UN environment programme

CMS

CONVENTION ON MIGRATORY SPECIES

UNEP/CMS/COP15/Inf.25.2.1

24 November 2025

Original: English

15th MEETING OF THE CONFERENCE OF THE PARTIES
Campo Grande, Brazil, 23 to 29 March 2026
Agenda Item 25.2.1

REPORT OF THE CMS MARINE POLLUTION WORKSHOP

(Prepared by the Secretariat)

Summary:

This document contains the report from the CMS Marine Pollution Workshop that was convened as requested in Decision 14.42 (d).

UN environment programme

Convention on the Conservation of Migratory Species of Wild Animals

CMS

REPORT OF THE CMS MARINE POLLUTION WORKSHOP

28 and 30 May 2025, online

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REPORT OF THE CMS MARINE POLLUTION WORKSHOP

1. WELCOME

1.1 BACKGROUND

The CMS Marine Pollution Workshop was convened as requested by CMS COP in Decision 14.42 d). The objective of the workshop was to identify priority species, populations and habitats for immediate action, and develop recommendations for consideration by the 8th Meeting of the Sessional Committee of the CMS Scientific Council.

The workshop was convened and chaired by Mark Simmonds (CMS COP-appointed Councillor for Marine Pollution) and held over two three-hour sessions, structured as follows: Part 1 explored a wide range of issues and opportunities associated with marine pollution, while Part 2 focused on the development of recommendations to guide the work of CMS going forward. The workshop was developed with the help of a small steering group of experts, as per CMS Decision 14.42 e).

1.2 INTRODUCTION

Mr. Simmonds (Chair) introduced the workshop by underlining the role of CMS to make recommendations addressing marine pollution. He highlighted the triple planetary crisis of climate change, pollution and biodiversity loss, and noted that pollution remains the least recognised threat, with lower public recognition and political engagement.

Melanie Virtue (CMS Secretariat) presented an overview of previous work by CMS to tackle marine pollution, including through initiatives such as the *International Light Pollution Guidelines for Migratory Species*[1] and the *CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities*[2].

1.3 PRESENTATIONS

Experts delivered a series of presentations addressing a range of pollution issues, followed by Q&A and discussions among participants.

Sarah Nelms (University of Exeter) presented the impacts of plastic pollution on marine species. She emphasized the distinction between entanglement and bycatch; highlighted the negative impacts of plastic ingestion – ranging from injuries and obstruction to digestive track, to malnutrition, to disruptive effects on reproductive and immune systems. She underlined the growing threat of microplastics and shared an update on the negotiations of the global plastic treaty.

Krishna Das (University of Liège) delivered a presentation on chemical compounds and threats. She highlighted the threat posed by persistent organic pollutants (POPs) (which is being tackled under the Stockholm Convention); the fact that climate change is exacerbating the effects of mercury pollution; the presence of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in marine

[1] https://www.cms.int/en/publication/international-light-pollution-guidelines-migratory-species
[2] https://www.cms.int/sites/default/files/document/cms_cop12_res.12.14_annex_marine-noise_e_0.pdf

mammals and birds, even including Antarctic species; and the particular vulnerability of animals using coastal migratory corridors.

Rosie Williams (Institute of Zoology, Zoological Society of London) presented the results of a research project investigating the **impacts of polychlorinated biphenyls (PCBs)** and sea surface temperature (SST) on disease mortality. The research showed PCB concentration and SST were both associated with an increased risk of infectious disease mortality. She highlighted the need for integrated conservation strategies addressing multiple stressors simultaneously where possible.

Simone Panigada (Chair of ACCOBAMS Scientific Committee) presented **on Important Marine Mammal Areas (IMMAs)**[3], an area-based conservation tool that identifies, based on scientific evidence, critical marine mammal habitats with the potential to be delineated and managed for conservation. IMMAs have found real-life applications for example in the Mediterranean Sea, where they have been used as the basis for the design of Particularly Sensitive Sea Areas (PSSAs) to mitigate ship strikes in the framework of the International Maritime Organization (IMO). Moving forward, efforts are underway to overlap IMMAs with maps representing threat intensity, including marine pollution.

David Santillo (Greenpeace International) highlighted emerging **marine geo-engineering techniques aimed at climate mitigation**. These pose potential risks to migratory species, their prey and their habitats. CMS could play a role in governance alongside the London Convention and Protocol and the Convention on Biological Diversity (CBD), given the global and potentially polluting nature of these activities.

1.4 DISCUSSIONS

Issues discussed in the workshop:

a) Plastic, including micro- and nano-plastic and plasticisers.

b) Chemical pollution: persistent organic pollutants (POPs) including legacy/classic POPs (polychlorinated biphenyls,(PCBs); polybrominated diphenyl ethers, (PBDEs); dichlorodiphenyltrichloroethane, (DDTs); and other organochlorine pesticides, (OCPs)) and new POPs (per- and polyfluoroalkyl Substances, (PFASs); organic ultraviolet absorbents (UVAs), including both UV filters (UVFs) and UV stabilizers (UVSs)), polycyclic aromatic hydrocarbons (PAHs, both petrogenic and pyrogenic), mercury and other toxic metals (e.g., cadmium and lead), emerging pollutants (e.g., new PFAS), elements from emerging technologies, plasticiser/softeners, current use pesticides-CUPs (many of which are nowadays fluorinated).

c) Pharmaceuticals and personal care products (PPCPs) including hormonal contraceptives (potentially posing a significant risk to fish based on the available literature), antidepressants, pain killers.

d) Antibiotics from human, agricultural, and aquaculture use.

e) Low-level radioactive pollution (and e.g. links to deep sea mining, oilfield discharges).

f) Anthropogenic radionuclides (Cesium 137 (Cs-137) following the Fukushima Nuclear Accident and past nuclear fall-out).

[3] https://www.marinemammalhabitat.org

g) Unexploded ordnance (UXO) and other dumped weapons, shipwrecks.

h) Interplay between marine pollution and climate change (and potentially other factors).

i) Light and noise pollution (touched on, but not discussed in any depth as CMS already has dedicated workstreams on these, with the exception of light pollution impacts in the marine environment away from coastal areas).

j) Potential pollution from marine geoengineering activities, such as nutrient pollution and/or shifts in nutrient availability and ratios; changes in biochemical cycling of nutrients and energy; noise pollution from ships.

Nutrients, sediments, and wastewater were not discussed due to a lack of time but should be considered at a later date.

2. DEFINING THE WORK OF CMS GOING FORWARD

2.1 EFFECTS-BASED MONITORING APPROACHES

Regarding chemical pollution, workshop participants concluded that CMS should promote the adoption of effects-based monitoring frameworks, which move beyond traditional chemical concentration thresholds to focus on the biological impacts and toxic health effects of chemical pollutant mixtures on migratory species. These approaches are particularly relevant for long-lived, wide-ranging species exposed to cumulative and synergistic stressors across jurisdictions.

Similarly, workshop participants expressed support for the development and use of biomarkers of exposure and effect (e.g., immune suppression, endocrine disruption, reproductive impairment) in CMS-listed species. The importance of encouraging the definition of biological response thresholds and environmental standards that reflect the combined effects of pollutant mixtures based on the weight of evidence, rather than assessing chemicals in isolation was also noted.

2.2 PROMOTION OF INTEGRATIVE CONSERVATION STRATEGIES

The workshop noted that CMS should promote conservation approaches that explicitly account for the cumulative and interactive nature of anthropogenic threats to migratory species. Pollutants—whether chemical, acoustic, or plastic—should not be assessed in isolation but rather in the broader ecological context of other stressors such as climate change, habitat degradation, disease spread and overexploitation. Noting, for example, that plastic pollution has been linked to the spread of invasive diseases.

2.3 STRANDINGS INVESTIGATIONS

The workshop attendees expressed their strong support for the recognition and strategic use of stranding investigations as a valuable, cost-effective, and ethical method for assessing the health of migratory marine species. Stranded animals provide rare access to data on otherwise hard-to-monitor species, particularly large cetaceans and elusive migratory taxa. Where possible, field necropsies and post-mortem examinations should be performed to understand the cause of death and other health parameters relating to marine pollution as well as general information about the individual.

The importance of the following was noted:

- Encouraging the development of standardised protocols for the collection of biological, toxicological, and pathological data from stranded individuals across CMS Party countries;
- Supporting international collaboration to integrate stranding data into long-term health surveillance networks for migratory species; and
- Recognizing stranded individuals as sentinels of ocean health, providing insight into the cumulative impacts of pollution, disease, and other stressors.

2.4 THE RELATIONSHIP BETWEEN CLIMATE CHANGE AND MARINE POLLUTION

The workshop gave consideration to the interactions between climate change and marine pollution, and it was noted that when identifying hotspots, vulnerable species, and habitats, consideration needs to be given to how climate-induced shifts in pollutant concentrations, migration routes, prey availability and distribution, species compositions and (trophic) interactions, and habitat locations (e.g. refugia) may alter future risk sea-scapes. Regular updating of assessments will be required as circumstances change. It was noted that this particularly relates to:

a) toxicity and bioaccumulation rates of chemical pollutants (e.g., mercury, PCBs; since they can be affected and/or exacerbated by e.g., sea surface warming, reduced ice cover, precipitation increase, shifts in currents, permafrost thawing),

b) possible home range shifts in species of concern and/or their prey species redistribution, and

c) effects of altered species assemblages/changes in the structure and biodiversity of local food webs and trophic interactions/competition in changing exposure routes across species-specific food chains, shaping pollutant uptake rates, (novel) exposures to areas of high pollution, etc.

It was concluded that CMS should consider developing or applying a published vulnerability matrix (see for example Butt et al., 2022) that integrates species' sensitivity, exposure, and adaptive capacity to both marine pollution and climate change, to help prioritise conservation actions under future environmental scenarios.

2.5 PFAS AND NOVEL POLLUTANTS

PFAS compounds were identified as being of particular concern (i.e., more than 15,000 substances and other chemicals) and the need for CMS to work with other conventions to ensure they are being addressed was highlighted. This would include supporting the inclusion of all persistent PFAS compounds under the Stockholm Convention. Generally, there needs to be a proactive, rather than reactive approach to regulate chemical groups like this. Group bans should be enacted with the onus on the producer to prove a chemical is safe before restrictions are removed.

The issue of pollutants arising from the clothing industry was also discussed and it was noted that microfibres shed from synthetic textiles during washing enter rivers and seas, accumulating in food webs and are found in migratory species such as fish, sea turtles, seabirds, and marine mammals. Toxic dyes and chemical additives used in textile manufacturing are discharged into freshwater systems, particularly in key migratory river basins (e.g., Ganges, Mekong), with downstream impacts on estuarine and coastal biodiversity. Single use plastic packaging and waste from the fashion supply chain add to macroplastic loads in coastal zones and oceanic gyres.

2.6 LIGHT POLLUTION

Although CMS already has a workstream on this, and the workshop therefore only briefly touched on it, the workshop participants encouraged consideration of the impacts on migratory species of light pollution in the offshore oceans, which are not covered by the existing guidelines.

2.7 IMMAS AND MIGRATORY CORRIDORS

Further to the presentation from Panigada, the workshop acknowledged the value of IMMAs (for cetaceans), ISRAs (for elasmobranchs), IBAS (for birds) and IMTAs (for marine turtles) to help CMS and others to determine areas where action may be urgently needed. The overlap of these with spatial observations of current and modelled future areas of high accumulation/presence of marine pollution to identify potential impact hotspots might be helpful.

Similarly, where they are known, migratory corridors might be considered to establish where pollution threats to migratory species are highest.

3. RESEARCH NEEDS

Future research needs were discussed, and it was suggested that the following should be promoted:

- further investigations into the impacts and mechanisms of toxicity of emerging pollutants (e.g. PFAS) and PPCPs across various taxa.
- encouragement of the routine archiving of tissue samples collected through biomonitoring. (This enables retrospective analyses as new chemicals of concern are identified or as new analytical techniques become available.)
- continuation and/or expansion of long-term environmental and biological monitoring.
- standardised data sampling protocols[4] regarding recording plastic ingestion in stranded animals, as appropriate to the taxa concerned.

It was emphasized that big data gaps remain around plastic pollution impacts at species and population levels. Hence studies on plastic impacts should:

i) be published open access whenever possible, and/or data should be made publicly available in the form of Supplementary Materials, etc.
ii) record and publish also findings of no plastics ("negative" findings) to allow generation of a broader and more accurate picture.
iii) consider the amounts, impacts and sources of marine debris.

[4] Noting that CMS Resolution 12.20 states: "Further encourages the Scientific Council to promote harmonization or standardization of protocols for the analysis of marine litter, including microplastics, in stranded organisms" and contains other relevant/overlapping provisions.

More research is also needed:

- to better understand microplastic exposure via dietary ingestion and inhalation (e.g., impacts on health of individuals, species level impacts, connection with chemical pollutants and diseases; factors possibly increasing uptake rates and/or influencing impacts (colour, shape, type of plastic));
- to understand possible translocation of micro-/nanoplastics from digestive tracts to organs;
- to understand impacts of chemical mixtures or “cocktails” on species (and develop thresholds of pollutant loads based on those (e.g., effects based if assuming similar modes of action), which may be more adequate than the ones we currently use and are mainly derived from toxicity levels of single chemical substances); and
- on fish and other underrepresented and/or hard-to-assess migratory species.

4. HIGH PRIORITY/MOST AT RISK MIGRATORY SPECIES AND POPULATIONS

The workshop discussed which species and populations should be prioritized for action. This generated a list (see Annex 1). This list was further developed during the review of the workshop report and should be seen as a living document. Some of the discussion about specific species and species groups is recorded below.

The workshop concluded that the most vulnerable stages of the life cycle were generally:

- where feeding occurs (foraging/feeding grounds),
- where breeding occurs e.g. nesting sites for seabirds and marine turtles; breeding and calving grounds for highly migratory baleen whales (e.g., humpback whales, grey whales, sperm whales),
- along migration corridors (especially along coasts); and regional biological corridors (e.g., Eastern Tropical Pacific Marine Corridor (CMAR), comprising Galápagos, Malpelo, Coiba, and Cocos Islands),
- oceanic life stages (e.g., in sea turtles).

4.1 MARINE MAMMALS

Cetaceans, pinnipeds and sirenians are at risk from bycatch (active fishing gear interactions) and entanglements (passive entrapment/entangling with ALDFG (abandoned, lost, or otherwise discarded fishing gear) and plastics), as well as ingestion of plastics. They are also impacted by POPs such as legacy POPs (PCBs, DDTs, PDEBs) and emerging POPs (PFASs, UVAs, including both UVFs and UVSs (e.g., UV-328, designated as a POP in 2023)); PAHs, including both petrogenic PAHs (oil spill-related hydrocarbons) and pyrogenic PAHs, mercury (organic mercury or methyl-mercury), and anthropogenic radionuclides (Cesium 137).

Mediterranean sperm whales (*Physeter macrocephalus)* provide some of the clearest examples of threats from both marine debris and chemical pollutants. Stranded individuals have routinely contained macroplastics causing fata gastric impaction, while their blubber and tissues carry high levels of PCBs, PBDEs, heavy metals and PAHs, many at or above established toxicity thresholds (see e.g. Bargagli and Rota, 2024).

4.2 SEA TURTLES

Sea turtles are particularly at risk during their pelagic life stage (especially in the great ocean gyres) and at nesting sites. Threats include light pollution, plastic ingestion, entanglements, macro- and microplastics in nesting beaches, as well as POPs, including legacy POPs (PCBs, PDBEs, DDTs, and other OCPs) and emerging, new POPs (PFASs, UVAs), current use pesticides (CUPs), and toxic metals (mercury, cadmium, lead). Consideration should include the effects of plastic pollution on sea turtle nest properties (temperature, permeability, hatchling exposure to chemical leachates etc.) as well as causing a physical barrier to nesting females and emerging hatchlings.

4.3 SEA BIRDS AND SHORE BIRDS

Marine plastic debris affects over 44% of seabird species worldwide, including Albatrosses. Seabirds mistake plastic pollution for prey and also feed it to their young. The negative impacts and health effects inflicted can cause "plasticosis", impairments to the gastrointestinal (GI) tract microbiome, starvation, and death. Pollutants such as PFASs and mercury can be measured in feathers and microplastics in 'guano' samples, methods of non-invasive sampling. The dynamics of microplastic trophic transfer in the Common tern, a migratory piscivore seabird species, has also been assessed by analysing microplastics in spontaneously regurgitated prey throughout the non-breeding season. As sentinels of ocean pollution and climate change in the Antarctic, penguins such as the emperor penguin, are also affected by plastic pollution, POPs (e.g., DDTs) and toxic metals (i.e. mercury, cooper and lead).

Shorebirds such as dunlins, sandpipers and phalaropes are also another group of the migratory avifauna susceptible and prone to ingest and bioaccumulate microplastics, PAHs and toxic metals (e.g. mercury, cadmium, lead) via direct and indirect exposure when foraging in intertidal biofilm and sediment mudflats, and inland wetlands of stopovers each summer to feed and for energy refuel during the long migration along their superhighways.

4.4 FISH

Fish are at risk from microplastic ingestion, PPCPs, light pollution, chemical pollutant loads, including legacy POPs (PCBs, PDBEs, DDTs, and other OCPs) and emerging, new POPs (PFASs, UVAs such as UVF and UVSs), mercury.

4.5 POLLUTION HOTSPOTS

The workshop also concluded that pollution hotspots (i.e. areas of high pollution that overlap with critical habitat) include the following:

- Coastal areas (especially in the vicinity of industrial zones, cities, pollution sources; with regard to macro-plastics, trace metals, PPCPs, chemical pollution, light pollution, etc.);
- the great ocean gyres – and other possible "ecological traps" including wavelines and frontal areas;
- the open ocean areas where feeding activities, high productivity, biodiversity and plastic pollution converge;
- migratory corridors, especially when along coasts (noting that some migratory routes are already changing due to climate change);

- oceanic seascape migratory corridors (e.g., Eastern Tropical Pacific Marine Corridor (CMAR), comprising Galápagos, Malpelo, Coiba, and Cocos Islands);
- the Mediterranean Sea (with regard to macro- and microplastic pollution, PCBs & POPs, pollution risks from vessel traffic)
- North Pacific and North Atlantic Oceans (with regard to macroplastics, pollution risks from vessel traffic, etc.);
- East Indian Ocean and Southeast Asia (with regard to macroplastics and entanglements of sea turtles); and
- potentially the Clarion-Clipperton zone (and potentially other regions) if deep sea mining goes ahead there.

Concerns were also voiced about the seas around the Galapagos with regard to new POPs (PFASs and UVAs), PPCPs, PAHs, mercury and plastics; and Cyprus (with regard to micro-plastic slicks).

5. COLLABORATION WITH OTHER INTERNATIONAL BODIES

The workshop discussed how CMS could best work with other international bodies working in the marine pollution sphere[5] - i.e. the Stockholm, Basel, Rotterdam, Minamata Conventions and,, CBD, and the Global Plastics Treaty (once it has been agreed). The Minamata Convention provides a global framework to reduce mercury emissions, but its implementation rarely considers ecological impacts on migratory species, such as toothed whales, tunas or eels, that may bioaccumulate mercury across trophic levels and borders. CMS can help bridge the species protection gap, promoting biomonitoring of mercury in CMS-listed species and advocating for their inclusion in Minamata reporting and assessments. Likewise, CMS should seek to liaise with the OSPAR Convention (for the Northeast Atlantic), which has produced robust data on legacy and emerging contaminants in marine mammals. (Please note that which part of CMS might best implement the recommendations outlined here is identified in the list of recommendations below.)

There was general agreement that CMS should not duplicate the efforts of other conventions and the upcoming plastics treaty, but, instead, focus on areas where it can add value for species conservation.

The workshop noted that CMS Parties should be encouraged to engage more actively within the above-named Conventions and treaties to speed up tackling marine pollution issues, enforce fast implementations of precautionary bans of chemicals, address issues around ALDFGs, and seek to build momentum around addressing the above-identified urgently needed and easiest-to-address pollution prevention/reduction measures.

[5] See for example BRS website, highlighting the decisions adopted by the 2025 COP of the Basel, Rotterdam and Stockholm Conventions; and the UNEA ad hoc open-ended working group a science-policy panel on chemicals, waste and pollution prevention, and its latest meeting.

6. CONCLUSIONS AND NEXT STEPS

Based on these discussions, the workshop drafted a set of recommendations, available in Annex 1.

It was also suggested that a resolution on chemical pollution be drafted for consideration by the Scientific Council and COP15. This would need to take into account the relevant CMS resolutions currently in effect, and the resolutions of relevant daughter agreements:

CMS Resolutions

- Resolution 14.9 *Conservation Priorities for Cetaceans*
- Resolution 13.5 (Rev.COP14) *CMS International Light Pollution Guidelines for Migratory Species*
- Resolution 12.20 *Management of Marine Debris*
- Resolution 12.14 *Adverse Impacts of Anthropogenic Noise on Cetaceans and other Migratory Species*
- Resolution 7.3 (Rev.COP12) *Oil Pollution and Migratory Species*

ACCOBAMS

- Resolution 8.20 *Marine Litter and Chemical Pollution*
- New resolution to be adopted at next MOP in November 2025

ASCOBANS

- Resolution 9.3 *Marine Debris*
- Resolution 8.8 *Addressing the Threats from Underwater Munitions*
- Resolution 8.7 *Impacts of Polychlorinated Biphenyls (PCBs)*
- Resolution 7.4 *Impacts of Chemical Pollution on Small Cetaceans*

Moving forward, the creation of an open-ended working group on marine pollution (with a focus on chemical pollution) was suggested. This group could continue to meet and further work on this topic. Terms of Reference for the working group would be submitted to the CMS Scientific Council and in outline might say:

- The group will meet occasionally as needs arise;
- Meetings will be virtual;
- It will be convened by the COP-Appointed Councillor for Marine Pollution; and
- Its outputs, when finalized, will be reported to the meetings of the Sessional Committee of the CMS Scientific Council.

In Annex 3, the workshop participants have provided a selection of some of the latest and most relevant literature which underpins the recommendations made here.

During the review of this report, workshop participants noted that the effects of pollution on migratory marine birds required more consideration and perhaps via a future workshop. In the meantime, Annex 4 provides a list of seabirds for which pollution has been recorded as a population-level threat on the IUCN Red List data. This was kindly provided by Tammy Davies of BirdLife International.

Annex 1: RECOMMENDATIONS

CMS Parties should be encouraged to address these important issues in the immediate future:

- The regulation and reduction of pollution caused by fisheries, vessels and maritime traffic, especially ALDFGs and other forms of (plastic) pollution from fisheries, as well as littering from fishing/commercial vessels[6].
- The securing of land-based sites of pollution (e.g., landfills, open dumps, contaminated sites) from inundation caused by coastal flooding/storm surges, extreme storms/rainfall (atmospheric rivers) and sea level rise.
- The prevention and abatement of nutrient, sediment, and sewage/wastewater discharges from land into the marine environment via rivers/estuaries/water catchment areas or directly.
- The prevention and abatement of emissions, spills and leakages from coastal industries (e.g. petrochemical and refinery industries, oil pipelines, transferring stations, tankers), including during transfers of material, and abandoned military bases as sources of petrogenic aromatic hydrocarbons (PAHs) and persistent organic pollutants (POPs), primarily including polychlorinated biphenyls (PCBs) and flame retardants (polybrominated diphenyl ethers/PBDEs and perfluoroalkyl and polyfluoroalkyl substances/PFASs).
- The urgent prevention and abatement of spills and losses of (raw) materials from ships during transportation and transfers in harbours, as well as following accidents (e.g., spills of plastic nurdles and other types of plastics, fuel and oil).
- The development of innovative product designs and just-transition processes to substitute plastic polymer or synthetic fibres and textiles (e.g. polyester and nylon) with more greener, more environmentally sustainable and biodegradable products to address the growing impact of the apparel and clothing industries as a diffuse source of marine pollution through multiple pathways.
- The need to recognize PFAS (per- and polyfluoroalkyl substances) as an emerging transboundary threat, now widely detected in apex predators and still poorly regulated under international conventions, including by:
    - advocating for the inclusion of all PFAS under the Stockholm Convention;
    - calling for harmonized monitoring in migratory species; and
    - advocating for broader action on the entire class of PFAS due to their persistence, bioaccumulation potential, and detection in migratory species.
- The urgent development of conservation strategies for migratory animals that address pollution, especially during particularly vulnerable stages of the migratory cycle (e.g., at foraging/feeding grounds, where breeding occurs, in migration corridors (especially along coasts) and regional biological corridors, and, where appropriate, during oceanic life stages (e.g., for sea turtles)).

[6] Noting that CMS Resolution 12.20 *Management of Marine Debris* "Calls upon Parties and invites other stakeholders to address the issue of abandoned, lost or otherwise discarded fishing gear (ALDFG), by following the strategies set out under the Food and Agriculture Organization's Code of Conduct for Responsible Fisheries".

- Urgent action in areas where critical habitat overlaps with pollution hotspots including:
  - coastal areas (especially in the vicinity of industrial zones, cities, pollution sources) with regard to macro-plastics, trace metals, PPCPs, chemical pollution, light pollution, etc.,
  - the great ocean gyres – and other possible ‘ecological traps’ including wavelines and frontal areas,
  - open ocean areas where feeding activities, high productivity, biodiversity and plastic pollution converge,
  - migratory corridors, especially along coasts (noting that some migratory routes are already changing due to climate change),
  - oceanic seascape migratory corridors (e.g., Eastern Tropical Pacific Marine Corridor, comprising the Galápagos, Malpelo, Coiba, and Cocos Islands),
  - Clarion-Clipperton Zone (and other regions where deep-sea mining may occur),
  - the Mediterranean Sea (with regard to macro- and micro-plastic pollution, PCBs and POPs, pollution risks from vessel traffic),
  - the North Pacific and North Atlantic Oceans (with regard to macro-plastics, shipping + pollution, etc.),
  - the East Indian Ocean and Southeast Asia (with regard to macro-plastic and entanglements of sea turtles).

In addition, CMS Parties should also be encouraged to:

- Recognize that mercury and other chemical pollutants (e.g., PCBs) are not only linked to historical industrial pollution but are also being remobilized due to, for example, permafrost thawing, an increase in forest fires and altertions to biogeochemical cycling in warming oceans. These processes may intensify exposure risks for long-lived migratory species in polar and low-latitude regions.
- Recognize and respond to the vulnerability of diadromous species (e.g., European eels (*Anguilla anguilla*) and hilsa herring (*Tenualosa ilisha*)) to combined threats from chemical pollutants (e.g., mercury, PCBs, PFAS, PPCPs) and disruptions to migration cues, which might also be adversely affected by light pollution. These species are often overlooked in marine frameworks yet carry high contaminant loads and face steep population declines.
- Strengthen cooperation between CMS and the Stockholm, Basel, Rotterdam and Minamata Conventions to address pollutant risks to migratory species.
- Improve strategic engagement with the Convention for the Protection of the Marine Environment of the North-East Altantic (OSPAR), including:
  - supporting OSPAR-style pollutant surveillance in under-monitored regions (e.g., Indian Ocean, Southeast Asia); and
  - exploring the potential for CMS to serve as a platform to translate OSPAR science into species-specific conservation actions by, for example, using OSPAR’s outputs to help identify hotspots and populations/species at risk.

- Seek better engagement with regional seas conventions.
- Promote the adoption of ‘Effects-Based Monitoring’ frameworks, which move beyond traditional chemical concentration thresholds to focus on the biological impacts of pollutant mixtures on migratory species.
- Promote conservation approaches that explicitly account for the cumulative, synergistic and interactive nature of anthropogenic threats to migratory species (especially interactions between marine pollution and climate change).
- Promote the recognition and strategic use of stranding investigations as a valuable, cost-effective and ethical method for assessing the health of migratory marine species.
- Share data gathered on impacts of marine pollution, e.g., from strandings networks.
- Mitigate the impacts of light pollution on migratory species in the offshore oceans.
- Recognize the value of IMMAs (for cetaceans), ISRAs (for elasmobranchs) IBAs (for birds) and IMTAs (under development for marine turtles) for determining areas where action may be urgently needed. The overlap of these areas with spatial observations of current and modelled future areas of high accumulation/presence of marine pollution can be used to identify potential impact hotspots.

The CMS Scientific Council should continue its work on this issue including:

A. Identifying and evaluating:

   - species/populations, habitats and migratory/life stages that are most at risk, noting the preliminary list provided in Annex 1 of this workshop; and
   - global hotspots where marine pollution and critical habitat for migratory species overlap.

B. Promoting the use of standardized methodologies for fieldwork methods and sampling, archiving of samples, and the open-source publishing and sharing of results.

C. Developing or applying a ‘vulnerability matrix’ that integrates species’ sensitivity, exposure and adaptive capacity to both marine pollution and climate change, to help prioritize conservation actions under future environmental scenarios.

D. Giving further consideration to the threat posed by chemical pollution to marine birds (i.e. seabirds and shorebirds), potentially via a further dedicated workshop.

Annex 2: LIST OF PARTICIPANTS

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Annex 3: SELECTED LITERATURE

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Annex 4: SEABIRD SPECIES THREATENED BY POLLUTION

The table here shows seabird species (n = 21) where the majority (50 – 90%) or whole (>90%) of the population are currently threatened by pollution (including light pollution) with associated population declines (‘slow, significant’ or ‘rapid’ declines).

Threats were classified using the IUCN Red List Threats Classification Scheme version 3.2

Please see Dias et al. 2019 for further details.

Family	Common Name	Scientific Name	RL	RL Assess-ment year	Threat (IUCN classification level 2)	Threats (IUCN classification level 3)	Source	Scope	Severity
PELECANIDAE	Great White Pelican	Pelecanus onocrotalus	LC	2021	Agricultural & forestry effluents	Herbicides and pesticides	terrestrial	Majority	Slow, Significant Declines
PROCELLARIIDAE	Mascarene Petrel	Pseudobulweria aterrima	CR	2018	Excess energy	Light pollution	terrestrial	Majority	Slow, Significant Declines
PROCELLARIIDAE	Tahiti Petrel	Pseudobulweria rostrata	NT	2018	Excess energy	Light pollution	terrestrial	Majority	Slow, Significant Declines
PROCELLARIIDAE	Black-capped Petrel	Pterodroma hasitata	EN	2018	Excess energy	Light pollution	terrestrial	Majority	Slow, Significant Declines
PROCELLARIIDAE	Hawaiian Petrel	Pterodroma sandwichensis	EN	2018	Excess energy	Light pollution	terrestrial	Majority	Slow, Significant Declines
PROCELLARIIDAE	Newell's Shearwater	Puffinus newelli	CR	2019	Excess energy	Light pollution	terrestrial	Majority	Rapid Declines
PROCELLARIIDAE	Flesh-footed Shearwater	Ardenna carneipes	NT	2018	Garbage & solid waste		marine	Whole	Slow, Significant Declines
ALCIDAE	Kittlitz's Murrelet	Brachyramphus brevirostris	NT	2018	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
ALCIDAE	Marbled Murrelet	Brachyramphus marmoratus	EN	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
ALCIDAE	Cassin's Auklet	Ptychoramphus aleuticus	NT	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
ALCIDAE	Craveri's Murrelet	Synthliboramphus craveri	VU	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
ANATIDAE	Velvet Scoter	Melanitta fusca	VU	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
ANATIDAE	White-headed Steamerduck	Tachyeres leucocephalus	VU	2018	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
LARIDAE	Black-legged Kittiwake	Rissa tridactyla	VU	2018	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
PHALACROCORACIDAE	European Shag	Gulosus aristotelis	LC	2018	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
SPHENISCIDAE	Southern Rockhopper Penguin	Eudyptes chrysocome	VU	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
SPHENISCIDAE	Northern Rockhopper Penguin	Eudyptes moseleyi	EN	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
SPHENISCIDAE	African Penguin	Spheniscus demersus	CR	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
SPHENISCIDAE	Magellanic Penguin	Spheniscus magellanicus	LC	2020	Industrial & military effluents	Oil spills	marine	Majority	Slow, Significant Declines
LARIDAE	Olrog's Gull	Larus atlanticus	NT	2018	Industrial & military effluents	Type Unknown /Unrecorded	marine	Whole	Slow, Significant Declines
PROCELLARIIDAE	Streaked Shearwater	Calonectris leucomelas	NT	2018	Industrial & military effluents	Type Unknown / Unrecorded	marine	Majority	Slow, Significant Declines