which are excellent quality, to teach agents in a variety of environmental police forces to perform specific forensic practices on the ground. We will not discuss whether or not these courses are suitable in this manual, but we will emphasise how important it is, as the main mission of the police forces, to ensure that samples reach the forensic laboratory in the best possible, most original, conditions, free of tampering. Let us now recall what we explained at the beginning of this manual regarding the differences between the work done by the police and the agents, and the key importance of ensuring that only qualified professionals perform the duties assigned to each party. If the agents overstep their duties in handling samples, they may be contributing to their deterioration, thus reducing the information that the qualified forensic staff can glean from them, such as eliminating traces of the criminal's DNA during peri- or post-mortem manipulation, leaving their own DNA, dropping shells in deteriorated carcasses, dropping granules of toxic compounds used as poison, eliminating fingerprints or overlapping the criminal's prints with their own prints, unjustified alteration of carcass disposition, identification of species by employees who are not scientifically qualified which could lead to conflicts with the species indicated officially by the laboratory and, finally, breakage of joints and loss of tissue. More than once, criminal proceedings have become unnecessarily complicated because the agent ventured to include personal opinions in the records, overstepping the competence of forensic experts with accounts that conflicted with the official forensic reports or by leaving their own prints and obscuring those of the real perpetrator of the acts.

- Collect samples separately, striving not to mix them even when they all seem the same. For example, when several pieces of bait are found, do not mix them, even though they are all apparently the same; package them separately instead. If diverse shells or cases are found, each and every item must be separately packaged because mixing them together could, for example, create marks that could render the ballistic analyses invalid in their comparison with known samples or with the unified database.

- As regards poisoning specifically, all the samples (e.g. pieces of bait) and carcasses found in the inspection area must be collected, not just some of them, as has occasionally occurred. They amount to possible proof of a crime and are necessary in trial, while also avoiding new crimes against fauna.

- Avoid contaminating the samples. For example, collecting bait containing aldicarb and then touching carcasses without taking precautions, wearing the same gloves, could lead to cross-contamination of the carcass.

- We strongly recommend sending the entire carcass to the laboratory because the best samples for finding a possible poison can be selected there. If this is not possible, such as in the case of a large-sized mastiff, the autopsy must be conducted by a veterinarian with wildlife experience and the laboratory shall be contacted to select the samples to be chosen and sent.

While police work entails contact with settings of varied origins (shootings, traps, snares, traffic), a good portion of them are related to poisoning episodes. When this is the case, or is suspected, law enforcement officers must take great care when handling samples; although this was mentioned above in the chapter on CSI, personal protective equipment (PPE) must be used from the beginning, not just when collecting samples. Basic PPE consists of nitrile gloves and FP3 masks. FP2 masks are an alternative, but they do not protect against very fine particles of potential powder-format poisons or against viruses (photo 15.1), although this actually depends on the specific regulations in each region or country.

Photo 15.1 Basic PPE must be used during the CSI.

In very hazardous conditions, such as when heat has caused gases to evaporate, there are large amounts of poisoned bait or they contain a high toxic load, or for all of the above at once, the use of coverall suits, protective goggles and even shoe covers may be necessary (photo 15.2). In addition to gloves and mask, this equipment protects us and also prevents us from contaminating the site and certain kinds of evidence (shoe tracks, hair or other clues left by the suspect, for example). In some cases, the agents or technicians are forced to work in highly toxic conditions and/or in complete anaerobiosis, such as inside a well, as shown in the photos here (photos 15.3). In this specific case, the criminal threw the carcasses of the birds of prey he had killed into a well to get rid of them, also doing the same with the pigs that died, in order to dodge veterinary inspections, contaminating aquifer and seriously jeopardising human health (photo 15.4). For the CSI inside the well, in addition to rope access equipment and duplicate auto-belay systems compliant with occupational risk regulations (photo 15.5), the agent was equipped according to the relevant official protocols, known as NBQ among gendarmerie forces. Personalised prior training is required for these specific procedures and the acting agent must always receive support

Photo 15.2 PPE for full body protection: Safety goggles; coveralls; HEPA filter mask; nitrile gloves; laboratory footwear and tights.

Photos 15.3 Preparing for an intervention inside a well with a toxic environment.

Photo 15.4 Bottom of a well with a toxic environment to be inspected.

from an assistant to certify the airtightness of the PPE, correct placement of the harness and other items and to perform a safety cross-check (photo 15.6).

Photo 15.5 Depending on the intervention type, agents must be perfectly equipped to ensure their safety.

Two questions are insistently raised among agents from numerous regions in Spain and neighbouring countries: one is related to keeping up the chain of custody when courier services are used to send samples to the laboratory, and the other addresses whether it is possible, in certain highly specialised actions, to rely on the help of specific experts that are not part of a police force for taking samples, such as rope access experts when the agent is not qualified to perform this work or it could pose a serious risk to their integrity.

Photo 15.6 In certain interventions, an assistant is required to verify the safety elements.

Let's start with the first question. Up to now, after twenty years of experience and tens of thousands of samples and criminal proceedings, no case has ever been dismissed from court because the samples were sent to the laboratory through a courier service. Quite the contrary, the courts have shown their support for this method of transport, provided that good written documentation exists showing all the steps taken along the way from the crime scene to the laboratory, and as long as the seals and warranties have not been broken. Something similar can be asserted with regard to the second question. It should be noted that no case, no matter how relevant, is more important than the safety of the acting officers. This means that acting officers must never jeopardise their own integrity or be unnecessarily exposed to toxic compounds or physically hazardous situations, as is often the case when collecting samples (carcasses) on cliffs and rock walls. Under these circumstances, legal procedure stipulates that the work can and should be performed by qualified professionals, always constantly accompanied by law enforcement officers who can, at all times, certify and bear witness to the fact that the activity took place under their direct supervision. Although many police forces now have specialised units, such as the Rope Access Unit of the Autonomous Government of Andalusia, sometimes civilian experts must be brought in urgently, and their participation is always valid under the circumstances explained here (photos 15.7).

Photo 15.7 Rope Access Unit of the Autonomous Government of Andalusia.

In the specific case of animal poisonings, the products used in poisoned bait are usually highly toxic insecticides. In general, any food item found in nature must lead to the suspicion that it could be poisoned bait. We must avoid handling them, not only because it could alter the sample but also because of the hazard it could pose to our health. Oftentimes, curiosity instinctively leads us to touch a sample too much or even to smell it; it is almost inevitable. However, we do not know whether the object we are handling is highly toxic or not. Let us recall that most of the toxic compounds used in Europe and Africa to prepare poisoned bait have a significant volatile fraction, e.g. evaporating gases. For this reason, never smell samples, especially if there is a suspicion that they may contain poison of any kind.

In general, some products used as poison, such as aldicarb or carbofuran pellets, are easy to identify and it is well-known that care must be taken in handling them. However, there are other even more toxic substances that do not have such a distinctive appearance as aldicarb. For example, material shaped like little yellowish-white stones could come from certain low toxicity pesticides (such as conventional carbaryl or methiocarb), but it could also be strychnine (photo 15.8), one of the most mortal poisons known. These latter are not at all familiar to agents operating in certain regions, but they are in others.

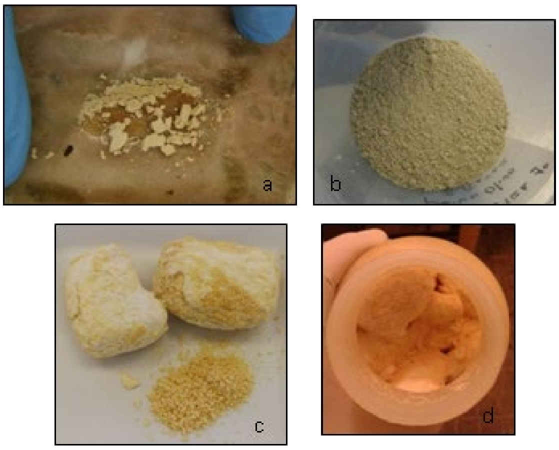


Photo 15.8 Confiscated strychnine samples.

It is very important to collect all the samples found (e.g. dead animals, bait, etc.) and any evidence such as resources and utensils allegedly used or possible offenders' signatures. It is important to completely collect all poisoned bait, not just because it could constitute a crime stipulated in the Criminal Code, but also because collecting all the bait can prevent further animal deaths (chain reaction poisoning) and risks to human health.

Packaging and labelling

Packaging and labelling samples is an especially important procedure which enables the laboratory to analyse exactly the same thing, under the same conditions as those found in the field. Mishandled samples can lead the potential poisons to deteriorate or to fall out during transport, fingerprints may be lost or the DNA on the samples may deteriorate. Agents may unknowingly have collected a sample containing DNA that provides the key to solving the case and identifying the perpetrator of the crime, as has proven to be the case increasingly. In relation to DNA samples, improper packaging causes the denaturation and subsequent deterioration of the double strands of nucleic acid, rendering them unusable in the laboratory. The same can be said of fingerprints and cartridge cases of ammunition of any kind.

After they are correctly packaged, they must be marked

- Individually catalogue and package the clues, endeavouring to maintain the integrity of each one. Avoid crushing or altering their original shape, which often happens when trying to fit numerous samples into a single container or drum (photos 15.9).

Photos 15.9 All the samples must be properly sealed and marked.

- The reference number on each sample is the same one used in the carcass removal record and in the chain of custody (photo 15.10).

Photo 15.10 The custody record must indicate the same code as that shown in the removal record.

- A detailed description of each sample will be included in the sampling record. Therefore, it is only necessary to assign each piece of bait, carcass or other samples (cases, items touched by the suspect, etc.) a number, provided that the same number is then used in the record, along with the detailed description of each sample. However, if the containers provided for storing evidence are equipped with spaces for writing, these spaces must be filled in (photo 15.11).

Photo 15.11 Whenever there are spaces on containers, they must be filled in.

Clearly, a carcass is not the same as bait or other types of samples, so we have drawn up a table for reference about the most important things to bear in mind for each type of sample, how to package them, the recommended amounts and other details of interest in the “remarks/sample use” column (Table 15.1).

The procedures to be followed for the samples most commonly found in our work are detailed below:

- Poisoned bait: wrap each one in aluminium foil (do not use plastic, especially if poisons are observed on the outside of the bait, as this could interfere with the toxicological tests) (photo 15.12), and put it into a sealed plastic bag or jar (one per piece of bait) (photo 15.13). Number each container and put it in a bag (photo 15.14 and 15.15). Si se recogen varios en el mismo lugar pueden introducirse en la misma bolsa para su remisión al laboratorio, aunque cada uno en su bote correspondiente. Debe congelarse antes de remitirlo o mantenerlo en su defecto en lugar más fresco posible para evitar degradación del tóxico.

Table 15.1 Guidelines for packaging samples

SAMPLE	PACKAGING	QUANTITY	OBSERVATIONS/ PURPOSE
Carcasses, skeletal remains, soil under carcasses	Double bags within drums	All	Cause of death, toxicology. Other analyses.
Bait	Aluminium foil within hermetically sealed containers	All	Collecting them all will prevent the death of other animals.
Vomit (sometimes vomited bait)	Aluminium foil within hermetically sealed containers	All	Toxicology. It contains large amounts of ingested toxic substances if it is produced within 3-4 hours of ingestion.
Dirt (natural environment, vehicle floor mats, shoe soles, etc.)	Hermetically sealed containers		Relationship between the place of appearance of a carcass and the suspect
Bullet shells or cartridges	Sealed paper bags, NOT plastic bags (to avoid moisture)	Each shell individually	Ballistics, fingerprints and/ or DNA
Liquid compounds	Hermetically sealed containers	All that is found or a representative part of it	Send a photograph of the original packaging in which they were found.
Solid compounds (powders, granulates)	Hermetically sealed containers	All that is found or a representative part of it	Send a photograph of the original packaging in which they were found.
Hair from leghold traps, snares, cage traps, wire fences, feathers from mist nets, etc.	Sealed paper bags, NOT plastic bags (to avoid moisture)	All that is found	Species identification. Offenders' signatures in snares. Other analyses.
Entomofauna	Hermetically sealed containers	Toda la que se encuentre	Búsqueda de venenos.
	In alcohol 70% if alive	Representation of larvae, flies, beetles.	When determining the cause of death is necessary
Soda cans, cigarette packages, wrappers or poison containers or jars	Poison detection.	Recoger por los bordes, nunca donde sea posible que haya huellas.	Huellas dactilares. Señales de autor.
Blood found on knives, stones, traps, inside cars, etc.	Scraping with a cotton swab (as used to clean ears). Box or paper bag (to avoid humidity)	As much as possible. If it is very dry, moisten with clean water (not contaminated with animal DNA)	Genetic species identification. Other analyses.
Gloves	Hermetically sealed containers	If more than one, collect separately.	Toxicology, fingerprints, DNA
Cigarette butts	Sealed paper bags, NOT plastic bags (to avoid moisture)		Genetics, fingerprints, offenders' signatures.

Photo 15.12 Bait must be collected in aluminium foil.

- Toxic compounds: Poisons are often found during inspections (jugs, bags, bottles, etc.), either in their original containers or –usually– in secondary packaging, mainly in enclosed spaces. These compounds must be collected and, if found in large quantities (sacks, large jugs, etc.), just one part must be sent to the laboratory for analysis. A sealed jar must be used for this purpose (photo 15.16). Number it, place it in a bag and seal it.

- Carcasses: regardless of whether the carcass is fresh or skeletonised (photos 15.17), it must be placed in double packaging, i.e. the carcass is first placed in a bag (photo 15.18) (one per carcass), which is in turn placed in another bag to prevent accidental leakage of liquids due to the decomposition of the carcass. Never place a carcass directly in the large transport drum (photo 15.19). Number and seal it. It must be frozen before being sent to the laboratory or, in absence of this, kept in a place that is as cool as possible.

Photos 15.13 Each sample must be placed in a jar.

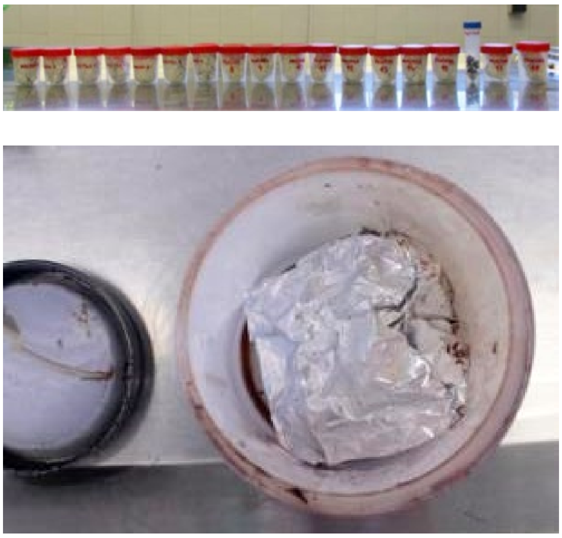


Photo 15.14 Bag with several pieces of poisoned bait and seal it .

Photo 15.15 The bag containing the samples must be sealed.

Photo 15.16 Samples of poisons must be placed in sealed jars.

Photos 15.17 Examples of fresh and skeletonised carcasses.

If leftover bits of bait or vomit are observed in the mouth (photo 15.20), we recommend collecting them in aluminium foil and then placing them in a sealed jar (same procedure as for bait). The head may also be wrapped in aluminium foil, thus preventing us from handling any leftover bits in the mouth.

Photo 15.18 Sequence for correctly packaging carcasses.

Photo 15.19 A carcass must never be placed directly in a drum.

Photo 15.20 If bait is found in the mouth, collecting it separately from the carcass is recommended.

- Soil samples: if substances suspected to contain poison are observed on the ground (such as bits of vomit or poisons) or if soil is needed for chemical testing comparing substrates and material collected from the suspect's shoe soles, place the material in a sealed jar and number, package and seal it. When a layer of decay has formed under the carcass, collecting samples of the soil underneath the carcass is also recommended, up to 5 cm in depth. This makes it possible to detect any remaining poisons (photo 15.21). In cases where the animal has been shot, a metal detector can even be used to find shells that have fallen from the carcass as it decayed (photo 15.22).

Photo 15.21 Collection of soil samples .

Photo 15.22 The use of metal detectors can help find ammunition traces in soil samples.

- Entomofauna: entomofauna devours the carcass, making it a very important sample for toxicological analysis because it may contain the poison ingested by the animal. In the event of other causes of death such as shooting, this is also essential because it is the only means of dating the time of death. All or a sample of entomofauna shall be collected (photo 15.23) in a sealed jar with diluted alcohol (photo 15.24), which is then numbered, packaged and sealed.

Photo 15.23 Entomofauna is another valuable sample to be collected.

Photo 15.24 Entomofauna must be placed in a jar with diluted alcohol.

- Vomit: this should be handled in the same manner as bait because that is exactly what it is, from a toxicological perspective; place it in a sealed plastic bag or jar. Number each container. Number it, place it in a bag and seal it. It must be frozen before being sent to the laboratory or, in absence of this, kept in a place that is as cool as possible.

- Samples of fur found in traps, snares, etc., for identification of the animal species (photo 15.25). As with all samples sent for DNA testing, they must be protected from moisture and heat, the main enemies of DNA, which can break down the double strands of nucleic acid in a very short time. These samples must be sent in paper envelopes (manila paper) because the static electricity of plastic bags alters the molecular structure of the DNA.

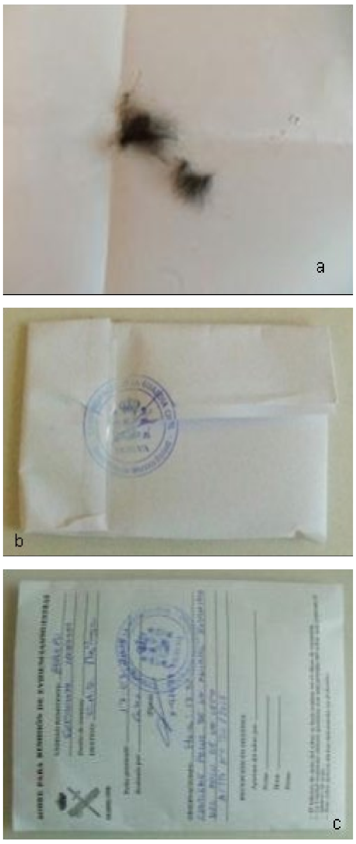


Photo 15.25 Fur is another sample that must be collected correctly.

- Blood samples found on any surface (knives, traps, spikes or clubs used to kill trapped animals, found inside vehicles or on any other support) for identification of the animal species (photo 15.26). In this case, samples should be taken with a swab and, if the blood is dry, moisten the swab slightly (just enough for it to soak up the dry blood). Let it dry and place it in a cardboard wrapping with all the sample details.

Photo 15.26 Collecting blood samples.

- Specific forensic samples. These are any samples that can only be analysed and processed by forensic laboratories of the judicial police department in many countries in the European Union, since each laboratory must be certified in its respective network. We are referring to dactylographic samples (palm-, finger- and footprints), human DNA and ballistics. Contrary to what one might imagine, in Spain the most active forensic laboratories, which process the greatest number of samples per year in crimes against biodiversity, are not those run by the police forces but rather those pertaining to government bodies in charge of environmental matters such as the Centre for Analysis and Diagnostics (CAD) of the Autonomous Government of Andalusia, or to the Spanish national government, as in the case of the laboratory of the Research Institute for Hunting Resources (IREC). In these cases, for procedural reasons neither the CAD nor the IREC have access to the dactylography, human DNA or ballistics databases, nor are they authorised (although they are equipped) to process these samples. For this reason, samples that fall into this category collected by agents of any police force must be sent to the respective forensic laboratories of the judicial police department.

As mentioned before, these are just some of the numerous possible samples. The table enclosed Table 14.1 contains a longer list of samples (plants, bullet shells, beverage cans, bits of cigarette packs, gloves and other types of samples), details on how to send them and the types of testing most often performed on them.

Sending samples to the laboratory in accordance with valid legislation on the transport of hazardous toxic/biological substances

To prevent samples from deteriorating it is very important to recall that they must all be frozen as quickly as possible prior to transport, especially where there is a suspicion of poisoning (carcasses, bait and vomit), as mentioned above. Most pesticides used as poison deteriorate quite quickly, for example. Freezing can prevent this, managing to halt the process of decay so that the laboratory is more likely to be able to detect the poison. Should you have any questions in this regard, contact the laboratory.

Why is it so important to follow these simple rules?

The answer is also simple, but convincing. There are rules and regulations in force, in Spain at least, that regulate the transport of hazardous toxic or biological samples. Many of the samples sent to the laboratory contain poison and some of the carcasses may even carry pathogens. The agent must bear in mind that most of the drums containing these samples are sent to the laboratory via courier services or taken by the agents themselves. Both the samples and the pathogens could have an impact on the people carrying out the transportation. We must remember that most of the samples sent are carcasses found in the field, many of which died from viral pathogens, bacterial toxins or mere poison, and all of these cases are hazardous to humans. It is not rare for blood, decomposition liquids and worms to rub off the drums onto the vehicles, whether our own or those of the courier service. If the acting officer does not comply with these legal provisions for shipment, other individuals may be harmed or even get sick due to malpractice. Unfortunately, forensic laboratories have received reports of cases that illustrate this matter.

As mentioned above, the steps to be taken to avoid this are quite simple. Specifically, the requirements for packaging and transport of toxic/infections substances, category B, in accordance with Instruction P650 of the valid European legislation, shall apply, as follows:

- All samples sent must be placed in well-sealed thick double bags which are then placed in an airtight container (photo 15.27).

Photos 15.27 Samples must be sent in double bags and in airtight containers.

- The container must have some kind of absorbent material at the bottom in the event of leakage. Paper towel may be used for this purpose, for example (photo 15.28).

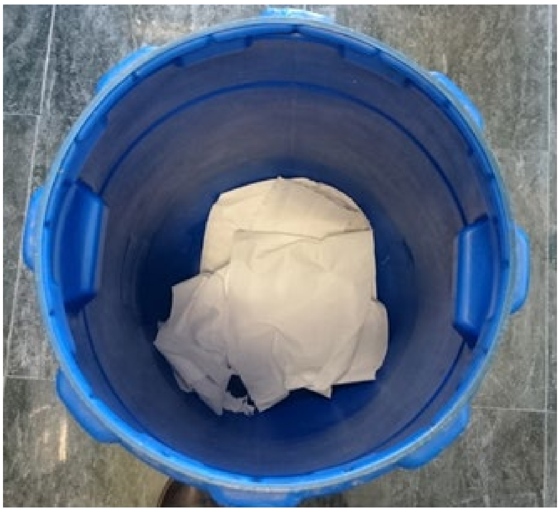


Photo 15.28 Placing absorbent material in the bottom of the sample drum is recommended.

- On the outside surface of the container, a white diamond-shaped sticker must be displayed that indicates the hazard classification of the substance it contains and another sticker indicating "Exempt animal specimen" when there is minimal likelihood that pathogens are present (photo 15.29).

Photo 15.29 The Exempt Animal Specimen sticker is used when there are samples with a minimal likelihood of containing pathogens.

Both the green bags and the container must be properly sealed (photo 15.30). These seals must also be indicated in the record and chain of custody that will accompany the samples.

Photo 15.30 Samples sent must be properly sealed.

The agent must not forget to send the records and documentation relating to the chain of custody. These must be attached to the outside of the drum (photo 15.31), never inside the drum; more than once this documentation has "disappeared" due to the effects of decomposition liquids or the action of maggots (photos 15.32).

Photo 15.31 The chain of custody record must be attached to the transport drum.

Photos 15.32 The chain of custody record must not be placed inside the transport drum, to prevent it from being damaged.

The records shall be placed on the outside, but folded and inserted into an envelope so that they cannot be read or damaged during transport (photo 15.33). These data cannot be disclosed to the public as they could be used to interfere with our investigations; moreover, data protection regulations require civil servants to safeguard the private information of citizens.

Photo 15.33 In the photo we can see the record in plain view, indicating that a griffon vulture is sent, description of the finding site, exact location, etc.

Acting officers must be familiar with these regulations, which aim to:

- Guarantee the protection of the acting officer.
- Prevent third-party exposure to biological and toxicological risks.
- Ensure that police procedures are impeccable in relation to laboratory procedures.
- Provide legal safeguards in forensic procedures on samples sent by environmental police officers.

Samples that are sent without complying with valid laws in this regard should not be processed by laboratories.

16. DETERMINING THE DATE OF DEATH AND FORENSIC ENTOMOLOGY

Basic knowledge about the essentials of forensic entomology is a highly important tool in the daily work of law enforcement officers investigating crimes against fauna. There are two reasons for this: on the one hand, if we are to gather proof that places a possible suspect at the scene of the crime at the time it took place, we need to have a clear idea of when the unlawful act under investigation took place. On the other, the dating process itself and the additional information provided by the arthropods comprising the cadaver fauna can significantly help us identify the individuals at fault. In this chapter, we will learn some basic concepts about forensic entomology, which is the scientific field devoted to determining the date of death of vertebrates based on the type of arthropods that inhabit the carcass at a given time.

Our intention here is not to provide training to become experts in this field, however, as this is a complex discipline that requires many years of experience; not in vain, forensic laboratories are tasked with issuing the final official reports in this regard. The aim of this chapter of the manual is to introduce a fundamental tool for gaining an in-depth understanding of the contents of field investigations, thus providing a greater volume of samples/clues/evidence and information in our reports and statements. Furthermore, comprehending these basic notions will, without a doubt, help us steer the CSIs conducted in the right direction and more precisely identify the true causes of death of the wildlife specimens we find in nature.

Thus, this chapter will address the basic notions of what is technically known as *chronothanatodiagnosis*, the science of estimating the time of death. The cornerstone of this entire discipline is called the post-mortem interval, which is the period of time elapsing between the moment of death and the discovery of the corpse.

Stages of decomposition

After a living being dies, a series of physical and chemical reactions occur in the body, caused by both intrinsic and external factors that spark the process of decomposition.

Based on the external features displayed by carcasses as this process advances, we can come up with an estimate of the time of death.

The generally accepted stages of decomposition of the body are as follows:

- Fresh, or chromatic, stage: This is deemed to span from the moment of death until the time at which the gases prompted by internal chemical reactions cause the body to start to swell. It may range from 1 to 3 days. So-called "green stains" appear over the right iliac fossa and blood vessels begin to be outlined through the skin due to the oxidation of blood haemoglobin. This greenish discoloration begins around 24 hours after death and spreads throughout the entire body in more or less one week. Some scholars divide this stage into two parts, with the faster signs of decomposition (rigidity, drop in temperature, lividity) occurring in the first part and green discoloration in the second (photos 16.1).

- Bloated, or emphysematous, stage: This stage spans from the time gases begin to accumulate until the pressure from the gases on the tissues, or the action of necrophagous insects, leads the organism to rupture, at which time the body deflates. This period may last from 2 or 3 days after death up to 10 days (photo 16.2).

Photos 16.1 Carcasses in fresh, or chromatic, stage.

Photos 16.2 Animal carcass in emphysematous state.

- Active decomposition, or colliquative, stage: This is the phase in which the larvae of necrophagous insects are most active. It begins with the release of the gases generated inside the organism and ends when the larvae have no more resources in the carcass to feed on, prompting them to leave the body and develop into pupae nearby. The skin and nails easily detach and a dark greenish liquid is also observed purging from the orifices of the body. The tissues are transformed by the action of the necrophagous insects into a substance called putrefactive liquid and lose their normal shape. This period spans from 10 to 20 days after death, approximately (photos 16.3).

Photos 16.3 Carcasses in decaying condition.

- Advanced decomposition, or post-colliquative, stage: This period is deemed to last from the moment at which there are no more larvae feeding until the time at which the only remains of the carcass are a mass of indistinguishable dry tissues, cartilage and bones. Some scholars treat this as the latter part of the previous period. It may last up to 2 months after death (photo 16.4).

Photo 16.4 Carcass in advanced state of decomposition.

- Skeletal stage: This consists in the complete disappearance of all soft tissues. It may span a period of 2 to 5 years (photos 16.5).

Photos 16.5 Carcasses in skeletal stage.

These are not exact periods; they may be influenced by numerous factors, such as environmental conditions or cause of death. Decomposition is accelerated by increases in temperature and ambient humidity. For example, a body will decay more quickly if it is exposed to the sun than one placed in the shade at the same location. Wind may delay carcass decomposition processes, usually in relation to a drop in temperature. In warm, very dry, places, desiccation occurs quickly, and the corpse's tissues take on a leathery appearance in a short period of time. Regarding the cause of death, decomposition is accelerated in processes that entail an increase in body temperature, such as infectious processes. On the contrary, bodies decompose more slowly under chronic debilitating conditions, dehydration, anaemia, etc. The existence of external wounds on the body facilitates entry for necrophagous insects, thus accelerating the process.

Decomposition processes are altered in water, as is the typical cadaver fauna. In general, submerged bodies take longer to decompose. Variations are also observed in relation to the water type. Due to its saline content, salt water tends to draw the water out of the organism's cells, causing dehydration of the body and thus delaying decomposition. In these cases, the boundaries between the stages are even less well defined due to the numerous factors that could be involved, including the almost complete absence of necrophagous insects.

The generally accepted stages of decomposition of submerged bodies are as follows:

- Chromatic period (submerged fresh body). The aquatic fauna typical of the site (small molluscs, crustaceans and leeches) are present on the carcass.

- Emphysematous period (early floating). The body floats to the surface of the water due to the accumulation of gases. The usual fauna are present on the exposed part (insect larvae, molluscs and crustaceans).

- Initial dissolution period (floating decay). The skin is pierced by aquatic fauna (fish and leeches).

- Terminal dissolution period (bloated deterioration). Tissue is lost, becoming detached from the carcass. Aquatic fauna (fish, freshwater amphibian tadpoles).

- Floating remains period (fragmentation). Joints lose their stability and become detached from the tissues.

- Sunken remains period. The gases remaining in the tissues rise to the surface while the remains sink to the bottom.

External signs of decomposition

During the early hours after death, approximately between the fresh period and the colliquative period, a series of events or external characteristics can be observed which help to establish the moment of death or post-mortem interval. These characteristics are:

- Rigor mortis (stiffening of the body): This sets in about 4-5 hours after death and lasts for some 2 or 3 days. Stiffness begins in the head region and progressively extends to the rest of the body, dissipating in the opposite direction. There are factors that may alter this process, such as body temperature at the time of death, ambient temperature (heat shorten the stiffness phase, whereas cold prolongs it), the cause of death (onset is faster in convulsive processes, slower when there is severe haemorrhaging and less intense in the presence of chronic disease), etc.

- Post-mortem lividity: When death occurs and blood stops circulating, the effects of gravity cause the blood to settle in the lower regions. This process is characterised by pinkish or bluish areas of discoloration, which is harder to observe on animals under their fur or feathers. It begins to occur as early as approximately one hour after death and, in addition to being useful for determining the moment of death, it is also important in terms of establishing whether the carcass has been moved (the signs of early lividity remain even after the position has changed).

- Drop in body temperature: After death, the temperature of the body begins to drop, tending to match the ambient temperature within about 24 hours. In general, a drop of 0.5-1ºC per hour is estimated until a balance is reached with the ambient temperature. Rectal temperature is normally taken for reference. It is important to understand the normal temperature for each animal species, which may vary considerably. This drop in temperature may be affected by other factors such as pathological processes (fever, hyperthermia) or physiological factors (reproductive status, fatty layer).

- Corneal opacity and sunken eyeballs (Stenon Louis sign): The eyeball surface grows dull and becomes whitish (corneal opacity). The eyes sink into the socket due to desiccation and the relaxation of the muscles adhered to them. This phenomenon may appear around 45 minutes after death if the eyes are open, but can take up to 24 hours if the eyelids are shut.

As time passes after the moment of death, it becomes increasingly difficult to establish the post-mortem interval based on the external characteristics of the carcass. Beyond 72 hours after death, the use of forensic entomology becomes much more relevant, and it is often the only tool available to us.

Necrophagous insects and insect succession. Examples based on ambient conditions

Forensic entomology is based on the study of the community of arthropods, mainly insects, found on carcasses. Due to their biological and physical characteristics, they can give us a more or less accurate idea of the date of death.

A wide range of necrophagous insect species are attracted to carcasses selectively, depending on their stage of decomposition.

In recent years, numerous studies have focused on insect succession models on cadavers and the species that are most often involved in these processes. All these studies were conducted under controlled conditions.

In practice, we must bear in mind that there are numerous factors affecting insects and their biological cycles in the carcass, and most times we are unaware of these factors.

The body of published literature contains studies conducted in certain regions of Spain at different times of year and under diverse conditions (sun/shade, different types of terrain, etc.). Some examples of the variations that may occur in insect development depending on ambient conditions are described below.

Temperature is a critical factor for most insects. Within the *Calliphorida*e family, the *Lucilia* and *Chrysomya* genera cannot withstand low temperatures (they do not develop under 15ºC). All other genera and other families of the Diptera order can develop, but much more slowly. Therefore, in Sierra Nevada (in the Spanish province of Granada), for example, at an altitude of 3,000 m and an average annual temperature of 20ºC, where temperatures normally only exceed 15ºC on average during the summer months, insect activity is much more limited than in other locations.

Thus, for example, larval development of *Chrysomya albiceps* (from egg hatching to cocoon formation) may be completed in 13 days during the summer in Sierra Nevada (average temperature 20ºC), or in 5-6 days in warm regions of southern Europe (average temperature 30ºC).

There are also variations between the seasons of the year at a single location, so in warm regions of southern Europe, for example, *Lucilia sericata* can complete its biological cycle in 22 days in spring (average temperature 18ºC), whereas in summer (average temperature 27ºC) it does so in 13 days.

In addition to ambient conditions, which clearly affect insect development, other factors must also be considered. Insects may be delayed from reaching the carcass (if the carcass is covered up, for example, or in an enclosed space or surrounded by water, all of which are conditions that hinder the arrival of insects), or their arrival may be accelerated (presence of open wounds, unsanitary conditions, etc., which enhance the odour stimuli that attract insects).

Therefore, the agent must provide any additional information possible that could help the specialised forensic laboratory establish the post-mortem interval more precisely; we can only endeavour to estimate this detail if we have gathered all possible details.

Insects related to cadavers can be classified in several manners. Based on their habits, we can distinguish between:

- Strictly necrophagous species, which feed on cadaveric remains.
- Predator species, which feed on the former.
- Omnivorous species, which feed on decomposing tissues and also on necrophagous species.
- Incidental species, which find the cadaver accidentally, are species that normally live in the place where the cadaver is located. Some of these species are important when there is a suspicion that the carcass has been moved, since they are typical of a certain type of habitat.

Another classification, which proves more useful for determining the post-mortem interval, was that established by Megnin, a pioneer in forensic entomology research, in 1894. He classified insects in waves, which he referred to as "squads of death" (Table 16.1).

Subsequent research has concluded that these insect waves are not very precise in practice.

Two tools are primarily used to establish the post-mortem interval of a cadaver by means of forensic entomology:

1. The degree of development of necrophagous insects: This is mainly used in the early phases of decomposition (fresh period or emphysematous period). The different development phases are used, normally dipteran larvae, which are first insects to colonise the carcass. To determine larval age, specific features must be observed that can only be seen in the laboratory with the help of a binocular magnifier, but in the field this detail can be estimated by noting larva length and type (based on certain macroscopic details, an estimate can be made of the group to which it belongs).

Table 16.1. Waves of insects related to the stage of decomposition according to Megnin

WAVE	STAGE OF DESCOMPOSITION	SPECIES RETRIEVED
One	Fresh or chromatic	Diptera *(Calliphoridae, Sarcophagidae)*
Two	Emphysematous (cadaver odour)	Coleopterans *(Dermestidae)*
Three	Colliquative (fat decomposition)	Coleopterans *(Dermestidae),* Lepidoptera Diptera *(Phoridae)*
Four	Colliquative (protein decomposition)	Diptera *(Piophilla, Fannia)* Coleopterans *(Necrobia)*
Five	Colliquative (ammonia decomposition)	Coleopterans *(Histeridae, Silphidae, Staphilinidae)*
Six	Post-colliquative (cadaver desiccation)	Mites
Seven	Skeletal (mummification)	Coleopterans *(Dermestidae)*
Eight	Disappearance of the remnants of previous waves	Coleopterans *(Ptinus brummeus, Trox hispanus and Tenebrio obscurus)*

2. Insect succession in the carcass: This is used at more advanced stages of decomposition. It is based on the knowledge of the biological cycle of different insect species that colonise carcasses and their succession according to the decomposition stage.

We must understand that forensic entomology is a complex science. To estimate the moment of death, it is not enough to merely examine the rate of larva development or to determine whether one or more generations of insects have developed in the carcass. It is necessary to know which specific species is concerned, because each species has its own biological cycle, which develops under certain conditions and is attracted by the carcass at one or more stages of decomposition. This could be complex and require lengthy study. Therefore, the best response is to take note of every detail (temperature, shapes observed on the carcass, etc.), create a detailed photographic report and send the samples to the laboratory for thorough investigation.

However, in the field we can still come up with an idea of the date of death that, while not very precise, can be quite useful.

The first thing to understand is necrophagous insect development. The biological cycle (photo 16.6) of most of these insects begins when adults lay eggs in a suitable place where there is food for the larvae (in this case, the tissues of a decaying carcass), the eggs hatch and the larvae that emerge feed for a certain amount of time (on the tissue or on the larvae of other insects, depending on the species). Once they are completely developed, pupation takes place (formation of the pupa or chrysalis), during which time they are transformed into adult form (metamorphosis) and, finally, they emerge as adults from the chrysalis and the cycle begins again.

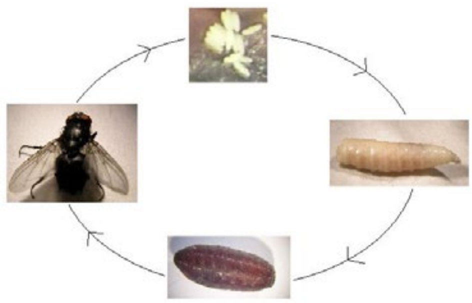


Photo 16.6 Biological cycle of insects.

Whenever we come across a carcass, we need to take note of all the arthropod forms found on it: eggs, larvae, pupae (chrysalises) and adults. This enables us to determine whether more than one generation or cycle of insects of one or more species has developed, comparing these data to fauna succession models published for similar ambient conditions.

It is essential to understand the insect succession that normally occurs on carcasses:

The first insects to reach the carcass are Diptera (flies). They are attracted by the gases given off by the carcass with the onset of decay processes. These insects are quite sensitive and have the ability to reach the carcass long before the odour is noticeable to humans. Their arrival depends greatly on ambient conditions, but at an average temperature of 25ºC, they are estimated to arrive within about two hours after death. The *Calliphoridae* and *Sarcophagidae* families are among the first Diptera to reach the carcass (photo 16.7). The latter family is observed mainly during the summer months. The two families do not usually coincide on the same corpse because *Sarcophagidae* larvae are predators of the *Calliphoridae*, although they do coincide when the animal is wounded while still alive, and it is even possible to date the time at which the wounds occurred. The most commonly found species of the *Calliphoridae* family in Spain, in any season, are *Calliphora vomitoria* (photo 16.8) *Chrysomya albiceps* (photo 16.9) are observed mainly in warm ambient conditions, as are *Lucilia sericata* (photo 16.10), which stop developing when the temperature drops below 15ºC. These two species are hard to distinguish macroscopically.

Photo 16.7 *Sarcophaga carnaria.*

Photo 16.8 *Calliphora vomitoria* specimen .

Female Diptera in the *Calliphoridae* family usually deposit their eggs in the carcass' natural cavities (photos 16.11), because the tissues in these areas are softer and, as such, more suitable for feeding the larvae. If the carcass has open wounds, eggs may also be laid there. The eggs measure some 2 mm in size and hatch between 24 and 72 hours after being laid, depending on the species and ambient temperature. Female *Sarcophagidae* deposit previously formed larvae directly on the carcass.

Photo 16.9 *Chrysomya albiceps.*

Photo 16.10 *Lucilia sericata*.

Photos 16.11 *Calliphoridae* family Diptera generally deposit their eggs in the carcass' natural cavities.

The larvae born are usually white in colour, cylindrical shape and apodous (lacking legs), although larvae belonging to the *Chrysomya* genus may display a kind of fleshy process on the cuticle (which could be mistaken for legs but this is obviously not possible). They feed on the carcass' tissues (photos 16.12), and develop throughout the course of three larval instars (larva I, II and III). Larva instar III, in its final stage, is known as the wandering stage because the larvae stop feeding and disperse toward certain areas inside or outside of the body (skin folds, for example) to evolve into pupae (chrysalises). As a general notion, at a temperature of 20-25ºC, larvae instars I and II are present on the carcass between 2 or 3 days after death. Larvae at instar III continue feeding on days 3 to 5 and begin migrating on days 5 to 9 (wandering stage).

As mentioned above, there are generally two types of dipteran larvae that can be observed on recent carcasses. The tables shown (Table 16.2) (photo 16.13) provide an estimate of larvae length, larval stages and post-mortem intervals based on type and at a temperature of 20-25ºC.

Photos 16.12 Larvae belonging to the genus *Chrysomya*.

Photo 16.13 Legless and smooth larvae (other genera of *Calliphoridae*).

As long as there are dipteran larvae on the carcass, other insects that feed on them will be present, such as Hymenoptera (in the wasp family) and some families of Coleoptera (beetles), mainly in the *Staphylinidae* (photo 16.14), *Silphidae* (photo 16.15) and *Histeridae* families (photo 16.16).

Photo 16.14 Coleoptera in the *Staphylinidae* family.

Photo 16.15 Coleoptera in the *Silphidae* family .

Photos 16.16 Coleoptera in the *Histeridae* family.

Most striking among these coleopteran species are those of the *Thanatophilus* genus (*Silphidae* family). They appear on the carcass early on, starting at 5-6 days after death, and their larvae can be observed starting at around day 10. Due to their early development when compared with that of other Coleoptera,

Table 16.2. Apodous larvae with fleshy processes (genus *Chrysomya*)

LARVAL STAGE	LENGTH	DAYS
L I	0-2 mm	1-2
L II	2-4 mm	2-4
	6 mm	4-5
	6-8 mm	5-6
L III	8-10 mm	6-8
	10-13 mm	8-9
Wandering L III	13-15 mm	9-13

Table 16.3. Smooth apodous larvae (All other genera of *Calliphoridae*)

LARVAL STAGE	LENGTH	DAYS
L I	0-3 mm	1-2
L II	3-6 mm	2-4
L III	7-11 mm	4-6
Wandering L III	11-13 mm	6-9

several studies have been conducted on this species, relating larvae size to the time elapsing after death, as is also common with Diptera.

As a result of this food source, large numbers of these insects can be found during the emphysematous and colliquative stages, at which time large larval masses develop. As these larvae complete their development and begin to pupate, near the end of the colliquative stage, the population of these predators starts to decline.

Diptera pupae (photo 16.17) can be observed from days 7 to 15 after death. During this phase, the insect develops into its adult form. Pupa formation may be accelerated by several factors including cases in which there is a sharp drop in ambient temperature, when food becomes scarce or when the larvae are diseased (which may be the case if the animal died as a result of insecticide poisoning or if parasitoid larvae are present). In these cases, the larvae try to pupate as quickly as possible to protect themselves and reach adult phase sooner, when they are less vulnerable. In most of these cases, metamorphosis cannot be completed because the larvae have not ingested the necessary quantities of food required to withstand the enormous expenditure of energy entailed in transformation.

Photo 16.17 Diptera pupa.

After day 10, always depending on the ambient conditions and species, open, empty pupal casings can be observed on the carcass (photo 16.18) as well as adults emerging from them (photo 16.19).

Photo 16.18 Empty Diptera pupal case.

Photo 16.19 Adult Diptera emerging from pupa.

All carcasses should display signs of the presence and passage of these insects. If this is not the case, it would lead us to suspect that the corpse has been moved, that it has been concealed to prevent insect colonisation or even that it has been soaked in insecticides or other products such as arsenic, lead or formaldehyde, which repel these species.

As mentioned above, we must bear in mind that these time spans only refer to the first generation of Diptera. As long as the carcass continues to be a food supply, or in other words as long as there are still decaying tissues, the adults that emerge will in turn place more eggs or larvae and the cycle will continue. Therefore, it is important to observe all the phases of development found on the carcass, taking the most advanced form as reference. For example, if we find larvae and closed pupae on the carcass, we should take the pupae into consideration as the most developed stage, thus more accurately reflecting the post-mortem interval. If we find larvae and open pupa casings, we should bear in mind that the larvae could be first or second generation, which complicates the assessment.

Another important coleopteran group is the *Dermestidae* family (photo 16.20). They are often observed on carcasses between days 8-10 and 18-20, sometimes even later. Their appearance coincides with the decomposition of fat (butyric fermentation) because they feed on the waste generated during this process. Their numbers increase visibly during the active and advanced decomposition stages, declining afterwards.

Photo 16.20 Coleoptera in the *Dermestidae* family.

Adult *Dermestidae* lay their eggs on the carcass' remaining tissues, and the eggs hatch 3 to 12 days later. The larvae (photos 16.21), which are easily recognised because they have a thick coating of hair, are cylindrical in shape, have visible legs and feed off of the dry tissue remains. One useful piece of information for dating is that adults and larvae of this species coincide for a very short period of time on the remains. Depending on the season, this happens around day 14 (summer) and 33 (winter) after death.

Lepidoptera (butterflies) are also drawn to the rancid odour of decaying fat. They lay their eggs in several waves, more or less at the same time as the *Dermestidae*. The larvae colonise the interior of the body and feed on the remains for about one month. Then they emerge and transform into chrysalises, remaining in this phase for about 20 days if the temperature is mild or until the following spring, if not.

After that, protein decomposition takes place (casein fermentation), attracting other dipteran genera such as the *Piophila* (photo 16.22) or the *Fannia* (photo 16.23), and also coleopterans like the *Necrobia* (*Cleridae* family) (familia *Cleridae*) Foto (photo 16.24). This happens some 20-25 days after death.

Photo 16.22 *Piophila* dipteran .

Photo 16.23 *Fannia* dipteran.

Photos 16.21 *Dermestidae* larva.

Photo 16.24 *Necrobia* coleopteran (*Cleridae* family).

Next, ammonia fermentation occurs, drawing other insects, especially coleopterans like the *Necrophorus* (photo 16.25). Other coleopterans in the *Nitidulidae* family are sometimes observed (photo 16.26).

Photo 16.25 *Necrophorus* coleopteran.

Photo 16.26 *Nitidulidae* family coleopterans.

After these stages, there are many species that can be identified on the carcass remains, both living species and their remains. This complicates estimations of the PMI quite a bit, making the dating process increasingly inaccurate. Another factor that hinders our work is, once again, the lack of data on the ambient conditions found at the site of the finding for an increasingly prolonged period.

At the stage in which the remains begin to disappear, about 3-6 months after death, large numbers of mites can be found on the carcass. Most of them are not visible at macroscopic level, so a magnifying glass must be used for this purpose, or samples (tissue remains and samples of the soil under the carcass) must be sent to the laboratory. *Dermestidae* larvae are also observed, feeding on the dry tissue remains. There are also remains of the arthropods that previously colonised the carcass.

Starting about one year after death, only the bones of the carcass are left, along with the remains of the different arthropods that colonised it. Sometimes, certain species of coleopterans can be observed feeding on these substances, such as those in the *Tenebrio* (photo 16.27) and *Trox* genera (photo 16.28).

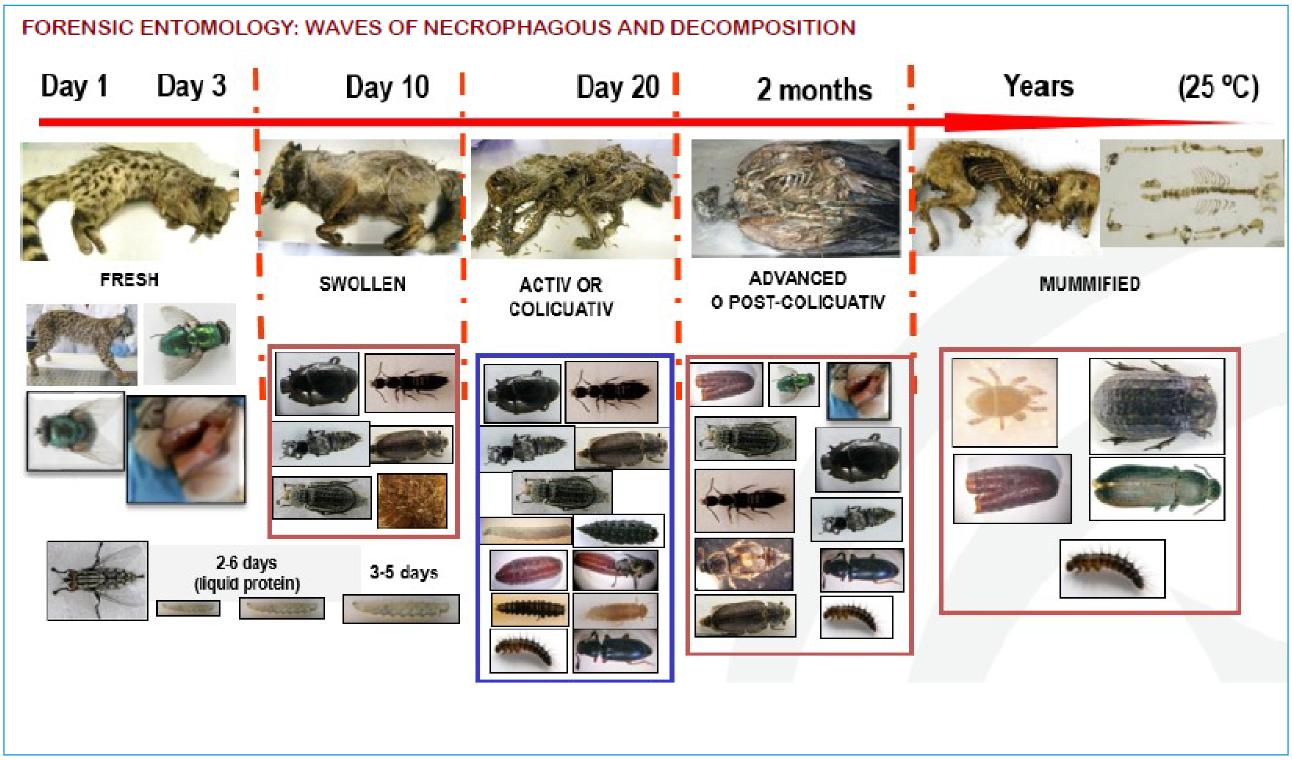
Photo 16.27 *Tenebrio* genus coleopteran .

Photo 16.28 *Trox* genus coleopteran.

At these final stages of decomposition, it is important to examine the ground underneath the carcass in addition to the carcass itself, because abundant arthropod remains can be found there.

As a simplified summary, the following diagram (Diagram 16.1) classifies the decomposition stages by the number of days elapsing since death and the entomological activity developing on the carcass.

Diagram 16.1 Stages of decomposition with days elapsing since death and entomological activity



17. THE FORENSIC LABORATORY. FUNCTIONS AND PROCEDURES

As we have seen throughout this manual, the forensic laboratory plays a decisive role in the entire process of investigating environmental crimes, particularly those investigations focusing on crimes against biodiversity. In Spain, these laboratories are publicly-owned and in some regions have independent facilities and resources, whereas in other regions, they belong to wildlife rehabilitation centres that answer to the regional government. In regions that do not have specific programmes or passive surveillance systems, these rehabilitation centres are crucial in the detection, early warning and analysis of samples and circumstances giving rise to crimes against biodiversity.

Obviously, they must be managed by experts with extensive knowledge about biodiversity who must also have expertise in forensics. Staff members often lack knowledge in fields related to forensics or criminal investigations, focusing narrowly on pathology, which quite often prevents certain crimes from being detected. The ideal combination of cross-disciplinary knowledge is rarely achieved, so the expertise of the employees at consolidated laboratories is extraordinarily valuable. Laboratories must be highly specialised in forensic aspects of wildlife, since experience has repeatedly shown that the techniques used in human forensic science are neither effective nor applicable in this case.

Toxicological analyses are one example that illustrates this assertion. In human, when poisoning is suspected, the forensic laboratory takes liver and kidney samples during the autopsy to attempt to identify the possible poison used from these organs. As we shall see below, an analysis of such samples from a poisoned imperial eagle or cinereous vulture often amount to a waste of time because there are huge differences between how birds of prey and humans die from poison. In birds of prey, death is caused before the poison reaches the liver and kidney under most circumstances of poisoning today. In these situations, analysing these organs does not make sense, or amounts to an unacceptable expense, given that the results will most likely be negative despite the total certainty that the bird died from poisoning. On the other hand, poisons that kill birds of prey in seconds take much longer to have an effect on humans or, rather, they are much more traceable. For these highly important reasons, the forensic laboratories that handle crimes against wildlife must be knowledgeable about the specific features of crimes against biodiversity and particularly about how the wild species they work with behave.

Laboratory specialists act in permanent advisory roles for agents and technicians of other departments or phases of investigations, they must prepare technical and expert reports for the courts and appear in court when summoned by the judicial authorities. In fact, this is a little known, relatively uncommon task in many countries but it is, without a doubt, decisive in the success of environmental crime investigations and subsequent phases.

We must bear in mind that all, or nearly all, of the samples in a case must be sent to a laboratory specialising in crimes against wildlife, which makes their workload truly enormous. Every sample, report and case must be meticulously kept track of, and not just the present ones but the entire log from the past, all in an orderly fashion. This entails a degree of preparation, willingness and commitment that is not easy to find, not to mention the ability to keep everything relating to one's job a secret, since the activities performed at work must be kept confidential. In the following photo (photo 17.1) we can see the

Photo 17.1 The director of the forensic laboratory of Andalusia (CAD) presents the samples received on an ordinary workday.

volume of samples to be analysed in one day, which, multiplied for the cumulative sum in a month, gives us an idea of the extraordinary workload involved in managing a laboratory of this kind.

The laboratory is the place everyone turns to when looking for answers, fielding questions at all hours and days of the week, even on holidays, which also means there is a tremendous responsibility for its employees.

We need to remember that the forensic laboratory works with the material and samples we provide them with, so when these are lacking in quality, we are demanding results that sometimes go above and beyond excellence. We are constantly posing new challenges to them, new questions for which science has not yet created procedures or responses. Thanks to that pressure imposed on our laboratories and to the constant challenges facing them, forensic teams make progress and constantly refresh their knowledge, thus clearly spearheading a line of work that benefits our biodiversity. If there is any place that generates science, constantly renews knowledge and innovates incessantly, that place is, without a doubt, the laboratory. Under such circumstances, we can only reach one logical conclusion, which is that our forensic laboratory is the Sistine Chapel, the quintessence of the fight against crime, and its staff is a precious treasure that we must protect and care for, as if it were the most endangered species on the planet. Without these laboratories, we would be lost, and to a very great extent our work relies on theirs. Therefore, we would like to take this opportunity, first of all, to thank our forensic laboratory, the Centre for Analysis and Diagnosis of Wildlife (CAD) and all wildlife forensic laboratories in Europe for their unconditional commitment and dedication round the clock and always with a smile.

In relation to the work of specialised laboratories, one essential question must be raised from a police and forensic perspective, which arises during investigations of crimes against wildlife, such as poisoning:

How can the laboratory issue negative results, for example, of toxicology tests conducted on an animal that clearly died from poisoning?

There is not a single police officer with experience in poisoning episodes in Spain who has not been faced with negative results from an analysis of a carcass they found in nature, despite their certainty that the animal was poisoned. We know from experience that there is nothing so frustrating for the professionals in this field, especially when we are firmly convinced that poisoning was responsible for the death. When the tests run on a poisoned carcass are analysed and the results are negative, this is technically known as a "false negative".

False negatives generate tremendous confusion and obstacles; sometimes the entire case rests on the results of one particular sample, which is precisely the one that comes out negative. In any episode or investigation, some samples are more relevant than others, and when the most important one gives this fateful result, we often throw in the towel, dropping the case. Then we wonder whether perhaps the laboratory did not do their job properly or even whether there was a mix-up in transporting the samples, or they were not correctly analysed. We are so certain that the animal died from poisoning that we cannot resign ourselves to merely accepting a negative result.

Rule number one that we must learn is that, when faced with a false negative, the case is not necessarily lost, perhaps even quite the contrary. Whenever the forensic experts close one door, they open a window and, quite often, this may even be the best option. In fact, nearly all of the most interesting and high-profile cases that have been solved to date in Andalusia suffered serious setbacks during their initial stages. However, to achieve this, the police forces on the case need to increase the degree of cooperation and coordination with the forensic branch, and never give up on a case. The motto used in wildlife conservation programmes that states that "there are no lost causes, just hopeless professionals" must be applied, and good forensic laboratories are specialists in this regard.

False negatives exist, and will continue to do so, precisely because they are inherent to laboratory and field procedures. They need not be due to laboratory errors, but rather may be caused by ambiguities arising from the CSI itself or even from the nature of the poison or the ecology of the poisoned species. In recent years, extraordinary progress has been made in laboratory protocols, bringing the rate from more than 30% twenty years ago down to less than 5% at present.

So then, why do false negatives happen?

The toxicological analysis of a carcass is not a static, infallible, automated procedure. It does not consist in putting the animal's body into some high-tech modern device that does everything automatically, but rather it is a lengthy, tedious manual procedure. In turn, it does not entail just one analysis; instead, the laboratory must conduct up to three different tests to reach a reliable diagnosis, one of which even involves sending sub-samples to an external reference laboratory (or to many laboratories) to compare or confirm the results attained. Needless to say, the tests we are talking about are extremely costly and require numerous days of work for technicians and analysts. A typical case can illustrate this point: the team of acting officers can conduct a single CSI, in the course of which samples are collected to be sent to the laboratory. After being registered as incoming in the laboratory, these same samples will keep the laboratory staff busy for five working days, and even holidays and night shifts if necessary. The time devoted may increase to 15 working days if forensic entomology is required and up to 8 weeks if the skeleton needs to be cleaned for certain specific studies. Worse yet, when handling particularly relevant cases in which new evidence and a cross-disciplinary approach are required, along with numerous consultations and assessments, then the case may occupy the lab experts for a period extending several months. There are several reasons for this and they are diverse in nature. The longer the laboratory process is and the more steps to be taken in the analytical techniques, as in this particular case, the greater the complexity and, therefore, lower the likelihood of achieving reliable, conclusive positive results. If this is compounded by the fact that, in general, the work must be done on biological samples and deteriorated compounds because they were not collected at the time the animal died but rather days, weeks or months later, then this difficulty multiplies. In order for the laboratory to produce positive results, a series of conditions must be met by the work done by the agents and that of the laboratory, and these conditions cannot always be met in real life. Therefore, it is best to know which steps must be taken correctly in the laboratory and how agents must act in the field to minimise the likelihood of getting false negatives. When the techniques and procedures in the field and in the laboratory are synchronised, the rate of false negatives drops considerably.

If we aim to clarify the events, we must first fully understand how poisoning works. To do this, agents need to know that the toxic compounds regularly found in our work have certain features in common that make them especially lethal. The first is that the usual poisons in Europe have such a strong affinity for the neurotransmitters in the nervous system that the animal could die with the bait in its mouth, without even giving the toxic substance time to reach the stomach. If we consider that the stomach is the main organ analysed in a conventional laboratory not specialising in wildlife, it is easier to see how the number of positive results might be lower in proportion to the number of samples taken. If the baits were literally loaded with poison but the result was negative, this could be the reason for the negative result: simply because the more poison there is in the mouth, the more quickly it acts and the less time is available for it to reach the stomach. If the laboratory only analyses the stomach then a false negative is inevitable. This is obviously one aspect that forensic laboratories for wildlife must take into consideration.

The second feature is that these compounds can deteriorate rapidly in the sun, sometimes in just a few hours, so even if they were once present, it is possible that, by the time the environmental police agent arrives on the scene, takes samples and sends them to the laboratory, the traces of poison may already have disappeared.

For this reason, it is important to collect vomit and the soil underneath it and inside the animal's mouth. On numerous occasions, we have found poison only in these samples and not on the carcass itself. Finally, we must recall that it is important to collect all the evidence linked to the case. Here, it is in the agents' work where there is room for improvement.

Needless to say, the samples must be intact when they reach the laboratory, well-preserved and labelled, and accompanied by the corresponding documentation, records and full background details. The documentation must accurately describe the original carcass dispositions of the animals as they were found in the field, including photographs. Here too, police agents must have an understanding of this reality and apply it in their procedures as they work. When these conditions are not met from the outset, it is no easy task to issue a diagnosis similar to that gleaned from a fresh carcass with all its documentation in perfect order. The experience and skill of the laboratory plays an essential role because many of the samples sent by the agents for analysis often exceed the limits of what can be technically achieved, and this is exacerbated by the deteriorated conditions of many samples, as mentioned before. Based on extensive experience gathered over the years, we have developed concepts of what we might call conventional and unconventional samples. This latter category includes those body tissues that, under normal conditions, are not analysed according to international toxicology protocols, but which take on vital importance in our circumstances: talons, beak, palate, etc. In emergency cases, this may even include fly larvae feeding on tissues that have been in contact with the poison. Here, the opportunities for improvement fall to the forensic laboratories.

Of the numerous examples we could describe to illustrate this, let us take the example of a case involving an adult imperial eagle: out of all the samples taken from the carcass and analysed, of all the digestive organs, just one positive result was found and it was from the least expected part of all the tissues processed: the interior of the talon, which was clenched by the poison-induced convulsions prior to the bird's death.

Next, let us take a look at the eight most common causes of false negatives from carcasses in Spain:

- The animal has ingested so little poison that it can barely be detected by the analytical methods available to the laboratory.
- The poison was absorbed through the skin, very quickly in the digestive system or inhaled, preventing it from being detected easily.
- The animal vomited just before dying, expulsing the poison in the vomit or on the underlying soil, which was not collected by the acting officers.
- The poison did not cause immediate death, biodegraded inside the animal as it worked its toxic effects and was not detected through the laboratory methods. As a general rule, the longer the period between intoxication and death, the more complicated it is to detect the poison. This is relatively common with rodenticides, which break down slowly and go undetected, although they do cause microhaemorrhaging. In these situations, the poison will not be detected in the liver or in any other sample. The same may occur with sub-lethal concentrations of certain poisons in particular.
- The poison deteriorated inside the carcass due to the sun/heat and insects.
- The laboratory analysed the wrong organs or tissues, for example, kidneys or

liver, which is the usual practice in human toxicology.

- The laboratory used unsuitable analytical methods for the decayed condition of the sample.

- The laboratory used unsuitable analytical methods to detect all possible poisons. For example, if only gas chromatography is used, heat-sensitive poisons like aldicarb cannot be detected. This is a common occurrence in laboratories throughout Europe where only gas chromatography is used, thus eliminating aldicarb, which is deteriorated by the heat. To a great extent, this explains why so much carbofuran is detected in Europe and, on the contrary, so little aldicarb, even though this latter carbamate is one of the most widely used and sold throughout the world.

- The laboratory was not specialised or had no experience and used unsuitable analytical methods for the type of poison. For example, not measuring acetylcholinesterase inhibition or looking for anticoagulants when the cause of death is an organophosphate or carbamate. This cause is more common than it might seem at first glance.

- The agents only collected some of the carcasses or baits in the field, which were precisely the ones that gave false negatives. The other samples were lost or never collected.

- Finally, we must mention the case of specific poisons that do not cause rapid death and accumulate in the animal's tissues, which are not easy for the laboratory to predict.

Quite often, the actual cause is a combination of the above.

In sum, contrary to popular opinion, achieving positive results in poisoning cases is more like an art than an infallible analytical process in the laboratory. As we can see, to minimise the rate of false negatives it is essential for both the field agents and the laboratories to take all these criteria into account, which afford excellent results when applied.

18. INTERPRETING RESULTS AND REPORTS. ANSWERS TO FREQUENTLY ASKED QUESTIONS ADDRESSED TO LABORATORIES

This chapter has two separate, but clearly related, sections:

On the one hand, we will discuss the most important aspects of the forensic toxicology reports issued by the forensic laboratories in most European countries, which supplement the police action. Most of the time, these reports are fully comprehended by the technicians and agents who must subsequently interpret them in the course of the investigations.

On the other, we will provide answers to the questions most frequently asked of laboratories, normally related to the interpretation of the toxicological results and their relationship to the carcass that is the subject of the investigation.

In addition to performing necropsies and analyses, laboratories must carry out work involving the interpretation and communication of these results to all the parties that make use of this information to continue the investigations or at trial, where appropriate (judges, lawyers, prosecutors and NGOs, when the latter appear in the proceedings).

In most cases, reports are issued by accredited reference laboratories, which means that, in order to receive this international accreditation, they must use technical and analytical procedures that have been validated by the international community and reference agencies, which are highly complex and standardised. Therefore, the reports issued by the laboratories are also complex and occasionally difficult to understand for professionals in other fields. However, the structure of these reports cannot be changed because this would infringe on the scientific rigour required internationally under Standard UNE 197001 on the general criteria for the development of expert reports. For example, even though everyone understands the expression “a disgusting-looking wound”, this cannot be included in an official report because it lacks scientific rigour and could lead another laboratory or expert (such as second opinions given at trial) to dismiss all the work done as being unprofessional, thus weakening the case. In fact, judges demand language that is strictly technical but at the same time comprehensible, which calls for an effort in synthesis and pedagogy. This is important because, in the end, the judges are the ones who assign more or less value to the expert reports.

In sum, for a report to meet official requirements, its conclusions and arguments must be indisputable and decisive. To this end, a balance must be found in the structure required under international standards so that the text can also be read, understood and verified not only by experts but also by other professionals related to the case who lack scientific training in toxicology. In the end, these latter are the ones who will use the report and the information it contains in court proceedings. Finding this delicate balance is no easy task.

Laboratory report structure

All expert reports must contain an introduction, an explanatory section, a section containing reflections and a conclusion (Standard UNE 197001). Technical laboratory reports contain all the information related to the case: preliminary investigation, records, all the CSI documentation, information on the samples collected, laboratory results, subsequent investigation if applicable, etc.

Laboratory reports must comply with the terms of the official standards, so they need to include the following sections:

- Background (“Facts to be highlighted”): indicating the most relevant aspects contained in the records that accompany the samples.
- “Description of the material sent”: this section contains a detailed description of the material received, seals (which must coincide with those indicated in the records), and the analyses to be conducted.

The purely "technical" part:

1. "Necropsy", "macroscopic study of baits" or other materials sent, including explanatory photos of the most relevant findings.
2. "Toxicological analysis": all the tests performed, indicating the method used: toxicological, genetic, PCR, histopathological, virological, microbiological, ballistics, death dating tests, etc.
3. "Summary of results".
4. "Interpretation/remarks": this part offers a "translation" of the technical section.
5. "Conclusions", when anything can be concluded: they must be prudent but as clear and concise as possible.
6. "Additional information" in the event that a toxic substance is detected. This section outlines the valid legislation (whether or not it is authorised), the hazard classification according to the World Health Organization (WHO), and the mechanism of action on the animal for the poison that may have caused symptoms and/or death.
7. Bibliography, when and where this is appropriate.

Understanding toxicology results in reports

The toxicology part is where most questions arise when it comes to interpreting results. For this reason, we will discuss the specific part on the toxicology results, and then focus on the frequently asked questions and possible answers to these questions.

To illustrate the toxicology part, we are going to use an actual case in which the agents collected the fresh carcass of a red kite (in adequate preservation conditions). Once it arrives at the laboratory, qualified staff conduct a detailed necropsy and collect the appropriate samples for the purposes of detecting possible poison that the animal may have ingested, or some other cause of unnatural death. In this case, the ventricle and gizzard. This generates toxicological results that are documented in various ways, depending on the laboratory. In all cases, the techniques used and the results obtained must be specified. The tests and results applied to the red kite in this case can be summarised in a table as follows:

Toxicological analysis

The table contains: the identification assigned by the laboratory for each sample analysed

Column 1	Column 2	Column 3	Column 4	Column 5
CAD identification or specific forensic laboratory	**External identification**	**Sub-sample analysed**	**Results of thin-layer chromatography at forensic laboratory (organophosphates and carbamates)**	**Results and quantification-liquid (UPLC-MS/MS) and gas (GC-MS/MS) chromatography method**
XXX/YY/ZZ/01/001	**"Red kite carcass"**	Crop contents (weight analysed in grams, 3.5 g in the example)	**Positive**	Not quantified
XXX/YY/ZZ/01/002		Gizzard contents (weight analysed in grams, 5.8 g in the example)	**Positive**	**ALDICARB (1 mg/kg) ALDICARB SULFOXIDE (0.2 mg/kg) ALDICARB SULFONE (0.05 mg/kg)**

(column 1), reference to that sample analysed in the record sent (column 2), carcass samples analysed (column 3) and most importantly, the toxicology results obtained using two different techniques (columns 4 and 5).

The parts of this table that undoubtedly require an explanation are the last three:

- Column 3: tells us exactly which samples were taken from the carcass to conduct the toxicological analysis. In our specific example, the crop and gizzard. Why these samples instead of some others? Clearly, the poison ingested is distributed throughout the entire digestive tract, but it is preferable to analyse the parts of the carcass in which the poison is most likely to be found; in this case, the crop and gizzard, which function like "pouches" in the digestive tract, where the poison could be trapped. There may be traces of poison in other parts of the digestive system, which are not analysed in the initial phase. This will be explained below in the section on frequently asked questions.

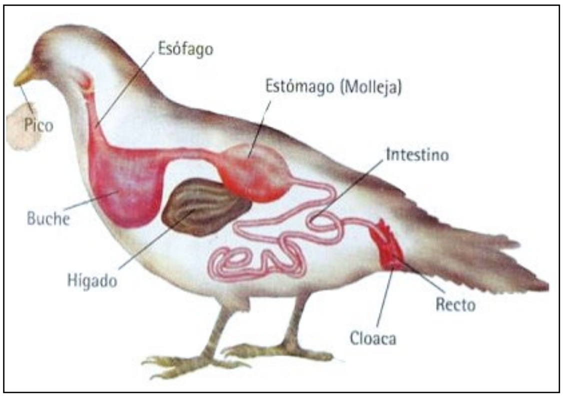


Photo 18.1 Digestive tract of a bird, where poison may be lodged.

- Columns 4 and 5 show the toxicological results of these specific samples, which were analysed using two different techniques. These are briefly summarised to make it easier to interpret the results:

- Column 4: "Thin-layer chromatography results". This is a preliminary analysis conducted at many laboratories. As a quick test, it tells us whether or not toxic substances are present in the sample (what is known as a qualitative analysis or screening), establishing the presence/absence of poison. The basis for the technique varies depending on the compounds we are looking for, and what it shows is a drawing or graphic that indicates the results:

  – Organophosphate- and carbamate-type cholinesterase inhibitors (aldicarb or carbofuran, to name a few).

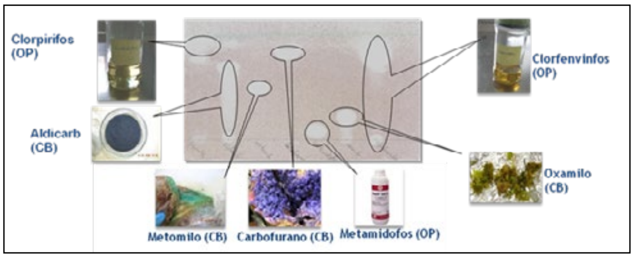


Photo 18.2 Positive results for cholinesterase inhibitors.

  – Anticoagulant rodenticides (e.g. bromadiolone).

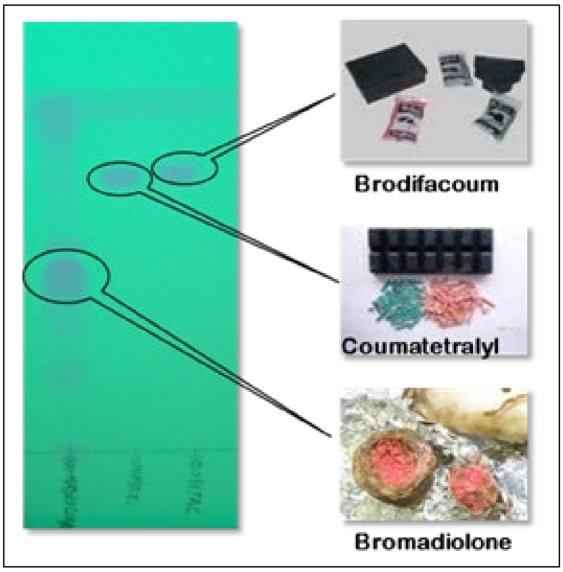


Photo 18.3 Positive results for rodenticides.

- Metaldehyde
- Strychnine (photo 18.4).

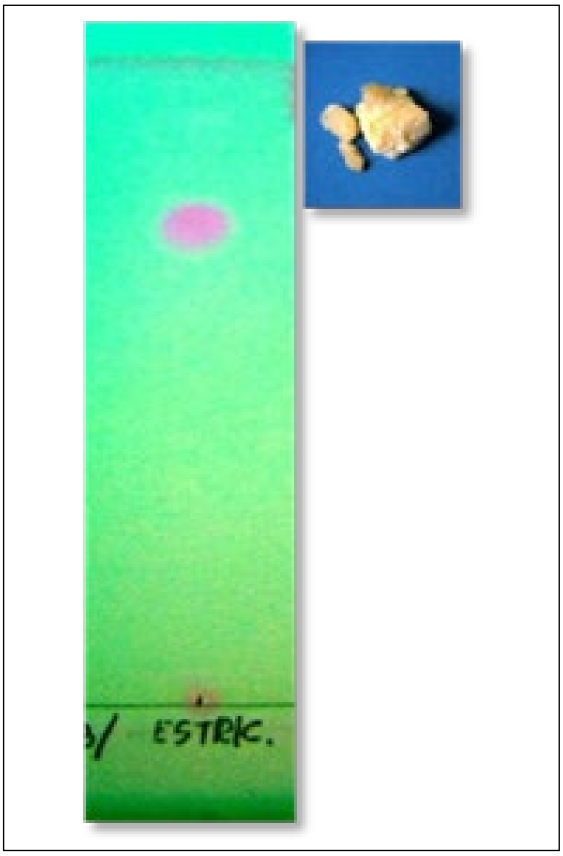


Photo 18.4 Positive results for strychnine.

It is important to understand that these techniques only tell us about the presence (positive)/absence (negative) of poison, although the inclusion of known poison templates can help us "guess" which poison is present.

In our example from the table above, toxic substances have been detected in both of the samples from the red kite (crop and gizzard). We can also see that the pattern or mark obtained is the one typically caused by aldicarb. Despite this, according to protocol, we can only state that we have a positive result, but cannot specify the product or the quantity.

However, for the results to be valid in legal proceedings - and this is essential - the sample must also be analysed using a second method, which is more costly and time-consuming than the first one but identifies the specific poison concerned and the quantity found. This result is shown in the last column:

- Column 5: liquid (UPLC-MS/MS) and gas (GC-MS/MS) chromatography. This is the legally accepted technique. The sum of these two chromatography techniques (liquid and gas) makes it possible to determine and quantify the vast majority of toxic substances. In the example in the table above, aldicarb (1 mg/kg)+aldicarb sulfoxide (0.2 mg/kg)+aldicarb sulfone (0.05mg/kg) was detected in the gizzard sample. A total sum of 1.25 mg/kg of aldicarb

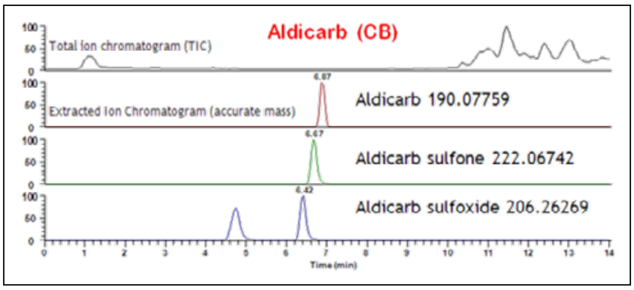


Photo18.5 Liquid and gas chromatography results.

The disadvantage of this latter method is that it only detects compounds that are included in a "compound library". At the laboratory in Andalusia, following this set of techniques, very low concentrations of nearly 300 compounds can be detected, between pesticides, rodenticides and strychnine, including the degradation products of the most important ones (as in our example, aldicarb decomposed into aldicarb sulfoxide and aldicarb sulfone, which is explained in further detail below, carbofuran and carbofuran-3-hydroxy, methiocarb sulfoxide and sulfone, etc.). This library is revised periodically as new compounds not already included are discovered.

If we return to the table, we will see that, although aldicarb was detected in both samples analysed (column 4), it was only quantified in one of them (gizzard). In addition, the entire contents of the gizzard are not analysed, but just one random part, just as when a vehicle full of cocaine is seized, only a portion of the cargo is analysed to prove that it really is cocaine. Furthermore, laboratories have a limited annual budget, which forces them to focus the analyses on the parts of the carcass in which they are most likely to find conclusive results.

Quantifying the poison from just one part of the carcass selected for analysis (random sample of the gizzard contents) can lead to confusion when it comes to interpreting the laboratory report because we may be led to assume that the quantity detected in our example (1.25 mg/kg of aldicarb, the total amount detected in the sample of part of the gizzard) is the total amount ingested by the animal, which led to its death.

This is not actually the case, and we will explain this concept in the following section with "answers to frequently asked questions addressed to laboratories". It is absolutely essential to understand these nuances.

Answers to frequently asked questions addressed to laboratories

Can we use the results obtained to assert that this red kite died from poisoning? Is it really possible to know how much poison it ingested?

These are some of the answers to the most frequently asked questions addressed to laboratories. Once the toxicology report has revealed that a toxic compound has been detected, the question that immediately comes to mind is: Is this the cause of death or, to the contrary, is it unrelated?

To try to answer, we will continue with our case above, the red kite, in which, as we recall, aldicarb was detected in two samples analysed from the carcass (part of the crop and gizzard contents), quantifying only the results of the latter (1.25 mg/kg total aldicarb).

To respond and understand this process, it is important to bear in mind these initial explanations:

Firstly, we need to remember that the poisons regularly used to make poisoned bait are used by the perpetrator of the crime because that person knows full well that the animal can be killed with very small quantities. Thus, the mere fact that aldicarb was found is already a fundamental piece of information. Let us also recall that the most common poisons (acetylcholinesterase inhibitors) do not bioaccumulate and, therefore, we can assume that the detected presence of poison is synonymous with the death-causing agent in a direct manner, or at least indirectly but closely related.

What is the dose of aldicarb that can kill a red kite?

This piece of information is not actually known because it would require experimentation that is forbidden by law. The toxicity of each toxic substance is determined by a parameter known as the Median Lethal Dose, or LD50, which we will not explain in this manual in further detail. The only way to calculate the LD50 is to experimentally poison the species to be studied and, logically, this is not possible for protected species or humans. Therefore, known LD50 values for other bird or mammal species are normally used as reference; in the case of aldicarb, this value is in the range of 1.8 to 5 mg/kg, although we know that a single granule of aldicarb can lead to the death of a bird the size of a house sparrow. This information is supplemented with data gathered in hospitals, relating to humans, or cases in which we know the actual amount ingested by a poisoned animal. In this way we can gain a sense or general idea, but science cannot currently offer precise data about the level of mg/kg for each and every endangered species.

Next, we need to think about the path taken by a toxic substance when it is ingested by an animal. This would be the sequence:

Mouth-throat-crop (the pouch that birds have in the middle of their throats where food is stored, moistened and softened)-stomach (usually referred to as the gizzard in birds)-intestine.

Therefore, traces of the toxic substance will definitely be distributed throughout this entire section of the digestive system. The exact location will vary depending on how quickly the animal died:

1. If it died very quickly, the poison will have made little progress and will be located mainly in the mouth. These are cases in which we find the bait in the mouth. This happens primarily in birds because they are much more sensitive to poison than mammals. In these cases, the laboratory also analyses the bait sample. For this reason, we must always bear in mind that if aldicarb is "highly toxic" and kills at low doses, for a bird this dose is even lower than for a mammaldosis son incluso menores que para un mamífero.

2. If it did not die so quickly, the poison may have progressed toward the stomach or gizzard. In birds, the mouth will be empty and the crop full. When the crop is opened up it is sometimes possible to see (and even smell) leftover bits of bait and, depending on the poison concerned, even the poison itself can be seen. When the stomach is opened up, we can also see leftover bait. In these cases, the laboratory selects both samples (crop and gizzard for birds, stomach for mammals).

3. If the animal did not die before this, the bait reaches the stomach and is processed like any other type of food. During absorption, poisoning symptoms set in and death occurs more or less quickly. The portion absorbed by the animal's organism is not quantifiable. This is interpreted in the laboratory report as decomposition of the compound through hydrolysis, and this concentration is lost is the quantification of the amount originally ingested by the animal. Even if some time elapses between ingestion and death, it may be entirely absorbed and, as such, cannot be detected in the laboratory.

Therefore, in order to know exactly how much poison this red kite ingested, it would be necessary to analyse every part of the digestive system, quantify it and add up all the amounts found in each part; even so, we would never know how much had already been absorbed or hydrolysed.

Sometimes, the laboratory results show a very low concentration or quantity of a certain poison. Although the amount found in a single point of the carcass is theoretically insufficient to kill the animal, we must consider that this is just one part of what it ingested. Actually, the laboratory confirms that a highly toxic poison was ingested, identifying this substance by name, but it can never precisely determine how much was ingested.

In sum, even if we were to analyse every millimetre of the digestive tract, plus any other parts that may have come into contact with the poison (such as talons), the actual amount ingested is, necessarily and invariably, much greater than what we would find in the laboratory, no matter how outstanding, modern and well-equipped it may be, for the following reasons:

1. As explained above, the portion of the poison that has been absorbed (through what we call hydrolysis) and processed when it reaches the stomach, as if it were any other type of food, cannot be quantified. This invisible amount is precisely what killed the animal, and everything we may find is merely extra poison that did not have the chance to take effect.

2. The majority of the pesticides used most frequently have the "virtue" of deteriorating quickly, so the effects of moisture, temperature or the action of bacteria in the environment also eliminate part of the poison, but, here too, we can never know how much. This deterioration is included in the diagnosis reports, referred to as chemical and biochemical oxidation. This deteriorated amount cannot be quantified either.

The more decomposed the carcass is, the greater this deterioration. For example, let's compare a skeletonised black kite (photo

18.6) with a fresh one (photo 18.7). Both died of aldicarb poisoning, but in the skeletonised one, as it had no internal organs, aldicarb was only detected on the talons and at a very low concentration (0.12 mg/kg) that, based on the lethal dose of aldicarb for birds, could lead to the erroneous conclusion that it was insufficient to cause death. We cannot know how much it originally ingested. On the other hand, digestive tract samples were taken from the fresh black kite and a quantity of 105 mg/kg was detected in the stomach alone, although there was more aldicarb in other areas of the digestive system that were not quantified. Fortunately, in this case, the concentration was higher than the lethal dose of aldicarb in birds, but this is not the situation we normally face in poisoning cases.

Photo 18.6 Skeletonised black kite specimen.

Photo 18.7 Fresh black kite specimen.

As we can see, regardless of the amount of aldicarb detected in a kite, it will never be the exact amount actually ingested and, as such, we can conclude that the laboratory's response will always be the same: it is impossible to know exactly how much poison a poisoned animal has ingested. We can only assert that aldicarb is an extremely toxic compound in birds, that ingestion leads to death, that it cannot bioaccumulate in the tissues precisely because it is deadly and that the amount found is lower than that actually ingested. Once again, what we do want to emphasise is that birds are particularly prone to these poisons and merely by detecting them in a bird found dead – especially in this case, in which it was detected in both samples analysed (random samples taken from inside the crop and gizzard) – poisoning can be confirmed.

In sum, this analysis must be taken as more, but not the only, proof because it is not uncommon for a properly conducted chemical analysis to be interpreted erroneously.

Is it possible to know how far an animal has moved from the time it ingested poisoned bait until the time it died?

This is a very interesting question for several reasons and understanding the answer enables us to more precisely plan specific inspections, in addition to entailing fundamental legal consequences in terms of criminal liability.

The answer is highly complex and the laboratory can in no way provide this information. There are multiple variables in each specific case, many of which are not toxicological in nature but rather forensic and zoological, and they must be assessed from a cross-disciplinary perspective. Even if we find the bait that allegedly killed the animals collected and analysed, there is no way of knowing exactly where the specific bait that killed that carcass in particular was located.

In this regard, the laboratory's response will always be tentative, depending on the exact type of poison and the conclusions that can be inferred from the doses found, but it cannot shed light on this matter if the acting officers have not provided essential details enabling it to issue a more precise report. The quality of the response that the laboratory can provide depends on the quality of the data it has received. In this case, the laboratory recommends that agents seek specialised forensic advice and approach the matter from a cross-disciplinary perspective.

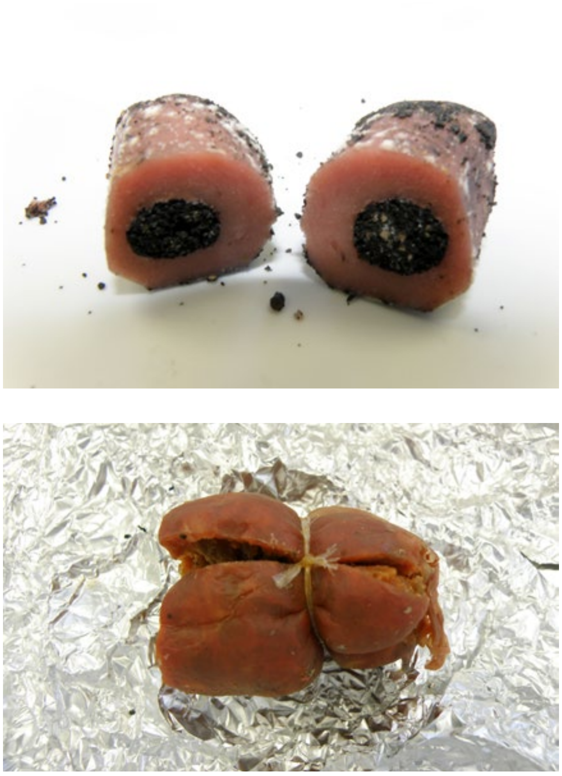
Photo 18.8 Baits coated with poison.

What can influence how far an animal moves from the time it ingested poisoned bait until the time it died?

This will depend on several factors but, assuming the animal is healthy, there are four essential factors that really limit this assessment:

a) Type of bait ingested: it matters whether the poison (e.g. aldicarb granules) is coated on the outside of the bait (what we call "strawberry bait"), or whether it is placed inside and well protected by sausage, meat or some other support material (colloquially referred to as "peach bait"). In the former, the toxic substance will be absorbed and will act much more quickly than in the latter, where the poison is not directly in contact with the bird's digestive tract. With "peach baits" (poison inside), the toxic substance will not begin to take effect until the meat covering has been digested and the poison comes into contact with the animal's tissues. We must mention here that many poisoners are familiar with techniques for preparing delayed-action baits, but we will not go further into detail on this matter here for obvious reasons..

When the carcass arrives at the laboratory, traces of poisoned bait are often found in the animal's stomach, but in conditions in no way comparable to their original state (it has been chewed, covered in saliva or shredded). In the best-case scenario, it is possible to identify the type of meat ingested (sausage, chicken, fat, etc.) but nothing else, so the laboratory cannot determine whether it was "strawberry" or "peach" bait.



Photos 18.9 Baits with poison placed inside.

b) Quantity of poison used in the bait: bait containing just a few granules inside is not the same as when it contains a large quantity. In this regard, two variables are combined – the one mentioned above ("strawberry" or "peach" bait) and something we discussed earlier, the poison concentration.

c) Whether or not the animal's stomach was full: the lower the stomach content, the greater the absorption and the quicker death takes place. Therefore, a hungry animal with an empty stomach before discovering the bait will ingest a greater quantity of poison in the bait and will probably die more quickly.

d) Capacity to move more or less quickly. This requires an understanding of the species, whether it is a bird, mammal or reptile. If it ingests poisoned bait, it will begin to feel sick and will be unable to run or fly and, if its stomach is also empty, absorption will take place more quickly. In a word, a poisoned animal will be unable to move as of the time it begins to notice the first symptoms.

To sum up, sometimes the laboratory's response will be the same: inconclusive and also tentative, unless the field information provided by the agents is sound and complete, in which case the laboratory and other forensic experts can work together to reliably reconstruct the facts. As in the previous section, agents must approach this study from a cross-disciplinary forensic perspective and bring in other professionals. Other highly specific parameters must be known which, for legal and strategic reasons, cannot be described in this text.

If poison is detected on the inner side of a bird's talons, is this indicative of recent poisoning?

Generally, yes. However, this frequently-heard assertion needs to be interpreted with caution because the pesticides used most often in Europe are absorbed through the skin. Some specific toxic substances used commonly as poison are absorbed and can poison an animal through the skin, but not all of them. Absorption through the scaly skin of birds is certainly much slower than in mammals and, among the latter, if the skin has a thick layer of fur this is also true. This means that a few granules of aldicarb in the palm of the hand, especially a sweaty one, will be absorbed much more quickly than if the skin is dry and covered in fur or if the granules are in contact with skin covered in thick, highly keratinised scales like those of birds of prey.

This means that the laboratory must first quantify the amount found on the talons, but once again, this requires time and specified assessments. However, these situations are always analysed in conjunction with other, more conventional, samples and the carcass as a whole, along with supplementary information. There is no general rule because there are almost never two equal cases.

19. DETERMINING THE CAUSES OF WILDFIRES

Introduction

Fire as a tool that is inseparable from human beings

"All pyromaniacs are arsonists, but very few arsonists are pyromaniacs". With this expression, we endeavour to break down the myth that most wildfires are caused by pyromaniacs. There is a false belief, partially fostered by the media, stating that most fires are caused by pyromaniacs when, in fact, the rate of pyromania and other mental disorders is actually quite low in comparison with other causes and motivations.

From an anthropological viewpoint, the domestication of fire is deemed to be one of the most relevant technological advances in the process of human evolution. Among other scholars, Lewis Morgan divided evolution into three separate stages: *savagery,* characterised primarily by the fact that it coincided with the period in which prehistoric man had no understanding of the use of fire; *barbarism,* the age in which fire arising naturally was harnessed and preserved; and *civilisation,* as the era in which fire was generated, when we were not only able to maintain it but also to light it.

That period marked a huge revolution for human civilisation given that fire brings light and heat, aids in hunting and the manufacturing of new instruments and tools, makes it possible to conquer the forest and generate new spaces, providing shelter from predators and insects and improving food preparation, thus enhancing the diet and preservation of food sources, which, in sum, fosters group cohesion as a society. For thousands of years we have honoured the use of fire, hence the atavistic power it has on us as we sit, mesmerised, in front of the fireplace listening to the crackling of burning wood, breathing in its aroma, feeling its heat and watching the embers and flames trace endless filigrees with their light in the darkness of night. We have also been using fire as a tool for vegetation management for thousands of years, but likewise, fire has also been used in criminal activities leading to the destruction of goods, property and even human lives.

Bearing in mind that countless infrastructures, from electric power transmission and transformation facilities to machines, combustion engines and a wide range of tools, are also sources of wildfires, in one way or another the human hand is almost always behind the origin of fires.

The need to investigate wildfires

In Spain, since 1994, when the first training sessions were taught on determining causes of wildfires, Wildfire Investigation Brigades (BIIF) have gradually been set up, consisting of Environmental Agents specialised in determining the origins of wildfires and later extending to other police forces. Up until that time, those of us who worked to prevent and fight against wildfires focused all our attention on extinguishing activities, unaware that a method could be applied to develop a complete, logical and scientific investigation process, not knowing that determining the cause of a fire played an essential role in preventing them. If you do not know what caused the source of heat that started a fire, you can hardly adopt a preventive policy aimed at preventing it from happening: *"Knowing the problems I have, in order to understand which solutions I need to implement"*, understanding the problem to assess and decide which treatment to apply.

For those of us who are bound to fight crime and administrative offences, it is clear that this investigation method often enables us to pinpoint the clues that will later become incriminating evidence against the perpetrator and party responsible for the fire, thus enabling us to take appropriate criminal or administrative action as applicable. This is no easy task, given that the destructive action of the fire itself, along with the environmental conditions and modus operandi of arsonists, in cases of intentional fires, considerably hinder our efforts. In many other cases, the method helps us determine whether a fire broke out due to negligence, by accident or even caused by forces of nature.

This working methodology is used in North American countries such as the United States and Canada and in diverse countries in the Mediterranean Basin, where the issue of wildfires is considered one of the greatest environmental risks affecting ecosystem conservation; the matter is further exacerbated by current processes of climate change which, in all likelihood, will increase the frequency and severity of the effects of fire in addition to making it a more common occurrence in certain northern countries in which wildfires were up to now relatively rare.

Although this has been mentioned before, we must stress the importance and necessity of investigating the causes of wildfires. The first aim is to try to discover what led to the fire, i.e., its cause, and who the alleged perpetrator was, keeping in mind that, whether deliberately or unwittingly, the human hand is behind 95% of cases. However, determining or discovering the origin must also lead us toward the search for a second broad objective: preventive planning.

Therefore, we can assert that investigating fires opens us up to and places at our disposal the tools we need to attempt to avoid and combat possible fires that may take place in the future. Once again, the problems I have, in order to understand which solutions to apply, thus preventing their recurrence. Thus, investigating fires enables us to identify situations of risk in order to correct them and, in some cases, even designing a means of reconciling the interests of different stakeholders in society, with the aim of minimising certain fires with underlying instrumental motivation.

Finally, it is obvious that preventive policies will not be effective in preventing certain types of intentionally motivated fires. Only punitive action can exercise a general and individual preventive function against intentional arsonists, which is why social prevention work must be accompanied by criminal prosecution of the crime, acting jointly to become effective. These two aspects are only successful if there is prior knowledge generated about the cause and origin of the fire through the investigation.

Foundations of wildfire investigations

As mentioned above, prior to 1994 in some EU countries, such as Spain, no method was applied for determining the causes of wildfires. Oftentimes, they were established on the grounds of an alleged hypothesis that was more often than not created in a rather unscientific manner, based on beliefs and intuition. The origins of many other fires were left to fall into that well-worn category of unknown causes, accounting for some 50% of all recorded fires, in addition to a large percentage stating pyromania as the origin of the fire, especially those with several ignition sites. Moreover, virtually the only reason for taking into account the causes of wildfires was for statistical purposes, with no subsequent practical application.

Thus, the adoption of a deductive and inductive investigation method represented a turning point in the determination and analysis of the causes of wildfires. This method is based primarily on the following cornerstones:

- A logical deductive procedure based on analysing the physical evidence resulting from the fire to determine its area and starting point, thus enabling a reconstruction of the events as well as searching for the ignition source.

- A logical inductive procedure based on analysing the evidence of human activity existing within the fire outbreak area, using feedback taken from indicators detected in prior experiences from previous cases.

- A hypothesis validation procedure based on the testimony of witnesses and individuals related to the origin of the fire.

Classification of causes of wildfires

Depending on their causes, wildfires may be classified as:

1. Natural: Those fires in which the causes are of natural, non-anthropic origin. This encompasses nearly all fires caused by lightning or dry thunderstorms, as well as other options that, while rare or even unheard of, are not impossible, such as volcanic eruptions, friction of stones falling down a mountainside, natural fermentation, etc.

2. Intentional: These are fires started deliberately by individuals, arsonists, as a result of a certain motivation that led them to do so. The motivation may be instrumental in nature (financial interests, profiting in some way, eliminating evidence, etc.) or expressive (revenge, disagreements, psychological problems and so on).

3. Negligent or reckless: These are caused by carelessness, actions or circumstances that do not, themselves, seek to generate a fire but, due to a lack of the duty of care and a failure to take adequate preventive measures, the ultimate result is the outbreak of a wildfire (for example, burning agricultural waste near forest vegetation during seasons or under weather conditions when this is not allowed).

4. Accidental: These are caused by carelessness, actions or circumstances that do not, themselves, seek to generate a fire in which, additionally, all the preventive measures have been taken in accordance with valid regulations, but despite everything, give rise to the origin of a wildfire (for example, a car that breaks down on the road and happens to catch fire, which then spreads to the adjacent wilderness).

5. Undetermined: These are fires in which, despite being properly investigated, the cause could not be determined or in which investigations are pending for some reason.

Deductive procedure

Activation and collection of preliminary information

Wildfires may affect a limited area, known as a small outbreak (fire area of less than one hectare) or, to the contrary, may cover thousands of hectares of burnt forest vegetation. Either way, the investigation procedure is the same, following an approach sequence that goes from large to small, from the fire as a whole to pinpointing the spot where it broke out and spread, in a complex process aimed at reconstructing the events.

When a wildfire is detected, in addition to the operations aimed at extinguishing it, it is important to act as quickly as possible in the investigation of its cause given that the destructive capacity of the fire itself is compounded by environmental factors such as wind, which can have a considerable impact in terms of destroying evidence. Thus, the team performing the visual inspection must arrive at the fire scene quite quickly. If it is not possible to get closer to the fire because it is still active, posing a risk to the investigation team, the fire's evolution and behaviour must be observed and initial environmental data can be gathered.

In addition, it can be very helpful to the fire investigation to gather information about the time at which it was detected, which is not necessarily the time at which it started (an electric shock from a high voltage line that touches or creates an arc to forest vegetation, which is the heat source that causes the fire, takes place at one time but it will not be detected until it reaches a certain magnitude or generates a visible smoke column). Likewise, recording the identification details of the source that reported the emergency is also important. The information provided by the first witnesses will be essential in subsequently validating hypotheses that may be formulated throughout the process, creating what is known as *testimonial evidence*.

Weather conditions such as wind, humidity and temperature are decisive in reconstructing the progression of the fire, even enabling us to rule out potential hypotheses based on the proneness of fuels to burn. Thus, for example, the fact that the wind is blowing in a certain direction, combined with topographical factors, will determine the fire spread vector, giving us an idea of its path. Similarly, a fire that breaks out under conditions in which there is a low likelihood of ignition could be indicative that an intentional cause hypothesis could be considered.

Therefore, it is necessary to compile weather data from the time and place closest to the fire regarding wind direction and speed, temperature and relative humidity. If possible, these data should be taken on site using portable weather stations or devices. If this is not possible, or if we have arrived at the scene of the fire some time after it started, we recommend consulting the data offered by official weather stations found in the vicinity. Fortunately, these values can now be queried or downloaded from diverse online sources, affording us meteorological risk data.

These data, which determine the weather conditions at the time of fire detection, can be referenced to a series of tables that offer the following parameters:

- Fine dead fuel moisture (FDFM): Relative humidity, expressed as a percentage of the water content displayed by fine dead fuel (e.g. dry grass) at a specific time.

- Degree of flammability: Proneness of fine dead fuels to begin the combustion process after a heat source has been applied. It is broken down into:

  Low: when the FDFM is greater than 12%.
  Average: when the FDFM is between 12 and 6%.
  High: when the FDFM is lower than 6%.

- Probability of ignition: An estimate expressed as a percentage, indicating how likely it is that ignition will take place when a spark or ember falls on the fine dead fuel.

- Danger index: An estimate of the underlying danger of wildfires that may exist in a certain area at a given time based on the probability of ignition, temperature and wind force and direction.

To establish these values, the following weather and topographical data for the time and place at which the fire started are needed:

- solar time at which the fire started or was detected
- temperature in ºC
- relative atmospheric humidity in %
- month in which the fire started
- exposure of the area of origin (N, E, S, W)
- average slope of the area of origin in %
- percentage of shading or crown cover
- wind speed in km/h
- wind direction or component (compass point letters or direction in degrees º)

These values can be calculated using certain pre-set double-entry tables. For example, a 16% FDFM value would indicate a low degree of flammability and a 10% probability of ignition; in other words, a very low probability that a fire could occur accidentally or out of recklessness, given that the flammability and ignition conditions are not optimal.

Determining the area of origin

After analysing the fire perimeter and the factors involved in the spread vector, such as wind, slope and orography of the terrain, fuel distribution and composition, etc., the space corresponding to the fire's *area of origin* will be marked out.

To establish this area, we must first analyse the geometric model of the fire spread, which enables us to define the boundaries of this area in a preliminary fashion. Theoretically, if a fire occurs on flat terrain with no slope or influence from the wind and with a consistent fuel source, it should trace a circular spread pattern; however, this is highly unlikely to be the case. Usually, wind direction and speed, the slope of the terrain and the configuration of the fuel itself generate a unique spread pattern in each case. Therefore, if the wind is blowing at high speeds, this will tend to generate a prolonged perimeter and there may even be secondary ignition sites in front of the head caused by the flying embers that will lead to new fires; or two slopes separated by a river bed will create a perimeter that branches off along each of the lines with the steepest slope.

A fire perimeter is basically defined by the following elements: the *heel* is the part of the fire that progresses at the slowest propagation speed; the *head* is the part of the fire that progresses at the highest propagation speed due to the effects of the wind, slope or a combination of these two vectors; the *left and right flanks* are the lateral parts of fire progression (sometimes, a flank may evolve into a head). Thus, the area of origin is always closest to the heel area, because this is the part of the fire that evolves or progresses the least.

Application of the physical evidence method

Once the fire origin area has been established, we shall apply the physical evidence method, whereby marker flags will be used to indicate the direction of propagation of the fire. Certain elements of physical evidence can help us interpret the direction that the flames took as the fire progressed in each case, enabling us to gradually narrow down the origin area and determine the point of origin and spread.

Some of the most relevant types of physical evidence that we may find in the burnt area include:

Table 19.1 BASIC HUMIDITY OF FINE DEAD FUEL
DAY: From 8 a.m. to 8 p.m., solar time

Dry bulb temperature °C	Relative air humidity (%)																				
	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100
< 0	1	2	2	3	4	5	5	6	7	8	8	8	9	9	10	11	12	12	13	13	14
0 - 9	1	2	2	3	4	5	5	6	7	7	7	8	9	9	10	10	11	12	13	13	13
10 - 20	1	2	2	3	4	5	5	6	6	7	7	8	8	9	9	10	11	12	12	12	13
21 - 31	1	1	2	2	3	4	5	5	6	7	7	8	8	8	9	10	10	11	12	12	13
32 - 42	1	1	2	2	3	4	4	5	6	7	7	8	8	8	9	10	10	11	12	12	13
> 42	1	1	2	2	3	4	4	5	6	7	7	8	8	8	9	10	10	11	12	12	12

Add the appropriate corrective amount according to the Monthly Correction Tables.

Table 19.2 BASIC HUMIDITY OF FINE DEAD FUEL
NIGHT: From 8 p.m. to 8 a.m., solar time

Dry bulb temperature °C	Relative air humidity (%)																				
	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100
0 - 9	1	2	3	4	5	6	7	8	9	9	11	11	12	13	14	16	18	21	24	25+	25+
10 - 20	1	2	3	4	5	6	6	8	8	9	10	11	11	12	14	16	17	20	23	25+	25+
21 - 31	1	2	3	4	4	5	6	7	8	9	10	10	11	12	13	15	17	20	23	25+	25+
32 - 42	1	2	3	3	4	5	6	7	8	9	9	10	10	11	13	14	16	19	22	25	25+
> 42	1	2	3	3	4	5	6	6	8	9	9	9	10	11	12	14	16	19	21	24	25+

No correction required, direct calculation.

Table 19.3 MONTHLY CORRECTION TABLE OF FINE DEAD FUEL HUMIDITY
MAY - JUNE - JULY
DAY: From 8 a.m. to 8 p.m., solar time
EXPOSED (Less than 50% of fuels in the shade)

Exposure	Slope	Solar time						
		8,00	10,00	12,00	14,00	16,00	18,00	20,00
North	0 - 30 %	3	1	0	0	1	3	
	> 30 %	4	2	1	1	2	4	
East	0 - 30 %	2	1	0	0	1	4	
	> 30 %	2	0	0	1	3	5	
South	0 - 30 %	3	1	0	0	1	3	
	> 30 %	3	1	1	1	1	3	
West	0 - 30 %	3	1	0	0	1	3	
	> 30 %	5	3	1	0	0	2	

SHADED (More than 50% of fuels in the shade)

Exposure	Slope	Solar time						
		8,00	10,00	12,00	14,00	16,00	18,00	20,00
North	Todas	5	4	3	3	4	5	
East	Todas	4	4	3	4	4	5	
South	Todas	4	4	3	3	4	5	
West	Todas	5	4	3	3	4	4	

Flat terrain = SOUTH exposure.

Table 19.4 MONTHLY CORRECTION TABLE OF FINE DEAD FUEL HUMIDITY
FEBRUARY - MARCH - APRIL - AUGUST - SEPTEMBER - OCTOBER
DAY: From 8 a.m. to 8 p.m., solar time
EXPOSED (Less than 50% of fuels in the shade)

Exposure	Slope	Solar time						
		8,00	10,00	12,00	14,00	16,00	18,00	20,00
North	0 - 30 %	4	2	1	1	2	4	
	> 30 %	4	3	3	3	3	4	
East	0 - 30 %	4	2	1	1	2	4	
	> 30 %	3	1	1	2	4	5	
South	0 - 30 %	4	2	1	1	2	4	
	> 30 %	4	2	1	1	2	4	
West	0 - 30 %	4	2	1	1	2	4	
	> 30 %	5	4	2	1	1	3	

SHADED (More than 50% of fuels in the shade)

Exposure	Slope	Solar time						
		8,00	10,00	12,00	14,00	16,00	18,00	20,00
North	Todas	5	5	4	4	5	5	
East	Todas	5	4	4	4	5	5	
South	Todas	5	4	4	4	4	5	
West	Todas	5	5	4	4	4	5	

Flat terrain = SOUTH exposure.

Table 19.5 ONTHLY CORRECTION TABLE OF FINE DEAD FUEL HUMIDITY
NOVEMBER - DECEMBER - JANUARY
DAY: From 8 a.m. to 8 p.m., solar time
EXPOSED (Less than 50% of fuels in the shade)

Exposure	Slope	Hora Solar						
		8,00	10,00	12,00	14,00	16,00	18,00	20,00
North	0 - 30 %	5	4	3	3	4	5	
	> 30 %	5	5	5	5	5	5	
East	0 - 30 %	5	4	3	3	4	5	
	> 30 %	5	4	3	2	5	5	
South	0 - 30 %	5	4	3	2	4	5	
	> 30 %	5	3	1	1	3	5	
West	0 - 30 %	5	4	3	3	4	5	
	> 30 %	5	5	4	2	3	5	

SHADED (More than 50% of fuels in the shade)

Exposure	Slope	Hora Solar						
		8,00	10,00	12,00	14,00	16,00	18,00	20,00
All	All	5	5	5	5	5	5	

Flat terrain = SOUTH exposure.

Table 19.6 PROBABILITY OF IGNITION

DEGREE OF SHADING %	DRY BULB TEMPERATURE ºC	HUMIDITY OF FINE DEAD FUEL %															
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0 - 10	40 +	100	100	90	80	70	60	50	40	40	30	30	30	20	20	20	10
	35 - 40	100	90	80	70	60	60	50	40	40	30	30	20	20	20	10	10
	30 - 35	100	90	80	70	60	50	50	40	30	30	30	20	20	20	10	10
	25 - 30	100	90	80	70	60	50	40	40	30	30	20	20	20	20	10	10
	20 - 25	100	80	70	60	60	50	40	40	30	30	20	20	20	10	10	10
	15 - 20	90	80	70	60	50	50	40	30	30	30	20	20	20	10	10	10
	10 - 15	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	5 - 10	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	0 - 5	90	70	60	60	50	40	40	30	30	20	20	20	10	10	10	10
10 - 50	40 +	100	100	80	70	60	60	50	40	40	30	30	20	20	20	20	10
	35 - 40	100	90	80	70	60	50	50	40	40	30	30	20	20	20	10	10
	30 - 35	100	90	80	70	60	50	40	40	30	30	30	20	20	20	10	10
	25 - 30	100	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10
	20 - 25	100	80	70	60	50	50	40	40	30	30	20	20	20	10	10	10
	15 - 20	90	80	70	60	50	50	40	30	30	20	20	20	20	10	10	10
	10 - 15	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	5 - 10	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	0 - 5	80	70	60	50	50	40	30	30	20	20	20	10	10	10	10	10
50 - 90	40 +	100	90	80	70	60	50	50	40	40	30	30	20	20	20	10	10
	35 - 40	100	90	80	70	60	50	50	40	30	30	30	20	20	20	10	10
	30 - 35	100	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10
	25 - 30	100	80	70	60	60	50	40	40	30	30	20	20	20	10	10	10
	20 - 25	90	80	70	60	50	50	40	30	30	30	20	20	20	10	10	10
	15 - 20	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	10 - 15	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	5 - 10	90	70	60	50	50	40	30	30	30	20	20	20	10	10	10	10
	0 - 5	80	70	60	50	50	40	30	30	20	20	20	10	10	10	10	10
90 -100	40 +	100	90	80	70	60	50	50	40	30	30	30	20	20	20	10	10
	35 - 40	100	90	80	70	60	50	40	40	30	30	30	20	20	20	10	10
	30 - 35	100	80	70	60	60	50	40	40	30	30	20	20	20	10	10	10
	25 - 30	90	80	70	60	50	50	40	30	30	30	20	20	20	10	10	10
	20 - 25	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	15 - 20	90	80	70	60	50	40	40	30	30	20	20	20	10	10	10	10
	10 - 15	90	70	60	60	50	40	40	30	30	20	20	20	10	10	10	10
	5 - 10	80	70	60	50	50	40	30	30	20	20	20	10	10	10	10	10
	0 - 5	80	70	60	50	40	40	30	20	20	20	10	10	10	10	10	10

Table 19.7 INTERPRETATION OF DANGER INDEX

INLAND AND COASTAL AREAS

Probability of ignition (%)	NON-FOEHN WINDS - Wind speed (km/h)			
	0-9	10-19	20-39	>40
10 - 20	PRE-ALERT	PRE-ALERT	PRE-ALERT	ALERT
20 - 50	PRE-ALERT	ALERT	ALERT	ALARM
50 - 70	ALARM	ALARM	ALARM	ALARM
> 70	ALARM	ALARM	ALARM	EXTREME ALARM

COASTAL AREAS

Probability of ignition (%)	FOEHN WINDS - Wind speed (km/h)			
	0-9	10-19	20-39	>40
10 - 20	PRE-ALERT	ALERT	ALERT	EXTREME ALARM
20 - 50	ALERT	ALARM	ALARM	EXTREME ALARM
50 - 70	ALARM	ALARM	ALARM	EXTREME ALARM
> 70	ALARM	EXTREME ALARM	EXTREME ALARM	EXTREME ALARM

PRE-ALERT:	Low to moderate danger. No special precautions.
ALERT:	Moderate danger. Resources must be ready to be mobilised.
ALARM:	High danger. Preventive surveillance needs to be intensified. Access to forest areas may be limited. Fire-fighting resources must be fully prepared. The general public must be informed through the media to take preventive measures.
EXTREME ALARM:	Extreme danger. Very high probability of multiple large fires. Emergence of secondary outbreaks caused by sparks. No fires should be allowed in the vicinity of forests (bonfires, barbecues, agricultural burnings, etc.). Access to forests should be limited as much as possible. Forest tracks should be closed. All resources must be fully prepared. The general public must be informed through the media to take preventive measures.

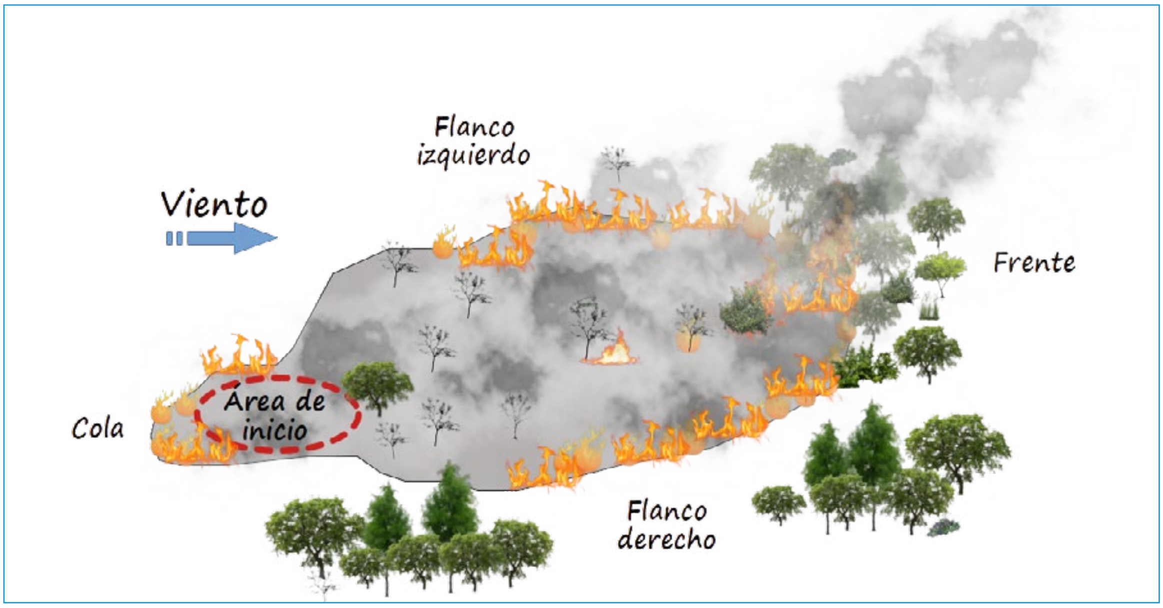
1. Degree of damage: The degree of damage increases as the fire progresses given that, as it spreads it gives off increasing amounts of energy through a process of feedback; thus, in the fire origin area, when still in the incipient stage, the degree of damage will be lower.

2. Foliage freeze: In the vicinity of the origin area of an incipient fire, foliage freeze caused by the radiation heat of the fire renders the branches less turgid, forcing them to point in the direction of the heat source. However, in a rapidly spreading fire, foliage freeze or petrification will be oriented in the direction toward which the flames are spreading.

3. Flaking on tree bark: Sometimes there may be flaking of the bark on the trunks of relatively thin trees and brush on the side opposite to that which received the impact of the flames. In other words, flaking indicates the direction in which the fire was headed.

Photo 19.1 Exfoliation on stalks. Sometimes the bark becomes detached from the stalk in the area less ex-posed to the flames, unlike the case with rocks.

Infografía 19.1 Partes de un incendio



4. Flaking of rocks: Some types of rocks that are not highly fire-resistant may display flaking in the flame impact area, i.e. this indicates the direction where the fire came from.

Photo 19.2 Spalling of rocks. The effect of the flames on rocks sometimes causes spalling in the areas most exposed to the fire.

5. Charring: Tree trunks or stumps may have a mosaic-like or crocodile skin appearance if there is deeper charring of the wood, which appears on the side most exposed to the fire, where the flames reached.

Photo 19.3 Charring. can be seen on the trunk, caused by a more intense combustion, also known as crocodile skin, demonstrating that this area was more exposed to the flames, which also indicates that this is the direction where the fire came from.

6. Grass stems: If grass is near the point of origin, it will curl or fall in this direction; additionally, as a general rule, grass stems fall in the opposite direction to the passage of the flames while at the same time generating a bevel cut, with the highest part of the cut pointing in the direction in which the fire was progressing. If some time has passed since the fire occurred, we may observe that vegetation has begun to regenerate in the less exposed area, i.e. the direction the fire was heading.

Photo 19.4 A bevel cut occurs on grasses, with the lower part of the cut on the fire approach side and the higher part facing the direction the fire was heading. In this case, the fire was spread-ing from right to left.

Photo 19.5 Grasses and other herbaceous plants fall in the opposite direction to the passage of the flames.

Photo 19.6 As soon as the fire has passed and a bit of moisture or precipitation falls, grasses will begin to sprout again. Even in this period, we can see that regeneration is stronger on the side less exposed to the fire. In this photo, the direction of propagation would be from the lower right vertex to the upper left vertex.

7. Exposure-protection*:* Fuels and other objects or materials found close to the area of origin are marked by the fire, with the side not exposed to the passage of the flames being protected. In other words, the more exposed part will indicate where the fire came from and the more protected part shows us where the fire was headed. This evidence can be seen quite clearly on rocks, no matter how small, and on other non-combustible objects such as cans or bottles that may have been left on the ground. It is important to note whether the rock or other non-combus-tible element has a well-defined bed on the ground underneath it, and that it was not subsequently moved. We can even observe an area with greater exposure and more damage on snail shells, which sometimes display an orifice on the shell, compared to the area in the direction the fire was heading, which will be much less affected.

Photo 19.7 Exposure and protection. On stones and other non-combustible elements on the ground that have not been moved, we can see one area more exposed to the fire, in the direction it came from, and a protected area, which indicates the direction in which it was moving. In this case, the fire was moving from right to left.

Photo 19.8 Exposure and protection. Similar to the example above, in this case the fire was spreading from left to right, as seen in the traces of unburnt pine needles on the right-hand, protected side. There is also a snail shell displaying greater damage on the left side.

Photos 19.9 Exposure and protection. In these two images of the same piece of evidence, we can see that the lower part of the slope shows greater exposure to the fire (photo below) whereas on the opposite side, in the upper part of the slope, part of the trunk is not burnt, having been more protected from the effects of the flames (photo above).

8. Sooting and adherence: Soot will always be deposited on the side from which the fire approaches, leaving the unexposed side cleaner. We can observe this on wire mesh, fences, walls or isolated medium-sized rocks. Similarly, the combustion process causes certain substances to distil and water vapour to condense, and ashes may adhere to these surfaces. This mixture of substances creates a tacky layer of particles (white stains) that are deposited on solid objects as the fire progresses, indicating the point of impact of the propagation line.

Photo 19.10 The area with more sooting indicates the side most exposed to the fire, i.e. where the flames came from.

9. Ash colour: An abnormality on the burnt ground, which is mostly black, caused by white ash, may be indicative that the fire remained at this point for a longer period of time, leading the combustion process to be more intense. This is sometimes caused by the presence of a greater fuel load in this area.

10. Charring marks or patterns on tree trunks: When there is a static heat source, such as an incipient fire before it spreads, an L-shaped char mark may be found, with the more affected part of the trunk being closer to this heat source. However, we most often find char marks on tree trunks caused by a dynamic fire, which spreads at varying speeds depending on the wind, slope or convection currents. Thus, char marks will be seen in a lower area on one side of the tree trunk and higher up on the

other side. We might, in principle, be led to think that, as is the case in a fire with a static source, the higher char marks would be in the more exposed area, i.e. the side where the fire came from, but this is not the case. The side of the trunk on which the char marks are higher actually indicates the direction in which the fire was heading, the place toward which the flames were progressing. This happens due to a suction process that occurs on the opposite side of the trunk from where the fire approaches, caused by the propagation of heat through convection. The cut or dividing line of the char mark created by the flames scorching the trunk, which runs from forward to back and bottom to top, traces an upward curve toward the point where the fire is heading. Sometimes, if the wind is blowing in the opposite direction to the progress of the flames, for example in the fire backing, these char marks may tend to be more horizontal. On the other hand, if the direction of fire propagation is influenced by slope, as well as the wind, the difference in height between the entry and exit points will be much more obvious.

Photo 19.11 Scorching due to convection: In the image we can see that the fire, progressing from right to left, has engulfed the pine tree trunk and that the flames reach higher on the side oppo-site the direction they came from as a result of the suction caused by convection.

Photo 19.12 Char mark on a trunk. In this image we can see a char pattern generated by a situation similar to the previous one, in which the fire progressed from right to left, rising in height on the side opposite that from which it came.

Locating the point of origin and ignition

Once the fire origin area has been marked out and the point of origin and ignition of the fire has been determined, the next task is identifying the source of ignition. The point of origin (origin of the heat source that produces ignition) and the point of ignition (point from which the fire spreads over host vegetation fuel) may or may not coincide. For example, in a fire caused by a discharge from a high voltage power line, the point of origin will be at or around the power line element that caused the discharge and the point of ignition will be the spot where the glowing element that led to the propagation of the fire on the fuel landed; similarly, the point of origin in a fire caused by a barbecue that gives off flying embers will be the barbecue itself, as the origin of the fire, but the ignition point will be the spot where the embers bell on the fine fuel from which the fire ignited.

Sometimes, identifying the ignition source is relatively easy, as in the examples described above, but other times it can be quite complex because the fire may have destroyed the evidence of this source. Therefore, after we have marked out and cordoned off the area in which the ignition point is located, we must lay out parallel lanes using stakes and twine, being careful to avoid stepping on and destroying any possible evidence. The recommended lane width is shoulder width, so that, in a kneeling or squatting position, we can cover the entire area marked out with the help of one or two rulers to demarcate each section of the lane to be surveyed, using a magnifying glass, trowel, magnet and sometimes a sieve to sift through materials, searching for possible clues that will help us identify the ignition source, such as remnants of a fuse, matches, cigarette butts, metal filings or particles from a saw, welding device, electrical cable coatings, etc.

Conducting the crime scene investigation

The crime scene investigation described here must only be conducted by specifically trained specialised professionals with prior experience who are legally competent to perform this task. Therefore, in Spain, this duty may only be carried out by forestry or environmental agents, who are often members of the Wildfire Investigation Brigades (BIIF), or by members of national law enforcement agencies like the Civil Guard, through SEPRONA, or regional police forces – where these exist and are competent to perform environmental crime investigation activities – given that in their capacity as judicial police departments they are legally empowered to conduct this type of investigations, which often have criminal implications.

In turn, the crime scene investigation, which constitutes virtually all the material evidence in the investigation of a fire, must be recorded in an extensive photographic report including georeferencing, a general reference map, specific location map and detailed site map of the area affected by the fire and of possible clues and evidence identified; videos of the fire progression and of the visual inspection itself are also required, in addition to sketches or diagrams and a topographic map showing the perimeter and the affected area; it must include records of the inspection and of voluntary statements made by possible witnesses, the gathering of clues that could become a source of proof under appropriate guarantees of identification and inviolability of the sample and the chain of custody and any other documents aimed at assessing the damage, determining the causes and identifying the responsible parties, whether individuals or legal entities, as the alleged perpetrators of the crime. All of this must be taken down in writing in the ensuing technical report on the determination of the wildfire causes and, where applicable, in the enquiries leading to the corresponding statement, whenever the fire was caused by actions that are liable to criminal prosecution. Obviously, fires generated by natural causes such as lightning do not require a statement to be drawn up, other than preliminary informative enquiries reported to the competent judicial body, due to the possible implications that the fire may have.

As indicated above, the causes of the wildfire shall be determined on the basis of the set of physical evidence gathered and the natural cause or human activity indicators, establishing hypotheses that must be validated by statements from possible witnesses, when these exist, thus constantly enabling a logical scientific reconstruction of the fire from its outbreak.

Inductive procedure

Activity indicators

Up to now we have mainly discussed the deductive investigation side entailed in the wildfire investigation methodology. Now, we will take a look at that supplementary aspect, the inductive investigation, based on prior experience gleaned from other wildfires investigated in the past.

A series of items are outlined below that characterise the set of indicators for some of the main causes and motives for wildfires, to be used as support and guidance in the determination of the origin of the wildfire, listing situations, characteristics and observations that are most often seen in each of the possible situations described:

1. Natural causes: Activity indicators lightning-caused wildfires

1. Ignition source: Dry thunderstorm, lightning.
2. Cloudy sky, presence of cumulonimbus clouds, dry thunderstorm, thunder.
3. Presence of predominant trees or tree-tops above the canopy.
4. Presence of ferns or other indicators of ground moisture, acting to attract electricity.
5. Generally, fires break out inside the canopy cover.
6. Disturbed soil, shattered or rounded rocks.
7. Sometimes melted glass materials are seen.
8. The affected trees usually stand out above the others or are located along ridgelines, and display signs of recent lengthwise or spiral rips running from top to bottom.
9. Often several ignition sites appear when lightning has struck more than once in the same area.
10. Holdover fires may be generated, which can remain dormant for up to several days after the storm was recorded, waiting for moisture and temperature conditions that are more conducive to propagation.
11. Char marks appear on wood posts (old telephone or power lines).
12. It is common to receive witness statements.
13. Under lightning rods or high voltage lines the behaviour may differ.
14. There are official records of lightning strikes, which must be consulted (the Spanish national weather service, AEMET, keeps their own records).

2. Accidental or reckless causes

2.1. Activity indicators for wildfires caused by railroads

1. Ignition source: Sparks of diverse origins, brake shoes, etc.
2. Origin of fires linked to passage of trains (check if timing matches).
3. Appearance of several ignition sites along the railway line.
4. Poor maintenance of rights-of-way or safety zones, showing abundant vegetation.
5. Witnesses: Local residents usually observe flying sparks, which are sometimes quite obvious.
6. They may be caused by:
    1. Mechanical failures in braking systems, which can generate large quantities of sparks as the brakes scrape against the wheels (check for irregular wear, conditions of braking elements, etc.). These are more common on cargo trains, especially when they are overloaded, and in braking areas (curves, tunnels, slopes, etc.).
    2. Diesel locomotive exhaust systems, especially older ones, on non-electrified lines, may give off sparks in the form of glowing cinders through the exhaust pipe due to incomplete combustion or lack of maintenance and cleaning of the gas emissions system.
    3. Maintenance work on tracks, due to the use of welding equipment, grinders, lapping machines, etc., without taking due precaution.
    4. Falling objects or cargo, carriage and transport of hazardous materials (such as burning cargo that releases embers).
    5. Objects placed on the tracks (children's toys).
    6. Electrified lines: catenary failures, grounding, signalling and traffic wires, etc., in contact with vegetation.

2.2. Activity indicators for wildfires caused by agricultural equipment

1. Ignition source: Sparks or glowing materials of diverse origins.
2. Agricultural work done with farming equipment (harvesters, balers, shredders, harrows, ploughs and

other farm implements) or forestry equipment (bulldozers, string trimmers, harrows, etc.).
3. Fires starting accidentally due to overheated machinery, generally old or poorly maintained working elements (bearings, belts, electrical failures, etc.).
4. These are sometimes prompted by the presence of fine fuels (such as a harvester reaping grain and baling straw).
5. They normally start at the end of the day, after many hours of operation.
6. Exhaust pipes without spark arrestors (sometimes there are several ignition sites).
7. On rocky terrain, the friction of the implements against the rocks causes sparks, especially when there is warm, dry wind.
8. Fires caused by electric arc or shock between the machinery or implement and power lines (check the height of the machinery and the lines).
9. Friction from cables used in wood harvesting.
10. The person in charge of the work usually admits the facts.
11. Witnesses: The employees of the farm itself usually avoid making statements.

2.3. Activity indicators for wildfires caused by power lines

1. Ignition source: electric discharge, electric arc, glowing materials, heat conduction, burning animals, etc.
2. Short circuit caused by contact between two phases or breakage of a conductor, leading to the release of glowing material in the form of sparks (windy days, flocks of birds spontaneously taking flight).
3. Breakage of insulators or insulator chains.
4. Vegetation in contact with or in close proximity to conductors (assess line sag caused by conductor expansion resulting from high temperatures).
5. Braided insulated power line cables may experience wear on the insulation as it rubs against vegetation.
6. Reduced safety distances between vertically arranged conductors due to expansion, flocks of birds perching, insulators in poor condition, etc.
7. Lines in poor condition (twisted, fallen, rotting poles and supports, frayed cables, illegal connections that infringe regulations, very old lines, etc.).
8. Grounding devices, which are designed to channel toward the ground any overloads that may occur, whether caused by lightning or accidents (short circuits, impact with machinery, etc.), in poor upkeep conditions or surrounded by fine fuel (grasses).
9. Line overload leading to broken fuses, which are intended to protect the line and transformer, and could fall in burning condition onto fine fuel.
10. Power surges leading to increased temperatures on splices, clips and connectors, or anti-electrocution devices for birds, causing the release of glowing materials.
11. Electrocuted animals or collisions of birds in flight, which may catch fire and fall to the ground.
12. Witnesses: It is advisable to look for witnesses among the residents of the homes powered by the line to corroborate possible power outages and match the timing of the outage to that of the fire origin.
13. Immediacy of the power company in repairing the power outage.
14. Several ignition sites may be found along the line, caused by glowing particles falling at diverse points where a power outage has occurred.
15. Check history from previous years, as there may be recurring issues on a single line.
16. Lower voltage distribution lines belonging to owners of smaller properties usually display greater maintenance and upkeep issues.

2.4. Activity indicators for wildfires caused by military operations

1. Ignition source: Ammunition, burning materials of diverse origins, explosions, deflagration, bonfires, sparks.
2. Firing ranges and military training grounds.
3. Training activities with live ammunition, blanks, tracer ammunition, flares, smoke grenades, explosives, etc.
4. Survival camps and training activities (bonfires, stoves for heating individual camping rations, cigarette butts, burning rubbish, waste left behind, etc.).
5. Remnants of unexploded ammunition left behind (auto-ignition, deflagration or spontaneous explosion due to deterioration of materials accompanied by high temperatures).
6. Manoeuvres and training exercises with heavy vehicles (tanks, tracked vehicles, overheated engines, friction of metal elements against stones, etc.).
7. Aerial assets performing take-off and landing manoeuvres (for example, Osprey rotors in hover mode and vertical take-off).
8. Testimony: It is usually hard to get statements from military personnel. Neighbouring residents, however, often make spontaneous statements with no problem.
9. Check background information on previous fires in the same zone (they tend to happen repeatedly).

2.5. Activity indicators for wildfires caused by fireworks

1. Ignition source: propellants, sticks, powder, fuses.
2. Coinciding with holiday periods (pilgrimages, outdoor dances, patronal festivals, celebrations, etc.).
3. Festive decorations, banners, posters.
4. Remnants of rockets, fuses, sticks, firecrackers and propellants. Fine, very white lines of ash are usually found.
5. Fires often break out in the vicinity of populated areas, although it is important to remember that pilgrimages are usually held on land that is farther removed from the towns.
6. Point of origin or ignition within the canopy cover (ignition area in the case of rockets and sparklers).
7. Explosions in places where no one has been seen.
8. Unauthorised rocket launches.
9. Testimony: They almost always exist if the investigator is persistent enough. Possibility of cover-up if the fire started during the festivities.
10. Possibility of auto-ignition of unexploded rockets several days later due to deterioration of materials subject to heat.
11. Fires may start the day after the rockets were launched, when temperatures rise and relative humidity drops.
12. There have been cases of fires caused by the launching of maritime signalling flares at sites along the coast.

2.6. Activity indicators for wildfires caused by vehicle traffic

1. Ignition source: Cinders, sparks, glowing particles.
2. Cinders from exhaust pipes on steeply sloping stretches of road or straight areas appropriate for passing after stretches with curves.
3. Overheated braking or clutch systems (especially on heavy vehicles) on stretches of highways and roads with a steep incline.
4. Marks on the ground or asphalt that may indicate sparking due to friction or scraping metal elements becoming detached from the vehicle (such as an exhaust pipe falling off or breaking underneath the vehicle, or trailing safety chains on campers and trailers).

5. Traffic accidents or broken-down vehicles.
6. The machinery used to clean shoulders and ditches may cause friction on stones or metal elements.
7. Witnesses: It is often difficult to gather statements because the parties are en route. Check for 112 emergency call reports.

2.7. Activity indicators for wildfires caused by power generators, irrigation pumps and similar types of self-operating equipment

1. Ignition source: cinders, glowing particles, heat conduction.
2. Cinders or glowing particles released from the exhaust system on combustion or diesel engines (some models are equipped with a metal mesh that covers the exhaust pipe or other parts of the engine, which wears out over time due to corrosion and overheating).
3. Exhaust systems without spark arrestors.
4. Motors operating perpetually (such as irrigation pumps), surpassing the recommended operation time for the machinery and leading to overheating of the machine or some of its components.
5. Origin occurring in the afternoon or evening after many hours of operation.
6. Fires sometimes occur due to heat conduction if the motor is in contact with fine dead fuel.
7. Check whether firebreaks around the perimeter are required under regulations.

2.8. Activity indicators for wildfires caused by work done on metal structures

1. Ignition source: Glowing metal particles.
2. The responsible parties usually admit their actions.
3. Construction or maintenance of metal structures.
4. Roads: construction of guardrails, bridges, fences, etc.
5. Development areas: construction of homes, walls and general construction work.
6. Installation and repair of transmission towers.
7. Recently cut or handled iron pieces, clean, rust-free cut marks.
8. Use of tools such as welding kits, blowtorches, radial saws, etc.
9. Small ignition sites with drops of molten material in areas where welding work has been done.
10. Collect samples with a magnet.

2.9. Activity indicators for wildfires caused by agricultural work

1. Ignition source: Sparks, embers, direct contact with flames, convection, heat radiation.
2. The responsible parties usually admit their actions, but if they are employees, they may remain silent or refuse to admit their actions out of fear of retaliation from their employer.
3. Burning stubble:
    1. Dry farming crops (mainly grains such as wheat, barley, etc.).
    2. Presence of charred stubble.
    3. Quite hazardous activities which coincide with high fire risk periods, due to the rapid spread of the fire, currently banned in many places.
    4. Activities are more intense in years with large quantities of unsold hay (surplus production with very low prices, hay in poor condition due to late rains, harvest of little use due to drought, etc.).
4. Burning grasses along banks, ditches and berms:
    1. The purpose of this is to clear out and eliminate grasses and plants

along banks, borders, entrances, berms and drainage ditches.
2. Other burnt banks are often found in the vicinity of where the fire occurred, which indicates this is a common practice in the area.
3. Fires break out due to negligence, failing to properly extinguish the burn material or lighting it without any monitoring or control.

5. Burning agricultural waste:

    1. Piles of cut branches, garden waste, vine shoots, etc.
    2. The remains of other fires on the property, with recent, hot ashes or ashes recently scattered on the ground.
    3. Burning is done at the edges of the orchard or the property so as not to damage the other crops.

6. Records of smoke from fires at the area's coordinates, hours before the fire started (gather information from neighbours, possible witnesses, fire watch, etc.).
7. Sometimes the spread vector is aerial transport, because burning is done in the cultivated zone under the conviction that there is no danger.
8. Wind direction from the burn pile to the point of origin or ignition.
9. If the wind component is constant, a well-defined projection cone will be observed, displaying charred material and ashes on rooftops, walls, fences and rocks, decreasing in size as we near the ignition point.
10. In all cases it is common to find traces of other agricultural activities performed recently on the same farm (reaping, harvesting, irrigation, pruning, clearing, etc.).
11. Traces of the farmers' attempts to extinguish the fire are often found (cut branches, scraping on the ground, tools left behind, cleared ground, traces of water, etc.).

2.10. Activity indicators for wildfires caused by forestry work

1. Ignition source: sparks, embers, direct contact with flames, convection, heat radiation.
2. The responsible parties usually admit their actions, but if they are employees, they may remain silent or refuse to admit their actions out of fear of retaliation from their employer.
3. Burning forestry waste:

    1. Recently performed forestry work or operations (brush clearing, pruning, thinning, felling, harvesting, etc.).
    2. Waste piled up or already burnt in the vicinity.
    3. Winter-spring season (especially January to May) when extra precautions are not taken, relying on the weather conditions.
    4. Days with moderate to strong winds that rekindle poorly extinguished campfires.
    5. Certain fuels have a greater propensity to ignite fires (such as mulch composed of pine needles).
    6. The spread vector could be burning fuel (heat conduction or radiation) or aerial transport (projection cone of embers).

4. Forestry machinery and tools:

    1. Friction from the blades of a motorised trimmer on rocks, creating sparks.
    2. Faulty or poorly maintained chainsaws and motorised trimmers (exhaust pipes with cinder build-up, fuel exhaust released through tank lid due to wear or faulty sealing ring, etc.
    3. Refuelling with the motor running.

2.11. Activity indicators for wildfires occurring in recreational areas

1. Ignition source: glowing embers, rekindled coals.

2. The responsible parties usually admit their actions immediately.
3. If there are witnesses, they usually give an account of the events.
4. Areas heavily used by the public, receiving frequent visits by people (recreational areas, shaded zones, bathing areas such as streams and reservoirs, etc.).
5. Presence of areas lacking shrubby vegetation, containing rubbish and waste, cigarette butts, tyre marks, etc.
6. Remains of campfires, sometimes surrounded by stones, possibly poorly extinguished.
7. Piles of ashes and coals from grills or barbecues, possibly poorly extinguished.
8. Traces of recent camping activities.
9. Holiday periods (spring break, summer, long holiday weekends) and weekends.
10. Fire origin during the afternoon or evening.
11. Windy days (spread vector is wind-blown embers).
12. Partly prepared food and utensils left behind near the point of origin.

2.12. Activity indicators for wildfires caused by smokers

1. Ignition source: cigarette butts.
2. Responsible party difficult to find.
3. Witnesses difficult to locate.
4. From moving vehicles:

    1. Presence of cigarette butts in varying degrees of decay.
    2. Shoulders and ditches with abundant layers of fine dead fuel.
    3. Point of origin in ditches, shoulders and berms.

5. Pedestrians:

    1. Area of origin with abundant layers of fine dead fuel.
    2. Point of origin along edges of well-travelled paths.
    3. Areas frequented by pedestrians.
    4. Evidence of individuals walking by.

6. Check the FDFM, the probability of ignition must be greater than 70%. In roadside ditches it is possible for fine fuel to ignite when the probability of ignition is greater than 40% because certain very specific micro-climate conditions develop along road shoulders as a result of the colour and heat absorption capacity of the asphalt, in addition to the air currents (draughts) caused by vehicles passing at high speeds.

2.13. Activity indicators for wildfires caused by landfills

1. Ignition source: Embers, burning materials, radiation, deflagration, explosion.
2. Dumping sites that are illegal or non-compliant.
3. Dumping sites with flawed safety measures (lack of or faulty safety fencing, lack of firebreaks around the perimeter, presence of scattered fine fuel materials like paper, plastic, cardboard, etc.), that indicate poor management of the site.
4. Sometimes waste accumulates or is deposited at sites that are not actual landfills.
5. No separation between the waste and the wildlands.
6. Projection cone of burnt materials, plastics and other debris.
7. Small outbreaks that have not progressed.
8. More likely on windy days.
9. Evidence of the release of large amounts of energy in the form of smoke at the time of the origin of the fire and at the dumping site coordinates.
10. Infestations of rodents and other pests around the dumping site.
11. Burning domestic waste in areas where there is no rubbish pick-up.

12. Activities involving metal or iron recovery (waste selected and piled), scrap, remnants of burnt electrical wires for copper extraction.
13. Dumping sites may burn perpetually (which would violate the laws of some EU countries) or experience auto-ignition due to the presence of flammable materials or even fermentation of organic matter.
14. Consult records of past events.

2.14. Activity indicators for wildfires caused by beekeeping

1. Ignition source: Embers, heat radiation or conduction from the smoker fuel.
2. The responsible parties generally admit their actions.
3. Witnesses: Neighbours tends to act with a sense of protection or concealment.
4. Presence of hives in the vicinity of the fire origin area.
5. Fuel marks on the ground where the smoker was placed on top of fine fuels.
6. Debris and ashes of the material used in the smoker (rags, cardboard, pine needles, straw, dung, pine cones, etc.).
7. Smoker incorrectly used or deteriorated, leading embers to be released.
8. Evidence of handling of hives (honey extraction, disinfection, restoration of honeycomb, drops or bits of wax or honey on the ground, etc.).
9. Hives burnt possible for pest control.
10. Work is usually done during the warmest hours of the day, coinciding with high fire risk periods.

2.15. Activity indicators for wildfires caused by rituals

1. Ignition source: Candles, matches, cigars, bonfires.
2. Responsibility focused on relatively educated individuals seeking to experience new sensations.
3. Rituals generally of Afro-American or African origin.
4. They usually follow the lunar calendar.
5. Different offerings are made depending on the calendar.
6. Presence of elements with alleged protective powers in the vicinity (clay dishes, red roses, etc.).
7. Presence of matchboxes, candles, cigars, etc.
8. Presence of alcoholic beverages or remnants thereof (recently emptied or half-empty bottles).
9. Animal sacrifices (usually a rooster) may appear, sometimes subsequently burnt.
10. Near towns.
11. During the night.

3. Accidental or reckless causes

3.1. Activity indicators for intentional wildfires in general

1. Ignition source: Lighter (direct action), incendiary devices, retarder devices.
2. The responsible parties rarely admit their actions.
3. Witnesses: With some exceptions, they are difficult to locate, but are crucial for prosecution of the crime.
4. The source of ignition is not often found (in the event of a direct action, the lighter goes back into a pocket).
5. Retarder devices (fuses, candles, cigars with matches, etc.), which enable the perpetrator to leave the crime scene up to several hours before the time of fire origin.
6. Incendiary devices or accelerants (materials soaked in flammable liquids, barbecue firelighters, matchboxes, etc.) that make it possible to guarantee a sufficient heat supply to start a fire.
7. Combined retarder and incendiary devices sometimes.
8. Occasionally, several ignition sites. This indicator often confirms the intentional nature of the fire. However,

it must be confirmed that this is not a case of reburn, secondary ignition sites or origins such as power lines, railways, etc., which could prompt there to be more than one outbreak.

9. More frequent during the central hours of the day (when the degree of flammability or probability of ignition is greater) or at dusk (when the darkness offers cover to the perpetrator).
10. Near highways and roads of all kinds, enabling the perpetrator to quickly escape from the crime scene.
11. On roads, the point of origin is usually located at the top of a berm (the fire is lit on the road itself and the perpetrator quickly leaves in a vehicle).

3.2. Activity indicators for intentional wildfires due to livestock interests

1. Signs of the presence of livestock, areas with livestock operations (pastureland).
2. Brush growing for three years or more.
3. Invasive shrubby vegetation in pasture areas.
4. Evidence of previous fires in the area.
5. There are no animals on the property that day that could be affected by the fire.
6. Check records for fires registered in the same area in previous years (summary log), as they tend to be recurring.
7. Common practice firmly entrenched in some areas, districts or regions.
8. Usually coinciding with certain weather conditions.

3.3. Activity indicators for intentional wildfires due to hunting interests

1. There may be diverse motives behind intentional fires arising from conflicts or interests related to hunting:

    1. Creation of pastureland to benefit game.
    2. Facilitating access to the property for hunting practices.
    3. Scaring away wild animals that damage crops (wild boar), overpopulations of predators (mongoose, fox, wolf), etc.
    4. Revenge for reporting poaching activities, members expelled from the hunting club, etc.
    5. Changes in the administrative conditions of the reserve.

2. Presence of dense brush that hinders certain species from reproducing and feeding properly (partridge, rabbit, roe deer, etc.), which require open grazing areas and new growth to feed on.
3. Access routes blocked with abundant shrubby vegetation that hinders hunting activities.
4. Devices for scaring away wild animals (e.g. carbide cannons).
5. Damage to agricultural crops caused by wild animals.
6. Large numbers of predatory mammals (foxes, mongooses, etc.) that have an impact on game.
7. Point of origin located at the entrances to rabbit burrows (practices involving smoking out burrows to facilitate the hunt, sometimes aided by ferrets).
8. Hunting reserve signs torn down, destroyed or shot at.
9. Recent expansions or segregations of the hunting reserve.
10. Recent expulsion of members for violating internal rules, delays in payments, poaching, etc.
11. Recent changes in ownership, expiry or renewal of contracts, etc.
12. Recent reports or threats of poaching.

3.4. Activity indicators for intentional wildfires for the purpose of wildland transformation

1. Conversion into farmland:

    1. Uncut invasive vegetation on worked land, orchards, etc.

2. Borders between farmland and wildlands.
3. Large-size burning debris (stumps, roots, etc.)
4. Clearing of paths, entrances, etc.
5. Expansion of farmland, extending into forested terrain.
6. Highly profitable crops (olive trees, greenhouses, strawberries and other red fruits, avocados, etc.).

2. Urban development:

1. Dense shrubby or woody vegetation.
2. Clearing plots of land to facilitate construction.
3. Recent division into lots.
4. Illegal buildings in the area on rural land, lacking construction permits, in protected areas, etc.
5. Reappraisal of the land after the shrubby vegetation is cleared.
6. Recent changes in ownership of the land (inheritance, real estate transactions, segregations, etc.).
7. Areas where second homes are common, relatively near major cities.
8. Illegal occupancy of livestock trails or public wildlands.
9. Developable land covered in forest vegetation.
10. Lands adjacent to developed areas, golf courses, residential developments, industrial parks, etc.
11. Check the zoning category of the land and the legality of the buildings.

3.5. Activity indicators for intentional wildfires motivated by revenge

1. Lawsuits or disputes between neighbours relating to borders and property divisions, wells, irrigation, inheritance issues, etc.
2. Lawsuits or disputes among owners and tenants relating to termination, rescission, non-renewal or breach of leasing agreements, delays in payments or financial debt, etc.
3. Revenge motivated by claims, fines imposed or other financially-related conflicts.
4. Personnel excluded from selective examinations for entry into fire prevention and extinguishing forces.
5. Several, sometimes even numerous, ignition sites.
6. Occasionally, there is proof of a manifest intention to harm third parties.

3.6. Activity indicators for intentional wildfires caused by children playing

1. Areas where children often play.
2. There have been cases of fires started by minors so that they can watch the extinguishing efforts.
3. In the vicinity of settled areas.
4. Sometimes it is possible to find the ignition source used (matches, lighters, etc.), if it was left behind in fear of the consequences.
5. In the case of vandalism, it is not easy to establish a motive, there is no apparent motive.

3.7. Activity indicators for intentional wildfires caused by extremists or revenge against the authorities

1. During election periods or campaigns.
2. Iconic local or regional public wildlands.
3. Important dates (local, regional or national holidays, festivals, pilgrimages, other festivities, etc.).
4. Hostility about measures taken by the government relating to wildland management.
5. Recently expropriated property.
6. Opposition to declarations of protected natural spaces or measures imposed, due to the restrictions they entail.
7. Recently performed government actions taken (demarcation of public

lands, livestock trails, demolition of illegal homes and buildings on protected land, court-ordered repossession, administrative fines, etc.

3.8. Activity indicators for intentional wildfires caused for the purpose of eliminating bothersome situations

1. Areas in the vicinity of towns, residential developments, interface areas, etc.
2. Presence of infestations or elimination of pests such as rodents, snakes or insects (ticks, spiders, etc.).
3. Places generally covered in waste, rubbish or abundant vegetation somewhat near to inhabited homes.
4. Presence of rubbish containers in the vicinity of wildlands.
5. Unwelcome activities carried out by residents (places where sexual activities or prostitution are common, outdoor drinking, presence of drug addicts, etc.).

3.9. Activity indicators for intentional wildfires caused when committing other crimes

1. Destruction of evidence (e.g. vehicle stolen and subsequently burnt).
2. Fires started as a police distraction in order to facilitate the perpetration of other criminal activities (smuggling, drug trafficking, illegal entry of immigrants, etc.).

3.10. Activity indicators for intentional wildfires caused by pyromaniacs

1. This motive must be excluded unless the identity of the perpetrator is known.
2. Pyromaniacs find it hard to resist the impulse, motivation or temptation to carry out acts that could be harmful to themselves and others.
3. They feel tension or emotional triggers prior to committing crimes.
4. They display fascination, curiosity, attraction or a special interest for fire and everything related to how it develops. They may even act as employees or volunteers in fire watch and wildfire extinguishing forces.
5. They enjoy watching the destructive effects of fire and taking part in the consequences thereof, which gives them a sense of well-being, gratification and a release of the pre-existing tension when they light a fire. After committing the crime, they may or may not experience regret, guilt or self-reproach.
6. Their cognitive, intelligence and planning capacities, etc., remain intact.
7. The fire cannot be related to any kind of financial motive or socio-political ideology, as a means of covering up other criminal activities, a way of expressing rage or revenge, or for the purposes of improving the circumstances of their own lives.
8. Sometimes this condition is disguised by other mental disorders that are manifested through pyromaniac activity. However, from a psychiatric perspective, these disorders preclude pyromania, strictly speaking. Therefore, pyromania is not the case:

    1. If the fire was started in response to a delirious idea or hallucination.
    2. If the fire arises from impaired judgement, as a result of dementia, mental retardation or substance abuse (drugs, alcohol, etc.).
    3. If the fire is caused by the presence of a conduct disorder, a manic episode or an antisocial personality disorder.

9. A diagnosis of pyromania must be reviewed by a qualified professional (psychologist, psychiatrist, forensic doctor, etc.).
10. It is usually difficult to establish behavioural patterns.

4. Activity indicators for wildfires caused by secondary ignition sites

1. Secondary ignition sites created when burning materials are transported away from the primary fire site.
2. These are normally coals, pine cones, embers or other burning materials that can be blown very long distances due to the effects of convection from the fire and the action of the wind.
3. They almost always coincide with very intense fires in which there are strong winds.
4. In areas with steep slopes, glowing or burning tree trunks may roll downhill.
5. Burning animals fleeing from the primary fire.
6. These must be distinguished from intentional fires; they cannot be categorised as such merely due to the appearance of several ignition sites.
7. Look for potential witnesses that can confirm seeing windborne burning materials.
8. Check the spread vectors involved in the primary fire (convection, wind force and direction, slope, etc.), and the joint actions thereof (sum of vectors).
9. With a wind speed of 8 km/h, embers can reach a height of 30 metres at a distance of 1 km from the primary fire, generating secondary ignition sites up to 3 km away. If the wind speed is 64 km/h, the distance from the primary fire at which the embers reach a height of 30 metres is 6 km, thus causing secondary ignition sites at a distance of 10 km from the primary fire.

20. CROSS-BORDER COOPERATION IN WILDLIFE CRIMES: INVESTIGATION OF WILDLIFE TRAFFICKING

Much has been written on a global scale about environmental crime in general and about wildlife trafficking in particular, and it certainly ranks among the five most important areas of crime. There is a wide range of literature by both international organisations and scholars, so we would not be mistaken in asserting that there are nearly as many, if not more, people devoted to studying this topic as there are to fighting it.

However, it is about time that we stopped questioning how relevant environmental crime is. In other words, without discussing the battle of figures and the speculation on how the volume of illicit business should be classified, environmental crime has such undeniable effects on habitats and, as such, on humans that any financial disquisitions on the matter boil down to an exercise in cynicism or, at the very least, affectation. The consequences of environmental crime, particularly species trafficking, are serious enough for it to be considered a serious crime per se.

First of all, trafficking in wild flora and fauna species entails a whole range of related crimes: it has structures inherent to organised crime, finances terrorist activities, influences and affects human populations around the world and undeniably contributes to the imbalance of habitats and the subsequent loss of biodiversity. These reasons have a prolonged effect over time and are, in and of themselves, much more relevant than any classification that can be made regarding their economic impact, which overlooks elements that are intangible or hard to measure but that nonetheless remain present.

Therefore, regardless of criminal policy measures that are beyond investigators' reach, the latter must first of all be aware of how important their mission is. Consequently, they must be trained to deal with the challenges facing them, making the best possible use of the resources available to them depending on their position, the powers entrusted to their respective agencies or organisations and the geographic scope within which they work.

Photo 20.1 Illegal trafficking of fauna poses a serious risk to many protected species, including reptiles, one of the most commonly trafficked animal groups.

Below, we shall describe the main elements that investigators should take into account when organising their units and building criminal cases in the European Union, taking a practical approach and, when strictly necessary, referring to common features for officers in any Member State.

Organised crime and connections to other criminal activities

Not every case we come across need necessarily be linked to organised crime, but it is highly likely that at some time or another there will be some connection, whether direct or indirect. While the aim here is not to conduct an analysis of the law, in order to understand the context, let us begin by explaining certain concepts.

Organised crime: *a "criminal organisation" shall mean a structured association, established over a period of time, of more than two persons, acting in concert with a view to committing offences which are punishable by deprivation of liberty or a detention order of a maximum of at least four years or a more serious penalty, whether such offences are an end in themselves or a means of obtaining material benefits and, where appropriate, of improperly influencing the operation of public authorities.* Council of Europe, Joint Action of 21 December 1998, article 1.

The term is known as *"serious organised crime"*, and it clearly displays the need for a permanent organised criminal structure to exist in addition to the crime or crimes under investigation being classified as *"serious"*, given that the punishment for criminal offences is essentially what defines its seriousness.

Motives for species trafficking: we could highlight the construction of furniture and even homes, the attribution of alleged pharmaceutical properties, manufacturing of cosmetics, food, clothing and fashion items, pets and decorative purposes, use by tourists and collectors (falconry, hunting trophies, souvenirs). CITES Secretariat.

Let us discuss these two concepts. As with any other crime entailing illicit trade, species trafficking arises because there is demand for a *product* for a specific purpose that is not available at the destination. Thus, we have points of origin, transit and destination. The point of origin may be the same as that in which the demand arises, which leads to illicit trade but not actually trafficking. If the area of demand is far away from the point of origin, then trafficking will take place, passing through transit locations.

It is easy to conclude that a framework of human resources and logistics is required to carry out this process, even in cases of trade on a local scale. Namely, suppliers that capture the specimens and sell them to intermediaries or, in some cases, to individuals that manufacture the products using the specimens, a means of transport for short, medium and long distances, concealment to avoid detection and, sometimes, forged documents until the product reaches the consumer or final recipient. We can assume that this structure operates with a defined distribution of roles and that someone must supervise how the work is organised. The essence of the crime itself demands continuity.

Despite the relevance of the elements discussed, it is not enough merely to assert that organised crime exists: there must also be a serious crime, defined primarily by the applicable punishment, as mentioned above. In this way, not all species trafficking entails a serious crime.

As of the time at which this chapter was written, Directive 2008/99/EC on environmental crimes in the EU was in the process of being amended, to be completed foreseeably in 2021. Regarding the punishment to be imposed, it states that the criminal penalties shall be "*effective, proportionate and dissuasive*". Therefore, national lawmakers are left to define the penalties to be imposed and it is not possible to generalise here.

However, there is still one important element to be analysed, and that is existence of a combination of crimes. We do not wish to make a full-blown legal assessment, but will merely outline which crimes may be linked to species trafficking:

- *Poaching*: species trafficking is inevitably linked to unauthorised hunting in order to stock its networks.
- *Use of non-selective hunting methods*: poison, cage traps, nets, snares and leghold traps are often used to hunt the specimens.
- *Smuggling*: this applies to transnational and even domestic settings, as in the case of the Canary Islands in Spain.
- *Forged documents:* false customs declarations, forging administrative documents that certify the legal origins of the specimens or products.
- *Financial crimes*: tax evasion, money laundering of the unlawfully gained profits.
- *Crimes against public health*: in cases in which the products are used as food, spreading zoonosis that could affect humans.
- *Illegal use and possession of weapons*: when the person is not authorised to

use them and when the weapons used are illegal, indirect ties to trafficking in firearms.

- *Corruption*: public officials that take part in criminal activities by diverse means, mainly for financial reasons.

Photo 20.2 Police action in which a network devoted to capturing and trafficking finches was dismantled.

While there may be other related crimes, these are the ones found most often in species trafficking investigations. Investigators must appropriately analyse the initial events they are confronted with, in line with their authority and capabilities, in order to conclude whether they are potentially facing a case involving the activities of an organised group.

Combinations of several crimes will lead to an increase in the applicable penalties, thus leading the case to be defined as serious. Therefore, the investigator's approach to the case is often the first decisive factor in terms of the scope of the investigation and its possible connections to organised crime.

Need for the flow of information and intelligence

The previous section immediately leads to the need for information and intelligence to flow. At this point, we must stop to consider the investigator's scope and responsibility. Not all major anti-crime operations begin with information that immediately points to a large organisation. Quite the contrary, it is minor bits of information that, when appropriately processed, lead to the conclusion that an organisation is behind the activities, and the intelligence resulting from one specific action may even be the basis for a new investigation.

When it comes to criminal investigations, the distribution of powers in the EU is wide-ranging, and there is no single model. The element they have in common is that there are a number of agencies tasked with criminal investigations in relation to the environment. These are:

- Police forces (Carabinieri in Italy, GNR in Portugal).
- Customs authorities (with a wide variety of criminal investigation powers depending on the Member State).
- Agencies with specific criminal investigation powers (ASAE in Portugal, NVWA in the Netherlands).
- Cross-disciplinary organisations (OCLAESP within the structure of the French Gendarmerie).

We must also mention other fundamental sources that provide information and even intelligence to other civil service bodies, without which it would be extremely difficult to gather information, prepare intelligence and even build the technical foundations of the case:

- National CITES authorities.
- Civil servants in environmental departments.

- Government environmental inspection bodies, including departments responsible for fines.
- Managers of protected natural spaces.
- Official veterinary associations.
- Non-governmental organisations and foundations.
- Universities and academia in general.

Thus, we can see that there are a number of competent national agencies, making it necessary from the outset to have certain mechanisms of coordination and a strong spirit of cooperation. Only in this way can the human and material resources available to the Member States be used as efficiently as possible and, while they are probably insufficient, the results could certainly be multiplied through the use of adequate means of coordination.

Let us look at some graphic examples to illustrate how important the flow of information and intelligence is in effectively fighting species trafficking:

Case 1: forest rangers in southern Italy locate a series of poachers of finches within a specific area, using non-selective methods (nets) that bear a relationship to each other. The Guardia di Finanza seizes several hundred finch specimens from a citizen's vehicle.

> **Option 1:** preventive actions are taken, several perpetrators are located, their activities are expedited to the administrative and/or tax authorities. The hunting incidents cease for a period of time.
>
> **Option 2:** both agencies contact the Carabinieri, each collaborating within their scope of competence. Each agency submits police enquiries to the competent court, and certain surveillance measures are authorised. A police operation is undertaken, breaking up a nationwide network devoted to the capture and trafficking of finches throughout the country for breeding in captivity and song birds and for human consumption. The organisation is dismantled and ten individuals are arrested, including one civil servant who forged tags to legitimise the illegally captured specimens. A financial investigation concludes with the confiscation of a list of assets allegedly arising from the criminal activities.

Photo 20.3 Obtaining illicit financial gains is one of the main motives behind illegal species trafficking.

Case 2: diverse items, trophies and specimens concealed in a container from an African country and declared as a type of industrial material are seized by customs authorities at the port of Rotterdam in the Netherlands.

> **Option 1:** the customs agents proceed with the seizure, report to the public prosecutor and criminal proceedings for smuggling are undertaken.
>
> **Option 2:** the customs agents proceed with the seizure and contact the competent police unit at the port facilities, along with the competent agency in terms of CITES. The joint operations are forwarded to the public prosecutor, ending with a search of the facilities of the company that was the recipient of the confiscated cargo, finding an import and distribution logistics centre for CITES items from Africa bound for diverse destinations around the world. A financial investigation is undertaken and assets allegedly arising from the network's

criminal activities are confiscated.

Case 3: the fiscal department of the Civil Guard at an airport in northern Spain conducts a risk assessment of the flights for the coming days. They locate a cargo declared as glass eels (*Anguilla anguilla)* bound for London weighing nearly half a tonne. This is intra-community trade, which is legal for the species included in CITES Appendix II, Annex B. On the black market, the shipment could range in value between € 1 and 3 million.

Option 1: despite the fact that the species is included in CITES the trade is lawful. The competent customs authorities are consulted, verifying the cargo weight and documentation. As long as no irregularities are observed, the shipment is allowed to move forward.

Option 2: the acting Civil Guard unit is aware of the notification issued by SEPRONA (the Civil Guard's Service for the Protection of Nature) regarding the transfer of any information of interest relating to legal or illegal trade of glass eels. The responsible parties report the shipment and all related details. The matter is looked into and it is found that there are several flights from London to Southeast Asia on the following two days. The information is forwarded to EUROPOL and the British authorities for their knowledge, stressing the possibility that the cargo might be diverted for illegal export to Asia after it reaches London.

These examples are based on real cases. In all three cases, the actions taken in option 1 are correct in terms of competence and procedure, and no objections could be raised in this regard. However, in all the examples, the acting agencies in the first stage initiated an action protocol based on collaboration and cooperation that ended in the dismantling of criminal organisations, even including a parallel element related to financial crime.

Therefore, the key message is that the flow of information and intelligence improves results.

One new cooperation model stemming from the EU Action Plan against wildlife trafficking in Spain is the *National Central Office for Analysis of Information about Illicit Environmental Activities*, which was created in 2018 and aims to be a channel for information analysis and creation of intelligence nationwide. It belongs to the Head Offices of the Civil Guard's Service for the Protection of Nature (SEPRONA) and in addition to its assigned responsibilities, it also issues important theme-based strategic reports on criminal trends, new modus operandi, etc.

Photo20.4 Illegal species trafficking is often linked to the perpetration of other crimes against flora and fauna and the illegal possession of arms.

International cooperation

Crime in the 21st century knows no borders, and organised crime has found certain advantages in international expansion. Cross-border activities are even more evident, if possible, in trafficking crimes, specifically species trafficking. Differing domestic laws, lack of internal coordination among competent agencies, flows through heavily trafficked points and corrupt civil servants render the transnational element increasingly important.

Within the EU, the aforementioned EU Action Plan against Wildlife Trafficking (COM (2016) 87 final) can be considered a turning point. This plan highlighted the interest of the European Commission in tackling this matter, considering that the EU is a point of origin, transit and destination for numerous specimens and products deriving from wild flora and fauna, both endangered and non-endangered. Three specific priorities were set in which the plan developed diverse multidisciplinary activities in the 2016-2020 period. Priority 2 directly pointed out the need for *"implementing and enforcing existing rules and combating organised wildlife crime more effectively"*, indicating that the EUROJUST and EUROPOL agencies were relevant and necessary actors.

To a great extent, this was spark that prompted environmental crime to be declared in 2017, for the first time, one of the priorities of the EU Policy Cycle for the 2018-2021 period. Following this declaration, the EMPACT (European Multidisciplinary Platform Against Criminal Threats) launched the *"EnviCrime"* priority led by France with joint leadership from Spain, Italy and the Slovak Republic. Two priorities – trafficking of waste and trafficking of endangered species – were developed through a strategic plan valid for the entire cycle and an annual operating plan that contains a series of specific actions led by diverse Member States to conduct certain activities throughout the year. The first annual plan called for the creation of a EUROPOL team devoted to fighting against environmental crime, which has by now been fully implemented and is operative.

It is also worth mentioning that, in addition to virtually all the EU Member States, numerous other countries in Europe and other regions of the world, as well as European agencies like EUROJUST, FRONTEX and OLAF and international organisations such as UNODC, OECD and Interpol, have also joined the EMPACT initiative.

Regardless of the level at which an investigator works, it is important to be familiar with these instruments for international cooperation for two reasons: Firstly, because many of the actions carried out by investigators are likely to result from the work of these initiatives. Secondly, because the work done by the territorial units is what enables the identification and design of priorities and the addition of resources, with the aim of providing specific operational support instruments for investigations.

Let us go back to our examples above to illustrate the importance of the international component in the investigations, whether directly or indirectly:

Case 1: the Italian authorities perform several nationwide operations of similar characteristics. Ties are found with several bordering countries so information is exchanged and an operational analysis of the information is conducted through EUROPOL. At the same time, EUROPOL spotlights the criminal trend, which is identified as relevant by several Member States and third parties. An operational action is planned within the framework of the EMPACT priority, which has an immediate effect the following year on the illegal capture and trade of finches in the EU.

Case 2: the Dutch authorities share the information with EUROPOL. By cross-checking the databases, several connections are found to fraudulent financial transactions, some of them with ties to other criminal areas such as drug trafficking. EUROPOL draws up an operational report of the results of the analysis, which is shared with the Member States and associated third parties that are the recipients of some of the confiscated products. In addition, Interpol is contacted in order to involve the authorities of the African countries of origin of the products and the Asian countries that are the ultimate recipients of the products.

Case 3: EUROPOL coordinates Operation LAKE focused on glass eel trafficking. The national liaisons in the countries involved meet periodically to exchange information and have created a system for urgent communications. The information from the Civil Guard is sent to EUROPOL, which transfers it to the United Kingdom while also contacting the NWCU (police force) and the Border Force (customs). They take action, noting that the company receiving the shipment is suspected of trafficking glass eels to Asia by forging documents and making false declarations. An investigation is undertaken and the cargo is monitored as it leaves the airport facilities, locating provisional facilities. The same company submits a declaration two days later with a shipment of fresh food products to an Asian country. The declaration is, indeed, found to be false and the glass eels were going to be exported illegally to Asia. A search of the facilities discovered uncovers an illegal temporary glass eel farm. A financial investigation is undertaken and the company's assets are temporarily seized.

The British authorities contact EUROPOL and report the results, requesting support for the return of the glass eels to the Spanish authorities and their reinsertion into nature. EUROPOL, through the Civil Guard, contacts the CITES authority and the Andalusia Autonomous Government, bearing the expenses and finally releasing the glass eels in the marshes of the Guadalquivir River.

Here, the key message is that the transfer of information and intelligence throughout Europe is necessary both for the purpose of receiving specific support and for creating a true intelligence picture of the situation in the EU.

Finally, an example of the importance of the flow of information is the work being done by the non-governmental organisation TRAFFIC in collaboration with the *"EU Wildlife Enforcement Group"* hosted by the European Commission (DG ENVIRONMENT). Among other services, TRAFFIC gathers data from national authorities on all the confiscations conducted in the EU, preparing strategic reports that are highly valuable for the creation of action plans. It also offers a website with access to relevant information and swift communication by email to get responses to queries, even urgent ones. EUROPOL regularly works with the information offered, contacts the affected countries to supplement it with operational data and uses it for specific operations and strategic purposes.

Available resources and investigation difficulties

We must be realistic. Solving environmental crimes is no easy task. Given that there are still certain tendencies in case law that question the need for these conducts to be included in the national criminal codes of criminal law, we have a long way to go before this matter becomes a priority.

That said, investigators must not be distracted by legislative limitations, given that the principle of legality is, and must be, unwavering under the rule of law; instead, they must focus on gaining an in-depth understanding of the domestic and international legal framework within which they operate so as to harness the resources made available to them as fully as possible. They must also be familiar with the coordination procedures within their own agencies and the possibilities for international cooperation discussed above. It is not uncommon for investigations to fall short of their full potential out of a lack of knowledge of the available options.

However, it is not the aim of this chapter to detail all the resources and options available for investigations, which crime investigators should be aware of anyway as part of their basic training. We would like to focus, though, on certain aspects we deem essential and relevant for investigating species trafficking.

Building the case

We have mentioned before that the investigator's approach is crucial. How far can this case go? What are our limitations? Where do we want to go with it? It is essential to go through this exercise as soon as the case shows a certain weight. Even professionals belonging to agencies that are not competent for criminal investigations need to ask themselves these questions because – we must insist – the transfer of information is crucial. On the other hand, we must also be aware of our limitations, knowing how far we can go, so that we can perform our duties with the utmost precision while also having an awareness of when we need to seek out collaboration from colleagues at other agencies.

While we do not wish to discuss in further detail the topic of combinations of several kinds of crimes mentioned above, it is important to note that the type of crime investigated affords access to certain complex investigation techniques such as monitoring methods and telephone tapping.

OSINT (open source intelligence)

Not exclusively, but very strongly, based on exploring the Internet, training in open sources is essential for species trafficking investigators. There is common, somewhat mystical and mysterious, idea that everything can be found on the "dark web". However, in this crime area, while there is evidence of activity on the dark web, it is not necessary to go there to gather information. Bearing in mind how dependent people are today on information technologies and information in general, there is a lot of data that can be collected legally, without requiring any exceptional kind of authorisation. There are numerous tools available for this, some of which offer free access while a licence must be purchased for others. A number of training levels are possible, but we strongly recommend that all investigators have at least some basic notions of OSINT. Due to confidentiality issues, this matter cannot be described in more detail.

When it comes to the online sale of wild plant or animal specimens or their by-products in what is now known as *"cyber wildlife crime"*, merely patrolling the Internet offers a source of information. Across Europe, joint activities known as *"Joint Action Days"* are being developed within the framework of the EMPACT, in addition to ISF projects (*"Internal Security Funding"*) that aim to develop and standardise procedures and to extend their practices throughout the EU. Besides these actions, there are others devoted to parcel trade inspections, related to the following point.

Undercover agents and controlled delivery

Controlled delivery is an investigative tool that is particularly relevant in the field of species trafficking for obvious reasons. Regardless of whether it falls within the competence of the acting agents or other forces or agencies must be called in for support, the option of refraining from seizing the shipment after the illicit nature of the cargo is verified and instead continuing the investigation in order to dismantle a possible trafficking network must always be contemplated.

The role of the undercover agent is a resource implemented in the legislation of certain countries (such as Spain) specifically for species trafficking. Given the complexity entailed, it is true that it must be reserved for particularly relevant, complex cases. However, we must once again stress the importance of the focus and building the case in order to be granted the pertinent authorisations from the legal authorities, primarily when it comes to combinations of crimes.

Formal tools for international cooperation

Throughout this text we are focusing on the investigation from the police perspective. Due to differences in the legislation of each country, sometimes the support requested of agencies in other countries cannot be granted without certain tools. We are referring to European investigation orders, European arrest warrants, international arrest warrants and letters rogatory, as the most relevant examples.

In this regard, EUROPOL and EUROJUST play an important role, and figures such as the OTF (*Operational Task Force*) and the JIT (*Joint Investigation Team*) facilitate specific operational support for investigations and can even validate actions taken in other countries.

Investigation difficulties

We feel there is a widespread but erroneous belief that only crimes relating to the trafficking of endangered species can and should be investigated, while cases in which the specimens are not included in any of the protected species catalogues are immediately disregarded. Moreover, it is unfortunately common that not even the glimmer of an investigation will be undertaken for protected species that do not fall under the CITES Convention or that are not included in Appendix I-Annex A (EUWR, *"EU Wildlife Regulation"*). This is what led to the radical decline in European eel (*Anguilla anguilla*) populations prior to its inclusion in CITES Appendix II-Annex B and it is also affecting many other species, such as sea cucumbers and finches.

A somewhat absurd situation has been generated, in which the species concerned must be clearly in decline before any action is taken to protect it.

This debate is being addressed as part of the process of amending the European Directive on environmental crime, but until it is clarified, the approach taken must be considered and no information about species not included in the CITES Convention or even unprotected species should be discarded. Building the case is essential, as it may be justified due to the combination of crimes or on the grounds of technical reports regarding the impact on habitats, human health, etc.

One clear example of how criminal cases can be built and joint actions promoted once the relevance of a matter is established and justified is the illicit sale of pets, especially dogs: it affects numerous European countries, is linked to crimes against animal welfare and abuse, fraud, tax evasion and money laundering, and is a clear health hazard for spreading zoonosis. All of this despite the fact that there is obviously no type of protection for dogs and cats as species.

However, the most pressing issue facing us is the lack of specialised units within the competent agencies. No matter how obvious it may seem, it is still vital to recall that, without specialised forces in units devoted at least to prosecuting environmental crime, if not exclusively to species trafficking, it will not be possible to turn any kind of strategy into operational action. Due to the technical knowledge required in this area, even experienced general crime investigators are lost when confronting this type of investigation.

Usually, the dedication, the investment in resources and success in prosecuting crimes is measured in the number of seizures made. As we have seen, nothing could be further from the truth, given that a seizure may indicate the existence of a phenomenon but it is no less true that we have probably only detected the weakest link in the chain of the criminal organisation: *"the mule"* or some other low-ranking position, who quite often is not even aware of the cargo carried or received and is quickly replaced by organisation, which undoubtedly carries on operating.

Priorities in the European Union

Through a number of organisations, the EU and its Member States take part in cooperation projects involving species trafficking prevention, training and education and species conservation in various regions around the world. This may lead one to assume that the problems identified on a global level in terms of species trafficking are also those of the EU.

Thus, not only public opinion but even the executive bodies of the responsible agencies have prioritised and spotlighted the relevance of the trafficking of raw ivory and objects made from it, rhinoceros horns, tiger parts and by-products and, recently, pangolin scales, parts and products.

Unfortunately, this indicates a clear misunderstanding of the situation. As mentioned before, the EU and its Member States make significant efforts in this regard to support the affected countries of origin, but this does not mean that they are priority subjects for the EU in terms of the origin, transit and destination of trafficked species.

In fact, after focusing on this matter during the latest policy cycles, we have observed that operational actions have been conducted in virtually all areas. Therefore, the priorities detected are:

Trafficking of glass eels

The trafficking of young European eels probably represents the greatest crime against wildlife in the world. In the years with the greatest impact, an estimated 100 t of glass eels were illegally exported per year from Europe to Asia. Bearing in mind that each kilo of glass eels contains some 3,000 specimens, the magnitude of the issue cannot be overstated.

The motive is simple: demand for products deriving from glass eels has a long tradition and remains high in Southeast Asia although the native species (*Anguilla japonica*) dwindled years ago. Since eel reproduction in captivity has not, at present, been achieved, mass exportation has occurred, introducing the specimens on the farms as if they were native species. Following its inclusion in CITES and the "zero export quota" policy for exports outside the EU, criminal groups have engaged in this illegal trade, creating typically criminal structures. Consider that the "EU Wildlife Enforcement Group-WG Eels" has estimated the kilo of glass eels on the black market in Asia to have a value of € 6,500 to 1,500. Annual business could be in the range of € 2.5-3 billion in the strongest years.

Despite the fact that there are only four countries of origin (Spain, France, Portugal and the United Kingdom), this phenomenon affects the entire EU and other European countries, given that they are used as points of transit to skirt the attention of the authorities, which are more active and aware of the issue in the countries of origin. However, a total of up to 26 countries have participated in specific operations coordinated by EUROPOL.

Trafficking of reptiles and amphibians

This is an extensive phenomenon worldwide, managed by just a few criminal structures, all related, which operate in a highly specialised fashion. The motives include collecting and introducing wild specimens as if they were bred in captivity, so that they can then be legally sold. Amphibians are also exported illegally so that diverse substances can be manufactured from the toxins. In this case, the EU is a destination point for species from around the world, with varying turnover rates. There is evidence of breeding pairs of certain endemic iguana species reaching prices of up to € 90,000. While there is some increase in illegal trade coinciding with certain specialised events, this phenomenon is present throughout the year.

Trafficking of birds

The motives are similar to those for trafficking of reptiles with regard to species from other regions of the world, primarily Latin America. In this case, there are also specialised networks acting within criminal structures.

With regard to raptors, the motives include collecting and their use in falconry; here, the EU is a point of origin for many specimens that either remain within the EU, legalised as having been bred in captivity, or are exported to other countries, mainly in Africa and the East.

Finally, there is a large volume of illegal trading of "*song birds*", primarily finches, within the EU. The phenomenon stretches from Mediterranean countries to Central European ones and severely affects populations of both protected and unprotected species; non-selective methods are used indiscriminately, such as nets and glue traps. There is also a market linked to trade for human consumption, mainly for specimens captured that die and females, which are not valid for their song.

Other trends have also been detected:

Trafficking of wood

Both highly valued protected species and species resulting from illegal logging in protected zones of Latin America, mainly, and from Asia. This phenomenon is obviously linked oftentimes to illegal deforestation but also to illegal mining and, as such, to the destruction of habitats of extremely high ecological value and to mercury contamination of rivers and wetlands.

There is also a phenomenon of illegal logging within the EU, which EUROPOL has been monitoring quite closely in recent years.

Trafficking of flora

However, the vast majority of species included in CITES are plant species. Notable trafficking of orchids and cacti has been detected, as well as allegedly medicinal products made from endangered species.

Trafficking of insects

Sometimes linked to networks involved in trafficking reptiles or birds, an increase has been observed in cases of trafficking of butterfly and beetle species, to name a few, from Latin American countries into the EU.

Illegal fisheries

Strictly speaking, this is not species trafficking but, as mentioned before, in the EU crimes related to illegal fishing are handled by the wildlife area. As a result of the European glass eel phenomenon mentioned above, important cases have been detected relating to illegal fishing of Bluefin tuna and bivalve molluscs, with a clear impact on public health. It is also worth mentioning the existence of organised groups that fish in river water, unlawfully introducing fish into human consumption circuits.

21. CITIZEN COLLABORATION. THE ROLE OF NGOS IN THE INVESTIGATION OF BIODIVERSITY CRIMES

Introduction

Defending the environment cannot be achieved without citizens and society, while the actions of public authorities must focus on safeguarding rights to which each individual, group or private entity is also entitled. The environment is considered an established right to which all citizens are entitled and conserving it is an obligation shared by the public authorities and society as a whole.

The United Nations Economic Commission for Europe on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) establishes that, for citizens to enjoy the right to a healthy environment and fulfil the duty to respect and protect it, they must have access to relevant environmental information, must be entitled to participate in environmental decision-making processes and must have access to justice when environmental rights are infringed. This means there is not only a right but also a duty to conserve it.

In addition, along the same lines as the Aarhus Convention, certain constitutions, such as the Spanish or Portuguese Constitution, have enshrined the fundamental right of all citizens to a healthy environment and also the obligation to protect it.

To respond to attacks that violate the environment and the rule of law, access to justice and administrative stewardship on environmental matters calls for having adequate, real and effective instruments to ensure that citizen interactions with government bodies and courts are effective and fulfil their fundamental purpose: to protect the established collective right that is the environment.

In this context, non-governmental organisations (NGOs) act as agents of change for these rights and duties that concern all citizens. Their role in the fight against environmental crime focuses on the following contributions:

- Preventing illegal acts against the environment and expanding knowledge about their impact. Numerous studies and reports about the effects of crimes and offences against biodiversity have been sponsored by scientific entities and NGOs, which were later used as the foundations for prioritising conservation actions in response to illegal acts (photos 21.1).

- Publicising the consequences of crimes against the environment and raising awareness about the problems they pose. In relation to this, raising awareness among citizens and the public authorities is essential in promoting the adoption of environmental crime investigation measures.

- Ensuring legal cover and compliance with the law. NGOs are active entities in filing reports of criminal acts, bringing legal action and even participating as the prosecution and in class action suits in criminal proceedings undertaken as a result of police investigations conducted. In this case, the presence of these entities often contributes to the success of the proceedings, offering support for law enforcement officers' efforts to give rise to legal proceedings.

- Acting as liaisons with the authorities. NGOs play a role as mediators between civil society, public authorities and other stakeholders, acting in public participation processes of a legislative nature (such as the reform of Directive 2008/99/EC of the European Parliament and of the Council, of 19 November 2008, on the protection of the environment through criminal law) and of other kinds related to the approach to environmental crime.

- Bolstering the strength of police actions. Many NGOs are the driving force behind projects or initiatives that seek to improve the resources and capabilities of national police forces by organising environmental specialisation courses, raising funds for the purchase of

Photos 21.1 NGOs and other private entities, many of which are scientific in nature, devote some of their activities to expanding knowledge about the magnitude and impact of environmental crimes and making proposals for regulation and investigation .

new technologies or promoting the exchange of experiences and best practices in environmental crime investigation.

Photo 21.2 NGOs have aided in the creation of units specialised in investigating crimes against biodiversity, such as UNIVE, the unit specialising in the fight against poison use in Castile-La Mancha.

Some of these contributions and the possibilities for collaboration between civil society and law enforcement officers, particularly in the judicial phase following police intervention and the ensuing investigation, are detailed below.

Citizen environmental complaints

Adherence to environmental rules is a safeguard for preserving biodiversity, health and sustainable progress over time. Citizen complaints are an essential element in achieving these goals, understanding which acts damage our environment and responding to them, thus raising awareness about these acts and empowering society.

Throughout the EU, any citizen that witnesses or has knowledge of a crime against biodiversity may submit a complaint to the law enforcement agencies or the competent authorities. The authorities are required to analyse complaints submitted and to take any action needed to verify whether there are signs of an administrative offence and, if so, to undertake the appropriate infringement proceedings or to stay the proceedings, notifying the accuser in all cases of whether or not proceedings are brought. If the infraction could be classified as a crime or misdemeanour, in accordance with national regulations, the authorities will inform the competent judicial body and suspend the administrative infringement proceedings until the criminal proceedings are resolved.

These complaints are essential because they create a better understanding of criminal acts, incite police investigations and contribute to the work described in the previous chapters.

Complaints are often submitted directly by citizens to the authorities, or they may be channelled through NGOs, which offer assistance from the outset of the procedure and act as intermediaries with the authorities. In this regard, mechanisms can be created to facilitate this transfer of information, such as the initiative launched by the NGO SEO/BirdLife, which collaborated with several national environmental police forces to create a complaints portal[18] for citizens that receives some 500 reports per year on average, thus representing an important source of information for the police. This portal has a two-fold mission:

1. to make it easier for citizens to report complaints of environmental crimes and offences thanks to an online format and the simplicity of the form to be completed, while also ensuring anonymity;

2) to channel this information and provide it to the authorities so that they can take action as appropriate. In this way, the portal connects citizens to the environmental authorities and contributes to the investigation and prosecution of offences and crimes.

Through the online form, anyone that has knowledge of a potentially illegal action can report it to SEO/BirdLife, get information about how to submit their complaints to the authorities or ask the NGO to do so for them.

The role of NGOs in legal proceedings

The fight against biodiversity crimes has long been considered a strategic objective for ecologists, who have spent decades demanding an effective judicial and administrative response in numerous areas (training for law enforcement officers, provision of investigation resources, technical resources, processing of administrative and criminal cases, protective measures, education and awareness-raising among the sectors most prone to the use of poison, announcements in the media, etc.).

Within this context, it is common practice for environmental and conservation organisations to appear in criminal proceedings brought for environmental crimes or crimes against flora and fauna, bringing criminal action against the parties responsible for the prosecuted deeds. Indeed, one of the institutional aims of these entities is the defence and conservation of general environmental interests and infringements thereof lead to criminal charges. While these entities are not entitled to this right in all countries in the EU, it is common practice in others, where the ability for citizens to bring private prosecution in criminal proceedings is a constitutional right.

The exercise of *actio popularis* in criminal proceedings entails participation with legal aid to bring the case to court. NGOs that are present in the case can be informed of the progress of the proceedings, obtain copies thereof, submit pleadings, documents and additional evidence or hear the court's decision, as well as raising objections to it.

The effectiveness of NGOs in this task when it comes to criminal proceedings relating to the environment can be measured in certain cases, such as in the fight against the illegal use of poison. In Spain, entities like SEO/BirdLife and other entities in Programa Antídoto (a coalition of NGOs against wildlife poisoning), such as WWF or Ecologists in Action have appeared in nearly 25% of the criminal proceedings brought for the use of this non-selective mass method for hunting animals. Of all the decisions handed down for this crime (around 120 in the past 25 years) the vast majority of them (>69%) ended in convictions, and in these cases NGOs were present.

In addition to their legal role, NGOs also contribute to criminal and administrative proceedings for infractions against biodiversity by contributing expert reports both in and out of court. In these crimes, statements made by members of NGOs that work to defend the affected natural asset or resource are often crucial. Many of these entities are actu-

[18] https://seo.org/portaldedenuncias/

ally leading scientific entities that have been forced to address conservation issue in order to preserve the subject of their research.

The members of these NGOs may have a dual status as witnesses and experts. They normally have expertise in a certain subject matter and act as witnesses due to their personal insight on the events, or as experts when they have professional knowledge that enables them to offer an assessment or interpretation of the events.

Thus, cooperation between law enforcement officers, administrations and NGOs can be highly valuable in ensuring that police investigations of crimes against biodiversity resulting in legal proceedings end up in guilty verdicts and decisions. In this way, the impunity seen in relation to many of these crimes can be reduced.

The deterrent effect of announcing and broadcasting guilty verdicts

One factor of interest when evaluating the effectiveness of criminal law as a tool for protecting the environment is the announcement of the outcomes of trials leading to guilty verdicts. The aim here is to make sure that the legal consequences of committing a crime against biodiversity are known within the setting of potential perpetrators, while also raising awareness in society in order to promote a general rejection of the act, supplementing and expanding on the deterrent nature of the conviction.

The environmental NGOs that have appeared in proceedings of this kind have carried out this dissemination work, calling on public authorities to contribute to the publication of convictions handed down thanks to their investigation efforts or in their role as injured parties.

To evaluate the deterrent effect of these communication actions, we could point out the impact on the media and the potential audience that each of the press releases issued by the NGOs in relation to diverse court proceedings would have had. For example, during the course of the LIFE VENENO NO project coordinated by SEO/BirdLife, in 2010 eight press releases were issued to the media on this matter, leading to 59 news items in diverse media outlets (press, radio, television). In 2011, 21 press releases led to 202 news items in diverse media outlets; written press, digital press, news agencies, radio and television. In 2012, 29 press releases were sent to the media, generating a total of 415 news items in the written press, digital press, news agencies, radio and television. In 2013, 20 press releases generated 526 news items. This year alone, with this volume of news items, according to the company that tracks the media impact for the organisation, a potential audience of 79,246,744 people would have been reached (considering the number of times a person could have access to the news item). In 2014, 7 press releases were issued, which gave rise to 279 news items. As we can see from the trends in terms of the effects of dissemination, the problem caused by the use of poison had a growing impact on the media, which became increasingly sensitive and receptive to discussing the environmental damage caused and communicating to society and potential perpetrators the consequences of poison use.

ANNEX

Junta de Andalucía

Agriculture, Livestock, Fisheries and Sustainable Development Department

General Secretariat for the Environment, Water and Climate Change

SAMPLING RECORD
ANDALUSIAN STRATEGY TO FIGHT POISONING

RECORD NO.

Abcd

A-EAV

1	GENERAL INSPECTION DETAILS		
INSPECTION DATE	START TIME	END TIME	INSPECTION TYPE ☐ PREVENTIVE ☐ URGENT
NAME OF THE LOCATION		NAME OF THE LAND/OPERATION	
RESERVE REGISTRATION NO.	MUNICIPALITY		PROVINCE

2	ACTING LAW ENFORCEMENT OFFICERS	
N.I.A. / T.I.P.	BODY (CMAOT, CIVIL GUARD, ETC.)	BIO-GEOGRAPHICAL UNIT / SEPRONA PATROL

3	SPECIALISED CANINE UNIT	
SPECIALISED CANINE UNIT INTERVENTION ☐ YES ☐ NO	SPECIALISED CANINE UNIT INTERVENTION RECORD NO.	
DOG HANDLER IDENTIFICATION		IDENTIFICATION OF THE DOGS INVOLVED
NAME AND SURNAMES	ID NO.	CODE/NAME

4	WITNESSES		
NAME AND SURNAMES	ID	CONNECTION (1)	CONTACT PHONE

5	SAMPLE COLLECTION		
THE SAMPLES COLLECTED ARE DETAILED IN ANNEX I TO THIS RECORD. THE FOLLOWING GPS HAS BEEN USED TO GEOLOCATE THE SAMPLES:			
BRAND	MODEL	SERIAL NO.	DATUM ☐ ETRS89 ☐ WGS84

6	FACTS TO BE HIGHLIGHTED

7	SIGNATURE OF THE LAW ENFORCEMENT OFFICERS AND WITNESSES INVOLVED
In witness whereof, this record is drawn up and signed at the place and on the date indicated by all those involved.	

(1) CONNECTION: TECHNICIAN WITH THE ANDALUSIAN STRATEGY TO FIGHT POISONING, GAMEKEEPER, OWNER OF THE PROPERTY, ETC.

Avda. Manuel Siurot, 50
41071 Seville, Spain
Tel. 955 003 400 – 955 003 500

Junta de Andalucía

Agriculture, Livestock, Fisheries and Sustainable Development Department

General Secretariat for the Environment, Water and Climate Change

ANNEX I - DESCRIPTION OF THE SAMPLES
ANDALUSIAN STRATEGY TO FIGHT POISONING

Page______of______

REFERENCE TO SAMPLING RECORD NO. ________________________________

INDIVIDUAL DESCRIPTION AND COLLECTION DATA RELATING TO SAMPLE NO.:					
TIME OF COLLECTION	SEAL NO.	DESCRIPTION OF SAMPLE (BAIT, CARCASS, ETC.)			
UTM COORDINATES OF SAMPLE FINDING LOCATION: ZONE	X COORDINATE	Y COORDINATE	ACTIVITY DEVELOPED IN THE FINDING LOCATION (AGRICULTURE, LIVESTOCK, HUNTING, ETC.)		
CARCASS – POSSIBLE CAUSE OF DEATH	Poisoning/intoxication Fence/wire fence collision	Shooting Fall from nest	Electrocution Wind turbine	Disease Malnutrition	Roadkill Other
CARCASS – SIGNS OF POISONING	Stiff talons Convulsive posture	Blood in orifices (epistaxis) Vomit/Diarrhoea	Bitten tongue Dead cadaver fauna	Facial rictus Other	
CARCASS – CONDITION	☐ Fresh	☐ Decomposing	☐ Skeletonised		
DESCRIPTION OF BAIT		OTHER TYPE OF SAMPLE (DESCRIPTION OF EVIDENCE: CONTAINER, CONTENT, ETC.)			
CLIMATE DATA TEMP. (°C): RH (%):	EXPOSURE OF SAMPLE ☐ Sun ☐ Shade	DEGREE OF PROTECTION ☐ Exposed ☐ Under cover	CADAVER FAUNA ☐ YES (2) ☐ NO		
OBSERVATIONS					

INDIVIDUAL DESCRIPTION AND COLLECTION DATA RELATING TO SAMPLE NO.:					
TIME OF COLLECTION	SEAL NO.	DESCRIPTION OF SAMPLE (BAIT, CARCASS, ETC.)			
UTM COORDINATES OF SAMPLE FINDING LOCATION: ZONE	X COORDINATE	Y COORDINATE	ACTIVITY DEVELOPED IN THE FINDING LOCATION (AGRICULTURE, LIVESTOCK, HUNTING, ETC.)		
CARCASS – POSSIBLE CAUSE OF DEATH	Poisoning/intoxication Fence/wire fence collision	Shooting Fall from nest	Electrocution Wind turbine	Disease Malnutrition	Roadkill Other
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CARCASS – CONDITION	☐ Fresh	☐ Decomposing	☐ Skeletonised		
DESCRIPTION OF BAIT		OTHER TYPE OF SAMPLE (DESCRIPTION OF EVIDENCE: CONTAINER, CONTENT, ETC.)			
CLIMATE DATA TEMP. (°C): RH (%):	EXPOSURE OF SAMPLE ☐ Sun ☐ Shade	DEGREE OF PROTECTION ☐ Exposed ☐ Under cover	CADAVER FAUNA ☐ YES (2) ☐ NO		
OBSERVATIONS					

INDIVIDUAL DESCRIPTION AND COLLECTION DATA RELATING TO SAMPLE NO.:					
TIME OF COLLECTION	SEAL NO.	DESCRIPTION OF SAMPLE (BAIT, CARCASS, ETC.)			
UTM COORDINATES OF SAMPLE FINDING LOCATION: ZONE	X COORDINATE	Y COORDINATE	ACTIVITY DEVELOPED IN THE FINDING LOCATION (AGRICULTURE, LIVESTOCK, HUNTING, ETC.)		
CARCASS – POSSIBLE CAUSE OF DEATH	Poisoning/intoxication Fence/wire fence collision	Shooting Fall from nest	Electrocution Wind turbine	Disease Malnutrition	Roadkill Other
CARCASS – SIGNS OF POISONING	Stiff talons Convulsive posture	Blood in orifices (epistaxis) Vomit/Diarrhoea	Bitten tongue Dead cadaver fauna	Facial rictus Other	
CARCASS – CONDITION	☐ Fresh	☐ Decomposing	☐ Skeletonised		
DESCRIPTION OF BAIT		OTHER TYPE OF SAMPLE (DESCRIPTION OF EVIDENCE: CONTAINER, CONTENT, ETC.)			
CLIMATE DATA TEMP. (°C): RH (%):	EXPOSURE OF SAMPLE ☐ Sun ☐ Shade	DEGREE OF PROTECTION ☐ Exposed ☐ Under cover	COLLECTION OF CADAVER ☐ FAUNA YES (2) NO		
OBSERVATIONS					

(2) CADAVER FAUNA: PLACE EACH SPECIMEN IN A PLASTIC JAR, AND THIS IN TURN WITHIN THE SAME BAG WITH THE CORRESPONDING CARCASS.

In witness whereof, this record is drawn up and signed at the place and on the date indicated by all those involved.

A-EAV-ANEXO I

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Junta de Andalucía

Agriculture, Livestock, Fisheries and Sustainable Development Department

General Secretariat for the Environment, Water and Climate Change

ANNEX II - INVESTIGATION ASSISTANCE CHECKLIST ANDALUSIAN STRATEGY TO FIGHT POISONING

Page_____of_____

REFERENCE TO SAMPLING RECORD NO. ________________________

ACTIVITIES IN THE SEARCHED PROPERTY:	HUNTING	LIVESTOCK	AGRICULTURE		OTHER (....................)
TYPE OF HUNTING LAND: FREE	PRIVATE	INTENSIVE	SPORT		CONTROLLED
TYPE OF HUNTING OPERATIONS:	SMALL GAME	BIG GAME	SMALL/BIG GAME		BIG/SMALL GAME
TYPE OF EXISTING LIVESTOCK OPERATIONS:		EXTENSIVE	INTENSIVE		MIXED
TYPE OF LIVESTOCK FARM:	PORCINE CAPRINE	OVINE	BOVINE		OTHER (...................)
SAMPLES FOUND NEXT TO RESIDENTIAL AREAS, BUILDINGS, COUNTRY HOUSES, ETC.			YES	NO	UNKNOWN
SAMPLES LOCATED FOLLOWING A REPORT BY THE OWNER OR KEEPER OF THE LAND			YES	NO	UNKNOWN
SAMPLES LOCATED FOLLOWING A TIP-OFF FROM A PRIVATE INDIVIDUAL			YES	NO	UNKNOWN
SAMPLES LOCATED FOLLOWING AN ANONYMOUS CALL			YES	NO	UNKNOWN
EXISTENCE OF GUARDS OR SURVEILLANCE IN THE AREA			YES	NO	UNKNOWN
PRESENCE OF FENCES OR ENCLOSURES HINDERING ACCESS TO THE LAND			YES	NO	UNKNOWN
PRESENCE OF FENCES OR ENCLOSURES PREVENTING ACCESS TO THE LAND			YES	NO	UNKNOWN
HISTORY OF ILLEGAL ACTIVITIES INVOLVING THE USE OF PROHIBITED DEVICES			YES	NO	UNKNOWN
FINDING OF SAMPLES ON BOUNDARIES BETWEEN OPERATIONS/LANDS			YES	NO	UNKNOWN
FINDING OF BAIT DURING RELEASE OR BREEDING SEASON OF PARTRIDGES/RABBITS			YES	NO	UNKNOWN
SAMPLES NEXT TO FEED AND WATER TROUGHS, CAIRNS, SHEEPFOLDS, BURROWS…			YES	NO	UNKNOWN
DEAD SPECIES APPARENTLY FIT FOR HUMAN CONSUMPTION			YES	NO	UNKNOWN
BAIT APPARENTLY FIT FOR HUMAN CONSUMPTION			YES	NO	UNKNOWN
OTHER PUBLIC HEALTH RISKS (SPRINGS, RECREATIONAL AREAS, PATHS, ETC.)			YES	NO	UNKNOWN
CARCASSES BURIED OR HIDDEN TO COVER UP THEIR DEATH			YES	NO	UNKNOWN
TRACES OF CARCASS DISPLACEMENTS TO MISLEAD OFFICERS			YES	NO	UNKNOWN
VEHICLE TRACKS NEXT TO THE SAMPLES (TO BE RECORDED)			YES	NO	UNKNOWN
FOOTPRINTS NEXT TO THE SAMPLES (TO BE RECORDED)			YES	NO	UNKNOWN
BAGS OR CONTAINERS SUSPECTED TO HAVE CONTAINED BAIT OR TOXIC SUBSTANCES			YES	NO	UNKNOWN
PATHWAYS ASSOCIATED WITH THE FINDING OF SAMPLES			YES	NO	UNKNOWN
HOME RANGES/DISPERSAL OF ENDANGERED SPECIES			YES	NO	UNKNOWN
DUMPING SITES CLOSE TO THE LOCATION OF THE SAMPLES			YES	NO	UNKNOWN
PROXIMITY TO BIRD ROOSTING SITES			YES	NO	UNKNOWN
SUSPICIOUS PRODUCTS IN WAREHOUSES, FACILITIES OR TOOL SHEDS			YES	NO	UNKNOWN
SUSPICIOUS PRODUCTS IN VEHICLES LINKED TO THE OPERATION/PROPERTY			YES	NO	UNKNOWN
SUSPICIOUS PURCHASES AT SHOPS DEALING WITH PLANT PROTECTION PRODUCTS			YES	NO	UNKNOWN

OTHER CONSIDERATIONS TO BE HIGHLIGHTED, STATEMENTS BY WITNESSES, GUARDS, KEEPERS AND OTHERS; SKETCHES OR ANY DETAIL WORTHY OF NOTE:

In witness whereof, this record is drawn up and signed at the place and on the date indicated by all those involved.

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Junta de Andalucía

Agriculture, Livestock, Fisheries and Sustainable Development Department

General Secretariat for the Environment, Water and Climate Change

RECORD OF DELIVERY, CHAIN OF CUSTODY AND SUBMISSION OF SAMPLES
ANDALUSIAN STRATEGY TO FIGHT POISONING

1	**GENERAL DATA**
PROVINCIAL RECORD NUMBER	SAMPLES REFERRING TO THOSE DESCRIBED IN ANNEX I OF THE SAMPLING RECORD NO.
TRANSPORT BY (NAME AND OFFICE OF THE COURIER COMPANY. IN CASE OF OWN RESOURCES: OFFICIAL VEHICLE AND PUBLIC EMPLOYEE)	

2	**DESCRIPTION, NUMBER OF PACKAGES AND PRESERVATION METHOD**	
NUMBER OF JARS	NUMBER OF BAGS	NUMBER OF OTHER CONTAINERS
CONTAINERS PLACED IN HERMETICALLY SEALED DRUMS ☐ YES ☐ NO	DRUM OUTER SEAL NUMBER	
PRESERVATION METHOD/CONDITION BEFORE DELIVERY (1) REFRIGERATED ☐	FROZEN ☐	ROOM TEMPERATURE (STORED IN A COOL, DRY PLACE)

(1) IF IMMEDIATE SUBMISSION OF SAMPLES IS NOT POSSIBLE, SAMPLES SHALL ALWAYS BE KEPT REFRIGERATED OR FROZEN. ONLY IN CERTAIN CASES, ESPECIALLY IF THE CARCASS IS TO BE DATED, AND AFTER CONSULTATION WITH THE CENTRE FOR ANALYSIS AND DIAGNOSIS OF WILDLIFE (CAD) IN ANDALUSIA, THEY SHALL BE KEPT AT ROOM TEMPERATURE IN A COOL, DRY PLACE.

3	**OBSERVATIONS CONCERNING THE STORAGE, PRESERVATION AND DELIVERY OF SAMPLES**

4	**CHAIN OF CUSTODY DETAILS**		
DATE: SIGNATURE: NIA/TIP: ACTION TYPE:	DATE: SIGNATURE: NIA/TIP: ACTION TYPE:	DATE: SIGNATURE: NIA/TIP: ACTION TYPE:	DATE: SIGNATURE: NIA/TIP: ACTION TYPE:

RECEIPT IN THE LABORATORY

DATE:
TIME:
SIGNATURE:

(STAMP)

NAME:

A-EAV-R

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RECORD OF WILDLIFE INCIDENTS WITH HIGH-VOLTAGE OVERHEAD POWER LINES

RECORD NO.

1 GENERAL DATA

IDENTIFICATION NUMBER OF THE ACTING OFFICERS (NIA)	BIO-GEOGRAPHICAL UNIT/INTEGRAL UNIT

INSPECTION DATE	TIME	NAME OF THE PLACE OR LOCATION

MUNICIPALITY	PROTECTED NATURAL SPACE

GEODETIC DATUM ☐ETRS89 ☐WGS84	ZONE	UTM X COORDINATE	UTM Y COORDINATE

PROVEN FACT
☐SHORTCOMING WITH POTENTIAL RISK OF INCIDENT ☐CONFIRMED INCIDENT INVOLVING INJURY OR DEATH OF ANIMAL

TYPE OF INCIDENT DETECTED (WHETHER POTENTIAL RISK OR CONFIRMED INCIDENT)
☐ELECTROCUTION ☐COLLISION WITH POWER LINE ☐OTHER (Describe in Observations)

DESCRIPTION OF LOCATION FOR ELECTROCUTION CASES:
IS IT A SPECIAL PROTECTION AREA FOR BIRDS (SPA) OR A SPECIAL AREA OF CONSERVATION (SAC)? .... ☐YES ☐NO
IS IT WITHIN THE SCOPE OF RECOVERY/CONSERVATION PLANS FOR LISTED SPECIES?................. ☐YES ☐NO
IS IT A PRIORITY AREA FOR REPRODUCTION, FEEDING, DISPERSAL AND CONCENTRATION OF ENDANGERED SPECIES? ☐YES ☐NO

DESCRIPTION OF LOCATION FOR COLLISION CASES:
IS IT A SPECIAL PROTECTION AREA FOR BIRDS (SPA) BECAUSE OF ITS IMPORTANCE FOR GREAT AND LITTLE BUSTARDS? ☐YES ☐NO
IS IT LOCATED WITHIN A TWO-KILOMETRE RADIUS FROM THE MAXIMUM FLOOD LINES OF A WETLAND INCLUDED IN THE INVENTORY OF WETLANDS OF ANDALUSIA?.. ☐YES ☐NO

2 INDIVIDUAL DESCRIPTION OF THE AFFECTED WILDLIFE SPECIMENS

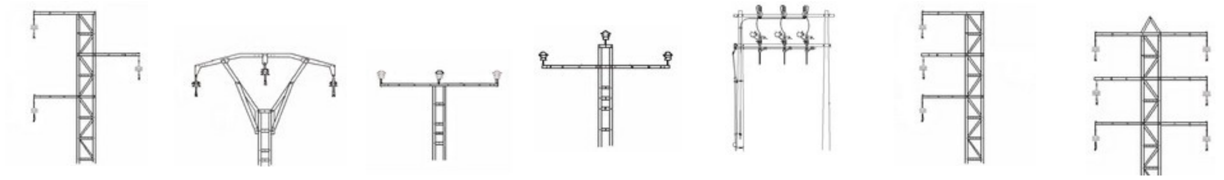
SPECIMEN NO.	SPECIES	AGE	SEX	CONDITION	CARCASS CONDITION	VISIBLE INJURIES	OBSERVATIONS
1		AD ☐YG ☐UN	♂ ☐♀ ☐UN	☐INJURED ☐DEAD	FRESH ☐DECOMPOSING ☐SKELETONISED		
2		AD ☐YG ☐UN	♂ ☐♀ ☐UN	☐INJURED ☐DEAD	FRESH ☐DECOMPOSING ☐SKELETONISED		
3		AD ☐YG ☐UN	♂ ☐♀ ☐UN	☐INJURED ☐DEAD	FRESH ☐DECOMPOSING ☐SKELETONISED		
4		AD ☐YG ☐UN	♂ ☐♀ ☐UN	☐INJURED ☐DEAD	FRESH ☐DECOMPOSING ☐SKELETONISED		
5		AD ☐YG ☐UN	♂ ☐♀ ☐UN	☐INJURED ☐DEAD	FRESH ☐DECOMPOSING ☐SKELETONISED		

3 POWER LINE IDENTIFICATION

POWER LINE OWNER	POWER LINE NAME

POWER LINE CODE/NUMBER	NOMINAL VOLTAGE (kV)	SUPPORT/S NO.	TRANSFORMER NO.

CROSSARM TYPE:
☐TREFOIL CROSSARM (CT) ☐ARCHED CROSSARM ☐HORIZONTAL PLANE (PH) ☐CROSSWISE CROSSARM
☐GANTRY CROSSARM (CP) ☐VERTICAL PLANE (PV) ☐DOUBLE CIRCUIT (DC) ☐OTHER (.............................)



CT CB PH CC CP PV DC

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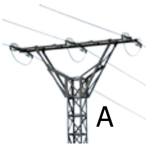
JUMPER TYPE:
☐ OVERHEAD JUMPER (PE)
☐ UNDERNEATH JUMPER (PD)


PE


PD

INSULATOR TYPE:
☐ STRAIN INSULATORS (A)
☐ SUSPENSION INSULATORS (S)
☐ PIN INSULATORS (R)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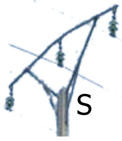
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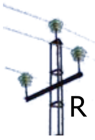
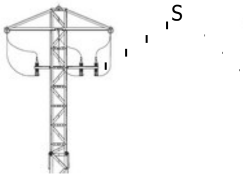

R

PRESENCE OF DISCONNECTORS OR TRANSFORMERS:
☐ DISCONNECTOR (S)
☐ TRANSFORMER (T)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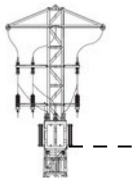
T

PRESENCE OF EARTHING:
☐ YES
☐ NO

GEOLOCATION OF OTHER INCIDENTS ALONG THE LINE (INDICATE THE START AND END OF THE LINE OR SECTION):

SUPPORT	X COORDINATE	Y COORDINATE	INCIDENT/OBSERVATION

EXISTENCE OF ANTI-ELECTROCUTION MEASURES:
ARE THERE INSULATION ELEMENTS COVERING CONDUCTORS AND/OR JUMPERS? .... ☐ YES ☐ NO
ARE THE ADDITIONAL INSULATION ELEMENTS IN GOOD CONDITION? .... ☐ YES ☐ NO
IF NOT, INDICATE WHAT TYPE OF SHORTCOMINGS ARE DETECTED (LOSS OF INSULATION, LOSS OF ADHESION, BREAKAGE, DETACHMENT, DISPLACEMENT, ETC.):

PRESENCE OF ANTI-PERCHING OR ANTI-NESTING DETERRENTS OR NESTING PLATFORMS:
ARE THERE ANTI-PERCHING OR ANTI-NESTING DETERRENTS? .... ☐ YES ☐ NO
ARE ANTI-PERCHING OR ANTI-NESTING DETERRENTS EFFECTIVE? .... ☐ YES ☐ NO
ARE ARTIFICIAL NESTING PLATFORMS INSTALLED ON THE SUPPORT? .... ☐ YES ☐ NO
ARE THERE ANY NESTS PRESENT ON THE CROSSARM POSING A RISK OF ELECTROCUTION? .... ☐ YES ☐ NO
FURTHER OBSERVATIONS IN THIS REGARD:

EXISTENCE OF ANTI-COLLISION MEASURES:
ARE THERE VISUAL DETERRENTS OR FLIGHT DIVERTERS? .... ☐ YES ☐ NO
ARE THE VISUAL DETERRENTS IN GOOD CONDITION? .... ☐ YES ☐ NO
IF NOT, INDICATE WHAT TYPE OF SHORTCOMINGS ARE DETECTED (BREAKAGE, DISPLACEMENT):

4	OBSERVATIONS

5	PLACE, DATE AND SIGNATURE

In witness whereof, this record is drawn up and signed by all those involved. , on the day of , ,

NIA

ACKNOWLEDGMENT

The preparation of this manual has been possible thanks to the long-standing work of many people who have dedicated their professional and personal lives to the conservation of nature and to the investigation and prevention of crimes and offences committed against it. We want to thank all of them, to forestry and environmental agents, *Guardia Civil*, veterinarians, conservation technicians, public administration officials, legal experts, judges, prosecutors, conservation NGOs and all those citizens who were eager to report crimes and collaborate when necessary. In particular, we would like to thank the agents from the Environmental Service of *Guardia Civil* (SEPRONA), Francisco Velasco and Carlos Plaja; the environmental agents and members of UFOA, Alicia Moreno, Alfredo Lineros and José Miguel Bellido; Ngaio Richards from *Working Dogs for Conservation* (USA) and all the members of the Andalusian Strategy to Fight Poisoning for their contributions to this manual.

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Thanks to the work of all of them, we have been able to gather the experience and knowledge that we want to transmit in this manual, which we hope will contribute to preserving our environment and the right that we all have to enjoy it.

Other publications:

Nature
GUARDIANS
against environmental crime

STUDY ON THE ORIGIN AND MOTIVATIONS OF ENVIRONMENTAL CRIME

More info: www.guardianes.seo.org

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