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CUMULATIVE EFFECTS ASSESSMENT FOR MIGRATORY SPECIES

(Prepared by the Secretariat)

Summary:

This document contains the report *Cumulative Effects Assessment for Migratory Species* that was written in accordance with Decision 14.205.

Cumulative effects assessment for migratory species

The role of migratory species in cumulative effects assessment in the marine environment

J.D.P. de Leur

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Cumulative effects assessment for migratory species: the role of migratory species in cumulative effects assessment in the marine environment

Prepared by the Secretariat of the Convention on Migratory Species (CMS), March 2025.

AUTHOR

Jennifer Daan de Leur

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Heidrun Frisch-Nwakanma, CMS Programme Management Officer

Emilie Doucet, CMS Aquatic Species Team intern

COVER IMAGE

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Executive Summary

The Convention for the Conservation of Migratory Species (CMS) aims to protect migratory species globally, particularly those listed in its Appendix I and II. These species face multiple threats, including climate change, habitat loss, pollution, and unsustainable use. A growing concern is the cumulative impact of these pressures. Environmental Impact Assessments (EIAs) are commonly required for new projects, in order to evaluate their environmental effects. In addition, there is increasing recognition of the need for Cumulative Effects Assessment (CEA) to account for impacts that accumulate over time and across locations. Migratory species, especially marine species, are highly vulnerable to cumulative impacts that extend beyond national borders. However, they are rarely explicitly considered in CEAs. This is an issue because the industrialization of oceans has intensified threats to marine migratory species, and the assessment of cumulative effects is particularly challenging due to the highly dynamic nature of marine environments. To address this issue, CMS COP14 adopted Decision 14.205. The decision requests CMS to consider the information submitted by Parties regarding the application of CEAs and the need for further guidance, to prepare a report on how such assessments are undertaken and the relevance for migratory species conservation. If required, the Secretariat is further requested to develop guidance on cumulative effects assessments for marine mammals. In response to this decision, the present report was drafted to increase the knowledge of how CMS Parties apply CEA within EIA and Strategic Environmental Assessment (SEA) in order to ensure consistent implementation of CMS obligations. Through a review of Party submissions, national policies, literature and international guidelines, this report provides a comprehensive overview of the current state of CEA, with a focus on marine migratory species and examples from various geographic regions. Best practices and key challenges are identified, based on which recommendations are made to improve the inclusion of migratory species in CEAs under the CMS Convention. These findings contribute to an improved understanding of CEA in CMS and will inform discussions on further action at the 8th Meeting of the Scientific Council in 2025, and subsequently the 15th Conference of Parties in 2026. The recommendations aid CMS in continuing its work on cumulative effects and contribute to improved transboundary conservation of migratory species worldwide.

1. Introduction

Climate change, habitat loss, unsustainable use and many other threats affect the lives of many species listed on CMS Appendix I and II. To undertake new projects or activities nowadays, a form of environmental impact assessment (EIA) is usually required to assess the potential environmental effects, including, for example, mitigation measures to reduce impact on migratory species/potential environmental effects, including impacts on migratory species, and measures to mitigate such effects. Historically, EIAs have often focused on the impact of one project or activity on one or more receptors (such as the effects of marine noise on marine mammals during offshore windfarm construction). However, an increasing number of studies have shown that these effects cannot be assessed in isolation, but that they accumulate – sometimes showing unexpected new effects (Hague et al., 2022; Elliott et al., 2017; Blakley, J. & Russell, J., 2019). To better understand and address this phenomenon, a new discipline within EIA emerged: cumulative effects assessment (CEA). Though many different definitions of cumulative effects and CEA have been put forward, the term generally refers to methodical procedures that attempt to identify, predict and evaluate the significance of multiple effects from one or multiple activities on a specified receptor (Hague et al., 2022; Judd et al., 2015).

CEA was first developed early in the 1970s in the United States, as part of the National Environmental Policy Act (NEPA). In the EU, CEA started to get attention in the 1980s, with the earliest requirement to assess cumulative effects set out in the European EIA Directive 85/337/EEC, and the European Community Habitats Directive 92/43/EEC (Roudgarmi, 2018). Over time, CEA has become more routinely integrated into EIA processes. In the past two decades, continued improvements have been made in CEA understanding and practice. The emergence of strategic environmental assessment (SEA) has given more attention to cumulative effects, sometimes forming the center of strategic studies. Cumulative effects have become more integrated in methods and tools for EIA, and procedures for CEA continue to be improved (IAIA, n.d.). Further developments have taken place regarding the inclusion of stakeholders, especially Indigenous Peoples or local communities, as well as the consideration of social and economic impacts, alongside environmental ones. The consideration of cumulative effects is mostly absent in developing countries (Roudgarmi, 2018).

Migratory species are particularly susceptible to impacts that may occur far beyond the territory of the country in which they originate, as well as to cumulative impacts that result from multiple, interacting pressures along their migratory routes. Although conservation efforts for migratory species populations, their habitats and ranges have increased, including through the efforts of multilateral environmental agreements such as the CMS, they are still rarely explicitly recognized in CEAs. This is despite the fact that CEA could address some of the avoidable detriment to migratory species which often occurs through lack of an adequate prior assessment of the potential environmental impacts of projects, plans, programmes, and policies (UNEP/CMS/Resolution 7.2 (Rev.COP14)). This is in part due to a scarcity of data, difficulty in assessing the effects migratory species are exposed to along their full migration range and challenges in international cooperation (Hague et al., 2022).

This is particularly true for marine migratory species. To mitigate the effect of greenhouse gas emissions, an increasing number of renewable energy projects are being developed, including a growing number in the ocean, such as offshore windfarms, wave energy and tidal energy. The – often harmful – impacts of these project developments (during construction, use and deconstruction) on marine life are compounded by the increasing industrialization of the ocean space with activities such as shipping, fisheries and potentially deep seabed mining occurring simultaneously (Hammar et al., 2020). In addition, climate change effects such as marine

heatwaves and ocean acidification, as well as marine pollution (from marine debris to oil spills and chemicals), put even more pressure on marine migratory species. However, assessment of cumulative effects in the marine environment is challenging, as marine environments are often dynamic and highly changeable. Moreover, they are physically and ecologically connected across wide areas – including coasts, estuaries, and high seas – and generally are less visible and accessible for observation and monitoring, which limits the extent to which cause-and-effect relationships can be quantified for assessment (CIEEM, 2018).

Although CEA has been widely studied, the perspective on marine migratory species is often absent from publications. To effectively work on marine migratory species conservation in the face of multiple threats, and to improve CEA methods and procedures, it is necessary to understand how countries undertake CEAs in relation to marine migratory species and where guidance is needed.

In CMS COP14 Decision 14.204-14.206 on Impact Assessment and Migratory Species, the Secretariat was asked to (a) request information from Parties about national policies regarding cumulative effects assessments, including any experiences and lessons learned, as well as indicating whether there is a need for guidance on cumulative effects assessments from EIAs and SEAs for marine mammal and (b) support the development of the report on cumulative effects assessments and of guidance, as required. The Scientific Council was requested to consider the information submitted by Parties regarding the application of CEAs and the need for further guidance, to prepare a report on how such assessments are undertaken and the relevance for migratory species conservation, and to develop guidance on cumulative effects assessments for marine mammals if required. This report was drafted in response to the Decisions 14.204-206 with the specific aims to: (1) increase the knowledge of how CMS Parties apply Cumulative Effects Assessment (CEA) within Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) in order to comply with their obligations under CMS Article III.4(b) to “prevent, remove, compensate for or minimize the adverse effects of activities or obstacles that seriously impede or prevent the migration of the species”; (2) assess new developments, best practices and recurring challenges of CEAs in relation to migratory species, in particular marine species, to identify where guidance is needed; (3) suggest, based on these findings, directions for the development of this guidance and make recommendations on their use to the 15th meeting of the Conference of the Parties (COP15) in 2026.

The scope of this work is determined by the above-mentioned Decisions. This report builds on the extensive work already done by the Energy Task Force regarding renewable energy and powerlines, particularly in relation to birds, bats and marine mammals. It also draws on the report *Linear Infrastructure And Migratory Species: The Role Of Impact Assessment And Landscape Approaches* (Slootweg, 2021) produced for COP14. Some elements addressed in this previous work have been covered in less detail in this report to avoid duplication.

2. Methods

2.1 State of the Art Overview on CEA

Due to the transboundary nature of many migratory species, including those listed on CMS Appendix I and II, addressing impacts on these species and their habitats is one of the cross-cutting themes CMS addresses. The CMS has a mandate to address cumulative impact assessments following from Decisions 14.204-206 as outlined above. Based on this mandate, the research question detailed below was developed:

How are cumulative effects assessments undertaken by CMS Parties?

- Sub question 1: What is the relevance of cumulative effects assessments for migratory species?
- Sub-question 2: What guidance should be developed to support cumulative effects assessments for marine mammals?

Drawing from this, the following objectives were established for this report:

1) Consider the information submitted by Parties regarding the application of cumulative effects assessments and the need for further guidance
2) Prepare a report on how such assessments are undertaken and the relevance for migratory species conservation
3) Develop guidance on cumulative effects assessments for marine mammals

This report provides an overview of how CEA assessments are currently undertaken by CMS Parties, offers recommendations for the development of guidance for marine mammals, and proposes draft Decisions to be considered at CMS COP15 to support continued work of CEAs within the Convention.

To adequately fulfil the mandate of Decision 14.205 despite limited responses from Parties, it was decided to gather additional information by consulting various external resources including an academic literature review and an evaluation of national and international policy and guidance documents available online. These different sources were analysed separately, but findings were combined and summarized, highlighting key challenges and best practices, the results of which are presented in Chapter 3. Given the extensive body of literature of EIA and CEA, this report focuses specifically on CEA in the context of migratory species, with particular attention to marine migratory species.

2.1.1 CMS Party Submissions

On 3 June 2024, CMS issued Notification 2024/016 to all CMS Parties to request information as per Decision 14.204 on "national policies regarding cumulative effects assessments from Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs), including any experiences and lessons learned, as well as indicating whether there is a need for guidance on cumulative effects assessments for marine mammals". The responses were compiled and presented to the ScC-SC7 as Inf.16 Responses to Decision 14.204 on Cumulative Effects Assessments | CMS.

In total, the Secretariat received submissions from two Parties: one from New Zealand and the one from the Dominican Republic.

The Dominican Republic combined their responses to Notification No. 2024/012 (marine noise), Notification No. 2024/013 (deep sea mineral exploitation), and Notification No. 2024/016 (cumulative effects assessments) in one document (17 pages). The document was submitted in Spanish, accompanied by a machine-generated English translation which was used for the development of this report. However, the documents submitted only contained information on marine noise and deep seabed mining, with no mention of EIA or CEA in the text.

New Zealand submitted five documents:

1) Addressing cumulative effects in marine management decisions: Summary (4 pages)
2) Addressing cumulative effects in marine management decisions: Guidance (16 pages)
3) Understanding cumulative effects from a te ao Māori perspective (webpage)
4) Hapū and iwi perceptions of cumulative effects: towards supporting kaitiakitanga (36 pages)
5) Developing decision-support tools for cumulative effects management (16 pages)

These documents were read in full and summarized. However, as only two out of the 133 CMS Parties submitted documents, no conclusion could be formulated yet based on this information alone. Additional research was deemed necessary.

To supply the information submitted by Parties to Notification 2024/016, the most recent round of National Reports to CMS COP14 was also consulted to check for any mention or analysis of CEAs.

2.1.2 Literature Review

For the literature review, a narrative approach was adopted. This approach was chosen because of limited time and capacity for a full systematic review, but more so because a narrative review can include a wide variety of studies and provide an overall summary on a topic while conducting a subjective examination and critique of an entire body of literature (Sukhera et al., 2022), which was relevant in this case to synthesize the literature in a way that is relevant to CMS by focusing on migratory species and marine mammals in particular.

There are multiple methods for analysing a narrative literature review. In this case, a state-of-the-art review was chosen. This type of review allows for information on a topic to be summarized in a tripartite argument: a summary of the current state of understanding, how such an understanding was developed, and an idea of future directions (Barry et al., 2022).

To structure the state-of-the-art review, the six-stage approach as proposed by Barry et al. (2022) was followed. For each of the key steps, a summary of the actions taken is given below.

Following initial searching, testing, and reading, and after having determined the timeline, it was decided to focus the review on CEAs in the marine environment, instead of exclusively targeting marine mammals, as the latter was found to be too narrow of a scope for a comprehensive analysis on CEAs.

Narrative reviews typically do not involve strict predetermined inclusion/exclusion criteria Sukhera, 2022). Nonetheless, in order to conduct a rigorous review, it is essential to clearly outline/determine/establish the boundaries and scope of the review, as well as key terms and definitions related to the research question and topic.

The databases Web of Science, Scopus and Google Scholar were included in the collection of literature. Scopus is an abstract and citation database of peer-reviewed literature including scientific journals, books, and conference proceedings. Scopus provides a comprehensive overview of worldwide research output in the fields of science, technology, medicine, social sciences, and arts and humanities. Web of Science is a multidisciplinary citation database containing scientific, peer-reviewed articles from disciplines in sciences, social sciences and humanities.

For this stage, only peer-reviewed journal articles were included. Special attention was given to review articles and seminal papers on the topic, as the review aimed to synthesize information encompassing many different countries. Articles were deemed relevant if they covered CEA/CIA, especially if the study is related to the marine environment. Articles that only addressed EIA, with no mention of cumulative effects, were thus not included. Articles that addressed CEA but in a different environmental context (terrestrial, avian, etc.) were not included unless they were considered seminal papers.

It should be acknowledged that narrative reviews may not capture all relevant literature on a topic. Therefore, care was taken to start with a broader scope, narrowed down by reading multiple papers and selecting those that most closely fit the topic.

Saturation was reached when papers read no longer provided new insights and instead reinforced supporting the themes, gaps and recommendations already identified.

In an Excel file, each paper was analysed, and the information on CEA was extracted, including the approach/methodology, key findings (including challenges), main conclusions, recommendations, and resources and ideas mentioned that required follow-up research.

2.1.3 National Policy and Guidelines

To collect national policy documents on CEA, the search string “[country name] + cumulative effects assessment” was used in the Google database to look for documents provided by governments or other institutes.

Although the national policy perspective is important to the implementation of this Decision, there are also non-governmental and international resources available on CEA and CEA guidance. The literature review and the search for national policy documents helped identify supplementary resources. Additionally, since CMS falls under the framework of the United Nations, a search was conducted for any relevant guidance within the UN system. The seventh review of implementation of the Convention on Environmental Impact Assessment in a

Transboundary Context along with its reports were examined. This Convention is particularly relevant to CEAs and migratory species due to its transboundary scope.

2.1.4 International Standards and Guidelines

The primary focus of this report is on CMS Party national policies on CEA and migratory species, but existing international standards and guidelines on CEAs also bear relevance for the inclusion of migratory species. Some of the major and newly published standards were reviewed and included as a separate section to provide additional insights.

2.2 Analysis

After collecting the sources and analysing the common themes and patterns, they were synthesized to summarize key points on how CEAs are undertaken, the relevance to migratory species, and where guidance seemed to be needed. This was done primarily by examining which best practices, challenges and themes came up across the different sources, and how frequently.

3. Results

3.1 Conducting Cumulative Effects Assessments

National legislations or policies often do not detail how CEAs should be carried out, focusing instead on identifying the cases in which they are required. Therefore, this report draws primarily from literature and policy or guidelines documents that focus on approaches to CEA.

CEAs is a subdiscipline and often part of EIA and SEA. It is one of the main tools used by regulatory agencies to ensure adequate protection of the environment, including species, communities and ecosystems. (Hague et al., 2022). CEA differs from EIA and SEA in that it focuses on the receptors – defined as Valuable Ecosystem Components (VECs) – rather than on the effects of a single project development proposal, as is typical in EIA or ESIA (Environmental and Social Impact Assessment) SEA is used to assess the impact of government-wide or sector-wide policies or plans not tied to a specific development project. CEA is increasingly recognised as an important component of EIA and SEA. CEA has the potential to provide a more comprehensive understanding of the overall consequences of human activities and other pressures, as well as the mitigation measures that could prevent or reduce harmful effects (Hague et al., 2022).

Ideally, a CEA would assess all effects in the chosen area but in practice, this is not possible. Therefore, CEAs are usually tailored to focus on pressures and effects that are the most relevant to the decision-making context. The terms “effect” and “impact” are often used interchangeably in CEAs and in the literature, which also leads to some papers using the term CEA, where others refer to CIA (Cumulative Impact Assessment). The terms effect and impact, and thus CEA and CIA, are considered synonymous in this report, though for consistency purposes, only the terms “effect” and “CEA” are used hereafter. However, it is useful to make a distinction between “pressures” (also referred to as “stressors”) on the one side and “effects” on the other, as suggested by Judd et al. (2015). Essentially, a pressure only results in an effect when an ecosystem component is exposed to it. To illustrate this logic: A human activity (e.g. pile driving) exerts pressure (e.g. underwater noise) on an ecosystem component (e.g. a dolphin), which produces an effect (e.g. avoidance of the noisy area). If the selected ecosystem components are not present and thus not exposed to the selected pressure, no effect is considered to occur (Korpinen & Andersen, 2016).

The literature contains many variations of how cumulative effects are defined (Jones, 2016; Judd et al., 2015). Generally, cumulative effects refer to effects that arise from incremental, accumulating, and/or interacting stressors from human activities and natural events that overlap in space and/or time (Rojas-Nazar al., 2024). Stressors can interact in complex and non-linear ways, leading to unexpected ecological responses subject to lag effects that can accumulate over time and that can cause ecological responses both within the footprint of an activity and outside the original activity area.

CEAs can assess similar or dissimilar pressure types acting on one or more different receptor types (Judd et al., 2015). Similar pressure types refer to multiple sources within the same category of pressure, for example, various forms of underwater noise such as military sonar, pile-driving, seismic surveys, explosions, and shipping. Dissimilar pressure types, on the other hand, refer to entirely different categories of pressure: underwater noise, pollution, and fishing. A single receptor type could be marine mammals, which can be further specified to a particular species or population (see selection of VECs). In contrast, multiple receptor types may include marine mammals, seabirds, fish, and local communities. In practice, however, consideration of multiple pressure types from multiple activities is rare (Hague et al., 2022 and references within).

One of the weaknesses commonly highlighted in the literature is the absence of a standardised process, methodology, framework or definition of CEA (Foley et al., 2017; Hague et al., 2022; Judd et al., 2015). However, some authors view the wide range of CEA frameworks reflected in the literature as an opportunity, offering ways to apply CEA in different contexts (Duinker et al., 2013). Nonetheless, in practice, CEAs generally consist of the same core steps, detailed in Figure 1 below (see Duinker et al., 2013; Jones, 2016; Judd et al., 2015).

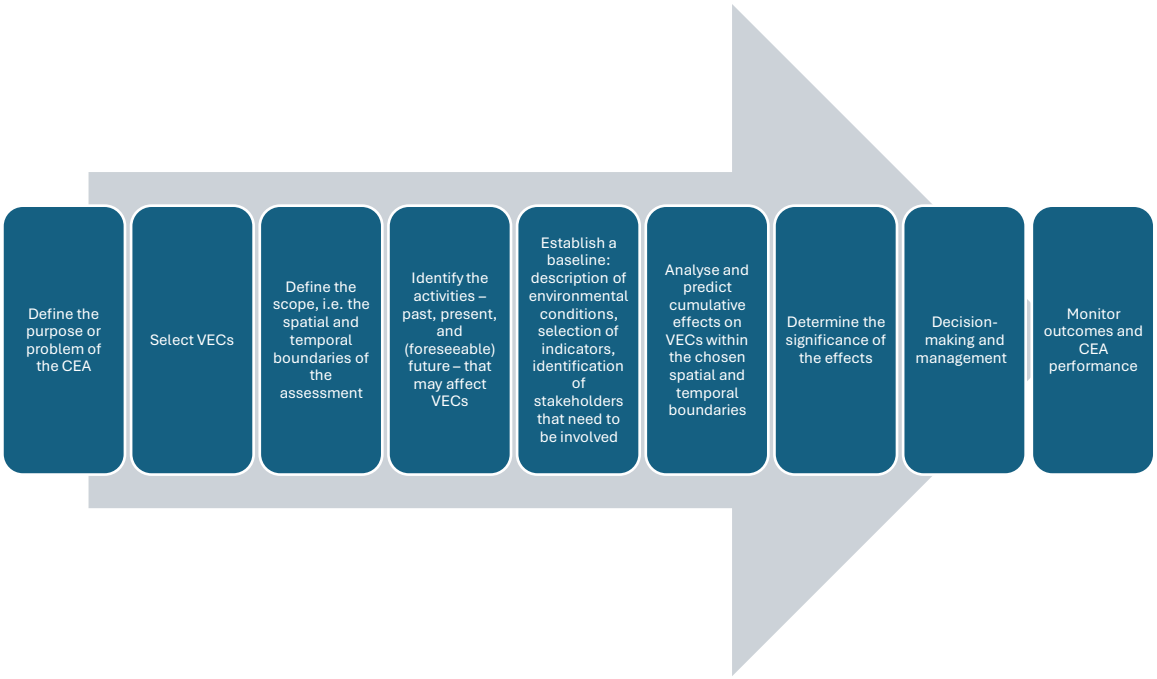

Figure 1. Core steps of cumulative effects assessments (Duinker et al., 2013; Jones, 2016; Judd et al., 2015).

Depending on whether the CEA is part of an EIA or SEA, additional steps are sometimes added from the EIA and SEA process, such as a screening phase at the start. The stepwise framework here only covers those steps specifically for CEA.

1. Defining the purpose and problem of CEA

A CEA is conducted to inform decisions made regarding VECs the relevant pressures, as well as the spatial and temporal boundaries. This purpose should therefore be clearly stated. The description should define what the CEA is needed for, and should include the context, the questions, the guiding principles, and the outputs required to meet end-user needs (Willsteed et al., 2024).

2. VECs

VECs are the receptors of the multiple, cumulative pressures chosen for assessment (Duinker et al., 2013). As this report focuses on migratory species in the marine environment, applicable VECs include species populations, habitats or ecosystems of CMS Appendix I and II listed species. Marine mammals in particular can be selected as receptor for marine CEAs, because of their high conservation value, high degree of (legal) protection, vulnerability to anthropogenic pressures, and strong correlation between their distribution and areas with human activities (Hague et al., 2022). Moreover, the cumulative effects of multiple pressures

on marine mammals represent a knowledge gap identified in the literature (Hague et al., 2022 and references within). During the selection of VECs, it is necessary to determine whether one or more receptors will be considered. Korpinen and Anderson (2016), in their review of 40 marine CEAs, noticed a lack of justification for why some species or habitats were selected and others not, despite the selection of VECs being a crucial step in the CEA process.

Best practices:

- ✓ Clearly set out purpose and scope (Hague et al., 2022; Judd et al., 2015)
- ✓ Standard practice to state which receptors are considered and which are scoped out, with reasoning (Hague et al., 2022; Judd et al., 2015)

Challenges:

- ➢ Unclarity regarding the criteria used for selecting VECs, e.g. which VECs are representative for the ecosystem

3. Spatial and temporal boundaries

After selecting the VECS, determining the spatial and temporal scale is crucial, as influences which activities and pressures are included in the assessment. However, choosing the appropriate spatial and temporal scale is one of the key challenges to effective CEA (Hague et al., 2022). This is particularly challenging in the case of migratory species, such as marine mammals, due to their high mobility. Some pressures occur at a global scale (such as climate change) but will affect VECs on a local scale. The frequency or duration of a pressure naturally influences the type and scale of response by the VEC.

Ultimately, the appropriate spatial scale is context specific, dependent on the activities that are the source of pressures (Figure 2). Some pressures require assessment at an ecologically meaningful scale, whereas other can be assessed within a defined radius (Hague et al., 2022). It is common practice for the spatial scale to be determined by the expected area of the effect or activity (Foley et al., 2017). With highly mobile species such as marine mammals, however, such an approach is likely to be insufficient, which means that the ecology and behaviour of the VEC must be considered when determining spatial scale. For migratory species, CEAs at the population distribution/migration level or higher would provide the most comprehensive information. However, consideration of migratory species on national and project level is still important.

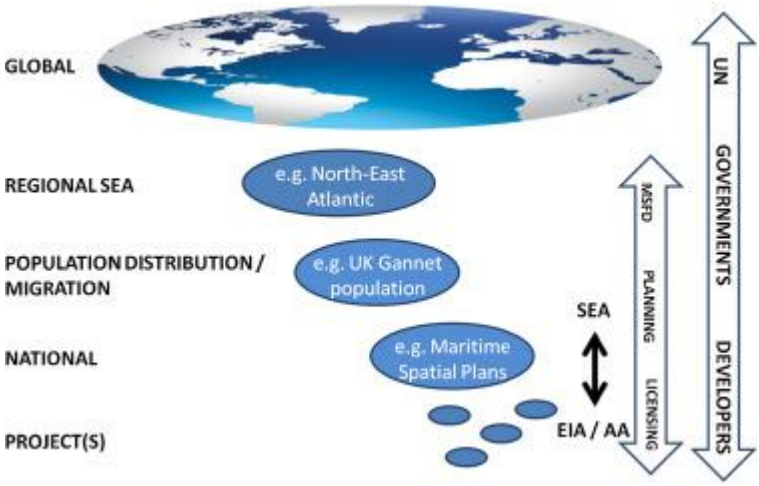

Figure 2. Relative spatial scales of CEA (Judd et al., 2015).

Regarding temporal scale, it is common practice to scale the assessment based on the duration of a proposed activity or project (Foley et al., 2017; Hague et al., 2022). Many of the CEA methodologies focus on a snapshot in time based on recent/current conditions (Simeone et al. 2023). Ideally, the CEA should cover the complete life cycle of an activity or project, from exploration to decommissioning, and the length of time required for the VEC to recover, as changes may be lagged (Hague et al., 2022).

Unfortunately, the literature consulted for this report did not provide concrete examples of approaches that can be followed when determining spatial or temporal scale of a CEA for migratory species, though migratory routes (spatial) and seasonality (temporal) were sometimes named as factors that can be taken into account.

Best practices:

- ✓ Temporal scale of each impact considered within the CEA based on the length of time required for the receptor to recover from that specific impact, with lags in response time incorporated where required, as per the best available science/current knowledge (Hague et al., 2022)
- ✓ Spatial scale of the CEA tailored to the appropriate context per impact, taking into consideration the spatial range of the receptors and the scale of impacts, as per the best available science/current knowledge (Hague et al., 2022)

Challenges:

- ➢ No explicit statement of the spatial or temporal scale of the CEA (Hague et al., 2022)

4. Identify activities and pressures

Once the VECs and scope has been established, the activities and pressures to be included in the CEA need to be identified. This depends on the spatial and temporal scale, but should generally include existing, new and foreseen activities within the area of the assessment.

In the UK, CEAs conducted in the maritime industry, most frequently included construction noise and vessel noise as pressures on marine mammals (Hague et al., 2022). Activities may be excluded, for example, if their potential effects are deemed insignificant or if a lack of data/knowledge precludes assessment. However, only including the activities and pressures that are deemed significant in isolation, excludes the possibility that these effects could result in significant cumulative effects, for example by acting additively or synergistically (Hague et al., 2022). Including only the activities and pressures for which a lot of data is available influences the robustness of the assessment, as it will not accurately reflect the full range of pressures marine mammals experience. When selecting activities to assess, it is necessary to consider the different pressure types that will be included: similar, dissimilar or both.

Best practices:

- ✓ CEAs to consider multiple stressors from multiple activities or sources (Hague et al., 2022)
- ✓ All impacts initially considered through a risk screening and prioritisation process uniform across industries, documented by a clear audit trail (Hague et al., 2022; Judd et al., 2015)
- ✓ Standard practice to state which effects, pressures, and activities are considered and which are scoped out, with reasoning (Hague et al., 2022; Judd et al., 2015)

Challenges:

- ➢ Imprecision in reporting time and duration of occurrence of pressures and considering accumulation of effects over time (Korpinen & Andersen, 2016)

5. Baseline

Establishing the baseline, using appropriate data and background information, is essential in the CEA process. It provides the level to which the potential negative effects are assessed, and determines how significance is evaluated (Hague et al., 2022). The baseline description should cover species presence – including abundance, distribution, and seasonality – as well as existing and potential (future) pressures in the area to be assessed. A description of the historic, non-affected environment is ideal, though in practice very challenging. Instead, it is common practice, such as in regulations in the UK, to use current conditions as the baseline (Foley et al., 2017; Hague et al., 2022). However, due to the shifting baseline phenomenon, where each generation assumes the current condition of the environment as a baseline against which to compare changes, this practice can result in a gradual shift to increasingly disturbed baselines over time, decreasing the protection and conservation potential of CEAs (Hague et al., 2022).

Best practices:

- ✓ Agree the baseline to permit iterations and incremental improvements, and to enable a common baseline from which to bind together marine plans (Willsteed et al., 2024)

Challenges:

- ➢ Assessment of vulnerability does not include historical effects that have already modified the marine environment but, especially with spatial data, only reflects the current situation (Korpinen & Andersen, 2016)
- ➢ Availability of data for baselines and assessment (Hague et al., 2022)

6. Analysis and prediction of cumulative effects

Cumulative effects present in multiple ways: they can be additive (effects add up), synergistic (the combined effects is greater than the sum of effects), antagonistic (combined effect is smaller than the sum of effects, direct, indirect, linear or non-linear (Hague et al., 2022; Jones, 2016; Korpinen & Andersen, 2016). Due to lack of data and information on how effects interact, in practice, it can be necessary to assume additive effects. However, it is then important to acknowledge this assumption this and evaluate potential under- or overestimation of effects (Hague et al., 2022).

Generally, cumulative effects are analysed numerically (such as with models of spatial damage and loss of individuals) or categorically (based on literature review and expert panels) (Korpinen & Andersen, 2016).

In the seminal paper by Halpern et al. (2008), a standardized, quantitative method, based on expert judgement, is proposed to estimate the relative impact of 17 anthropogenic drivers of ecological change on marine ecosystems at a global scale. The weighted impact scores for each activity were combined to produce a single comparable estimate of cumulative human impact. Using an additive model, predicted cumulative impact scores were calculated for each 1 km2 cell on a map of the global ocean, resulting in a global map of cumulative impact across 20 ocean ecosystem types. The model is limited in that it only considers present activities (excluding past or future ones), relies on highly variable ecosystem data, and may use imprecise spatial data for anthropogenic drivers.

The influence of this paper is shown by Korpinen and Andersen (2016), who, in their review of 40 recent marine CEAs, showed that 50% of those studies claimed to use a similar method to Halpern et al. (2008). Three main common components were found in assessments using this method: 1) spatial data on intensity of pressures, 2) spatial data on occurrence of ecosystem components, 3) some type of weighing factors to express impacts. That same review further showed that most CEAs assumed cumulative effects to be additive, while only 5 included synergistic or antagonistic effects. Most of the methods also assumed a linear relationship between activities, pressures, and impacts.

Estimates of effects were most often found to be expressed categorically, based on the sensitivity of the ecosystem component to the pressure or the severity of the pressure on the ecosystem component (Korpinen & Andersen, 2016). CEAS that used a continuous effect scale tended to have a more limited scope, usually focusing on a single species or species group, for which the effect parameter (for example mortality) could be estimated. CEAs with more diverse ecosystem components usually relied on (semi-quantitative) categorical scores. Quantitative CEAs so far have not been applied to more than a couple of pressures or ecosystem components. Despite considerable progress in developing sensitivity-based estimates for species and habitats, including development of tools that can predict and quantify vulnerable marine areas, their use in CEAs has remained limited (Korpinen & Andersen, 2016; Simeoni at al., 2023).

Notably, only a few of the CEAs validated the results by comparing cumulative effect scores with real-world observations of environmental status, to allow potential score re-evaluation. They note that recent CEAs contained novel approaches, mentioning the use of fuzzy logic for effect occurrence, fixed linkage frameworks, food web, and other statistical models, as well as describing best practices in validation and quantification of pressures.

To allow comparison between different types of pressures, values were typically normalized to a dimensionless scale, with the highest observed value set to 1 and all others expressed as a proportion of that maximum. However, this approach poses a problem: it assumes that the dataset used contains the maximum value for that pressure, even though the pressures in the assessment period may be lower than the long-term maximum.

Occurrence of ecosystem components was generally reported as presence/absence in the case of habitats and as probabilities for species (Korpinen & Andersen, 2016). Korpinen and Andersen (2016) note that, when using the additive approach as in most CEAs, an important choice to consider is whether to only apply one habitat type or to have multiple layers of ecosystem components in one grid cell. The latter is more complicated to interpret as it

requires the consideration of multiple components and effects. Both approaches are correct, but they present anthropogenic pressures differently.

In the case of marine mammals, two methodological approaches can be distinguished for population level CEA: rule-based method and predictive population modelling (Hague et al., 2022 and references within). Potential Biological Removal (PBR) is an example of a rule-based method, which essentially calculates the number of deaths a population can sustain without the population size falling below the optimal sustainable population size (Hague et al., 2022 and references within). Predictive models, on the other hand, quantify the magnitude of effects on a population trajectory. However, a limitation if this model is that it requires an extensive amount of information. Examples designed for marine mammals are: the Population Consequences of Disturbance model (iPCoD) and the Disturbance Effects on the Harbour Porpoise Population in the North Sea (DEPONS). These predictive models have been applied in UK waters to some CMS-listed species, such as the harbour porpoise (*Phocoena phocoena*), the sperm whale (*Physeter macrocephalus*) and humpback whale (*Megaptera novaeangliae*) (Hague et al., 2022).

Maps and Geographic Information Systems (GIS) are commonly used to visualize cumulative effects. However, two dimensional maps do not account for the actual 3D impact, for example across the water column (Judd et al. 2015; Simeone et al., 2023).

Simeone et al. (2023) observed that machine-learning based methods for CEA are emerging. Artificial intelligence and machine learning methods provide new opportunities to support CEA, which future research should look into.

Exposure and vulnerability are among the most cited concepts being integrated across different methodological approaches for CEA applying risk-based frameworks, the most prevalent of which is the DPSIR (Driver-Pressures-State-Impact-Response) framework. This framework forms the basis for the CEA methods used by international bodies such as the International Council for the Exploration of the Sea (ICES) and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) (discussed further below) (Judd et al., 2015).

Best practices:

- ✓ Benchmarking pressures for habitat sensitivity (Korpinen and Andersen, 2016)
- ✓ Where possible, use predictive models to assess cumulative effects, acknowledging caveats and surrounding uncertainties to the chosen approach. If this is not possible and/or proportionate, ensure professional judgement is based upon best available science (Hague et al., 2022)
- ✓ Use of Geographical Information Systems as a tool to aid the CEA process, to demonstrate spatial and temporal overlap of multiple stressors (Hague et al., 2022)
- ✓ Field research to identify and distinguish effects of single vs multiple disturbances, building further understanding of how stressors interact, coupled with the development of tools and frameworks that allow findings to be integrated into assessments (Hague et al., 2022)
- ✓ Acknowledge and evaluate uncertainty in data and information (Hague et al., 2022; Simeoni et al., 2023)
- ✓ Develop and test cutting-edge approaches (e.g., ML-based models) able to capture/evaluate the complex and non-linear inter-relationships among multiple pressures affecting MCEs, which increase the level of complexity and uncertainties underpinning the design of integrated plans (Simeone et al., 2023)

Challenges:

- ➢ CEAs do not benchmark pressures currently (Korpinen & Andersen, 2016)
- ➢ Non-linear responses, as well as synergistic or antagonistic effects, are not or rarely addressed (Hague et al., 2022; Korpinen & Andersen, 2016)
- ➢ Availability of data for assessment (Hague et al., 2022)
- ➢ More research necessary on interaction of effects (Hague et al., 2022)
- ➢ In addition, stressor and condition maps usually consider only one snapshot in time (Simeoni et al., 2023).
- ➢ This review also revealed a lack of consideration of the potential influence of specific ecosystem services in reducing/mitigating the effect of both endogenic and exogenic pressures while increasing the resilience of MCEs to further perturbations (Simeone et al., 2023)
- ➢ Methodological approaches published within the investigated timeframe (2000−2022) rarely considered all the three marine ecosystem services categories, and instead focused on single ecosystem services (Simeone et al., 2023).

7. Determine significance

Determining the significance of effects can be done qualitatively or quantitatively. In the review by Hague et al. (2022), most CEAs used a qualitative approach based on professional/expert judgement, whereas only a handful relied solely quantitative methods. The remaining CEAs used quantitative analysis where feasible, supported by expert judgement where this is not possible.

Best practices:

- ✓ Development of thresholds for disturbance for receptors (Hague et al., 2022)

Challenges:

- ➢ Limited understanding of how receptors respond to various pressures and associated thresholds for response (Hague et al., 2022)

8. Decision-making and management

Once the CEA has been completed, it can inform decision-making and management processes. This can include approving or declining new projects and licenses, suggestions to look for alternatives, identifying high risk areas, and implementing mitigation measures. For the latter, EIA and CEA often refer to the mitigation hierarchy, which dictates that negative effects should ideally be avoided, otherwise prevented, reduced or lastly offset (IEMA, 2024).

Best practices:

- ✓ Adaptive CEA management informed by regular reviews of CEA practice (Hague et al., 2022)
- ✓ Improved accessibility of CEA documents (Hague et al., 2022)
- ✓ The evaluation of management options in light of CEA outcomes is a key focus for future research (Judd et al., 2015).
- ✓ Develop capacity among practitioners, institutions, and users to deliver consistent CEA across marine planning and delivery (Willsteed et al., 2024)

Challenges:

- ➢ Conclusion of the CEA scattered, difficult to access or unclear (Hague et al., 2022)
- ➢ What is often missing is a direct account of how the outputs of the cumulative pressure mapping exercise may be applied in practical management measures to maintain or improve that state (steps 3 and 4 of the risk assessment framework) (Judd et al., 2015)
- ➢ Of the 101 papers reviewed, the majority (about 70 %) do not consider policy or management actions, despite the potential of CIA supporting policy/management (Simeoni et al., 2023)

9. Monitor the outcomes

It is crucial to monitor the outcomes of the decisions made based on the CEA after it has been completed (UNECE, 2023). Not only can monitoring inform future CEAs and assessment of ecological status, it can also verify whether proposed mitigation measures have been implemented, and whether the predicted effects in the CEA correspond with the actual environmental impacts.

Best practices:

- ✓ Specifically sharing of pre-, during- and post-construction monitoring data to learn from past developments and contribute to collective knowledge (Hague et al., 2022)

Challenges:

- ➢ The outcomes of CEAs are currently often not monitored

Specific challenges and best practices have been listed for each CEA step. However, across the whole CEA process, additional best practices and challenges were found.

One best practice that has helped move CEAs to the forefront in many countries is their inclusion in national legislation and policies (UNECE, 2023). Furthermore, many authors argued for the development of a standard comprehensive definition of cumulative effects terminology, and papers such as by Judd et al. (2015) put forward such standardized terminology (Hague et al., 2022; Judd et al., 2015; Simeoni et al., 2023). However, presenting a standard terminology in academic literature is only a first step, as policymakers and practitioners should cooperate to implement such a terminology. Providing reference to guidelines for CEAs is another best practice (UNECE, 2023), as this ensures that CEAs in a country or industry share a certain standard of quality, though this is made difficult by the specific needs of CEAs in different contexts. Consistency and standardisation in CEAs across industries is another good practice, as it could make comparison of data easier and improve understanding (Hague et al., 2022). Willsteed et al. (2024) therefore suggest the practice of designing and adopting an approach that supports the implementation of CEA as a process that can draw upon multiple CEA methodologies to address specific questions, while also providing consistency, coherence, and transparency. Another returning good practice is to include a thorough and transparent description of the methodology used in CEAs, including a description of knowledge gaps and implications for uncertainty of the output (Hague et al., 2022). Any CEA approach benefits from being adaptable to emerging technological advances (Willsteed et al., 2024). Data sharing has already been emphasized as a best practice, but it is equally important to share tools and codes to further develop CEA methodologies (Korpinen & Andersen, 2016). Another good practice is to use a systematic database as a source and archive for CEA associated data, evidence guidance and best practices, that can inform CEA (and even EIA and SEA) processes (Hague et al., 2022).

Due to a lack of data and knowledge, as well as the necessity to make choices in CEA to delineate the number of elements that need to be assessed, CEAs are always subject to assumptions. Halpern and Fujita (2013) identified and criticized nine major assumptions made in CEAs, particularly in the assessment step:

1) Pressure layers are of roughly equal importance
2) Pressures are uniformly distributed in a pixel or cell
3) Habitats are either present or absent in a pixel or cell
4) Pressures can be transformed and normalized
5) Ecosystems respond linearly to pressures
6) Ecosystems respond consistently to pressures
7) Vulnerability weights are sufficiently accurate
8) Ecosystems respond linearly to cumulative effects

Some of these assumptions could be resolved through additional data collection and future research. However, as assumptions will always play a role in CEAs, it is important to be transparent about the assumptions made and how they could affect the outcomes.

One of the challenges with data sharing and availability, is that some data are commercially sensitive (especially in industry) or expensive to collect (Hague et al., 2022). Furthermore, uncertainty regarding data and effects is often not explicitly included in CEAs but is crucial to a nuanced interpretation of the results, and to ensuring reproducibility (Hague et al., 2022).

Even in countries where CEA is included in legislation, there is often no national guidance given. As a result, how CEA is conducted can vary per project, locality, or at the discretion of the assessor, which can lead inconsistencies and make interpretation difficult, especially at the transboundary level required for migratory species. If there is any guidance, it is often a reference to one of the international standards or guidelines.

One major challenge is that there is very little information on the extent to which CEAs are actually implemented, and which methodologies are effective in practice (UNECE, 2023). Similarly, there is limited clarity on the specific challenges faced in different regions or contexts, for example those related to cultural factors or unique ecological environments.

3.2 CEA in Legislation and Policy

CEA is evolving from a strictly project-based approach towards a more strategic and regional context that is explicitly being promoted through EIA legislation in many jurisdictions (Blakley and Russell, 2019). Olagunju et al. (2021) reviewed cumulative effects assessment requirements in eight selected developed and developing countries. Regarding sector-based innovations, industry-led guidance and peer review and evaluation, they found that developed countries turned out to be leading. However, there is a universal need for strengthened government leadership and ownership of the CEA process. Though a foundation for CEA is slowly being laid in legislation, technical capacity and knowledge is limited in developing countries, and institutional fragmentation as well as inconsistent implementation need to be addressed for CEA to be practiced effectively. Analysing scientific collaborations among countries applying CEA methods in marine ecosystems, observation showed that the USA, Canada, the UK and China emerged as the first countries addressing this topic, with intergovernmental collaborations increasing in the last decade (Simeone et al., 2023).

The Convention on Environmental Impact Assessment in a Transboundary Context (informally called the Espoo Convention) is a United Nations Economic Commission for Europe Convention (UNECE) signed in Espoo, Finland, in 1991, and entered into force in 1997. The Convention sets out the obligations of Parties to carry out an EIA of certain activities at early planning stage. It also obliges States to notify and consult one another on all major projects under consideration that are likely to cause significant adverse environmental impact across boundaries. As the only international convention on EIA, the reports on the review of its implementation can yield additional insights into how Parties – many of which (43 and the EU) are also Parties to CMS – apply CEAs. Note, however, that due to the Convention being under UNECE, its focus is limited to Europe and Central Asia.

The seventh review of implementation of the Convention on Environmental Impact Assessment in a Transboundary Context (2019-2021) provides information on transboundary EIAs conducted by its 44 Parties and the European Union, including aspects on cumulative impacts. 34 of the Parties submitted a response to the questionnaire for the 2019-2021 period. The review showed that all respondents except three (Azerbaijan, Belarus and Ireland) report taking cumulative impacts into account in transboundary procedures (question I.1.6). Azerbaijan and Ireland both state that there are mechanisms in place to ensure that cumulative impacts are addressed, where relevant. Furthermore, two Parties explicitly state that cumulative impacts are not considered in their country's practices (question II.20). The

Republic of Moldova notes that this omission is addressed in their draft legislation, while no explanation is provided by Belarus.

Unfortunately, the seventh review does not report further on the aspect of cumulative effects and CEAs. However, when the Parties' individual responses to the questionnaire were examined, some recurring challenges were found.

- Including CEA in legislation has been done in many countries, but implementation – performing the assessments – is noted as a challenge.
- Wind farms are the most recurring example given by countries when asked about cases where CEAs were applied, as seen in responses from Belgium, Estonia and Latvia.

The eighth review of implementation of the Convention on Environmental Impact Assessment in a Transboundary Context (2022-2024), expected to be published in in 2025 or early 2026, could provide more up-to-date insights regarding the current inclusion of CEAs in transboundary procedures.

An example of how CEAs are incorporated in legislation can be seen in New Zealand's submission. New Zealand's Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act of 2012 (the EEZ Act) does not have specific provisions to consider the impacts of activities undertaken in the EEZ on migratory species, their prey, and their ecosystems. They do have a consenting process that mandates an Impact Assessment (IA), as outlined in Section 39 of the EEZ Act. However, there are no specific guidelines on how to conduct this impact assessment, except for the legislation in Section 31(1)(e) and 39(1)(f), which requires the identification and description of "the activity on the biological diversity and integrity of marine species, ecosystems, and processes, and on rare and vulnerable ecosystems and habitats of threatened species" and "consideration of impacts on threatened species' habitats". These legislations state that they can include migratory species. Sections 39 and 59 of the EEZ Act address cumulative impacts explicitly, stating that cumulative effects of the activity on the environment must be identified, described and considered when allowing an activity. Despite the lack of guidelines on how to present and measure cumulative effects, the EPA adopts a "precautionary approach" to assessing impacts using the "best available information". The EPA has four courses of action when an activity is determined to potentially harm the environment: 1) Seek advice from technical experts and government agencies/ministries; 2) Decline the application; 3) Impose conditions on the consent to minimize harm, such as avoidance, mitigation, monitoring or restoration measures); 4) Require the applicant to conduct further research or monitoring. Lastly, they included that the EEZ Act Section 59(20)(h-m) requires consideration of: 1) the nature and effect of other marine management regimes; 2) other relevant regulations and laws; 3) any other matters deemed relevant by the marine consent authority.

Though CEAs are not the primary focus of CMS, they are mentioned in the National Reports submitted by Parties to COP14 (a total of 55 reports). One question in the National Report survey addresses EIAs and SEAs:

> Are legislation and regulations in your country concerning Environmental Impact Assessments (EIA) and Strategic Environmental Assessments (SEA) considering the possible impediments to migration, transboundary effects on migratory species, and of impacts on migratory patterns and migratory ranges? Please describe any hindrances and challenges to the application of EIA and SEAs with respect to migratory species, lessons learned, and needs for further capacity development. (Q.VI.5)

In the analysis of CMS National Reports to COP14 (UNEP/CMS/COP14/Doc.23), which includes a summary of the responses from Parties to the above question, cumulative effects or CEAs are not mentioned at all. This shows that there is a lack of transparency regarding how CEAs regarding migratory species are applied by Parties.

On the broader topic of EIAs, the analysis does provide relevant insights, including that:

- Environmental impact assessments and/or spatial planning approaches were widely mentioned (by 15 Parties) as a tool to ensure that economic development considers the needs of migratory species, although there was variation between Parties in the sectors and the types of environments that were covered (UNEP-WCMC, p.13).
- Some noteworthy examples where migratory species conservation had been integrated more broadly included Australia, which cited regulations controlling the risks to migratory species from offshore oil and gas developments, as well as a Nature Positive Plan designed to ensure that species and habitat recovery is embedded in future reforms to planning laws and regulations. New Zealand also referred to a Living Standards Framework, which aims to inform government policy by understanding the links being the natural environment and human wellbeing (UNEP-WCMC, p.13).
- Forty-two reporting Parties (76% of reporting Parties) confirmed that considerations relevant to migratory species are considered in legislation and regulations concerning EIAs and SEAs. Among these 42 Parties, 27 (49% of reporting Parties) described challenges or lessons learned in relation to the application of EIAs and SEAs to migratory species. A lack of knowledge and scientific data on migratory species, including on their distributions and habitat use, was the most frequently reported challenge (UNEP-WCMC, p.14). Insufficient resources and low levels of compliance were also highlighted as challenges.

In the report's overall conclusions some broader challenges were highlighted, some of which relate back to CEAs and migratory species. Primarily, Parties pointed to insufficient financial resources and a lack of technical capacity hindering implementation. Additionally, over 70% of reporting Parties indicated that assistance in the form of information exchange and research/innovation was required in order to build the capacity needed to meet their obligations under CMS. Insufficient knowledge and data on migratory species were highlighted as major gaps hampering efforts to effectively conduct EIAs and identify important sites and habitats, and this includes CEAs.

3.3 CEA Guidance Beyond Legislation and Policy

Countries in which CEA is included in the legislation, the text itself often does not provide any detailed guidance on how such a CEA must be undertaken. In this context, it is useful to look at national policies or guidelines. However, guidance is provided through different means, some of which go beyond legislation and policy. Below, case examples of policies and guidelines used by CMS Parties and non-Parties across all regions are given. This non-exhaustive list of guidelines or methodologies used by countries provide a picture of what Parties and non-Parties in different regions rely on to guide or support CEA processes.

CMS itself has previously produced guidelines on EIAs, specifically addressing EIAs for marine noise-generating activities in UNEP/CMS/Resolution 12.14. The guidelines are accompanied by Technical Support Information to the CMS Family Guidelines on

Environmental Impact Assessments for Marine Noise-Generating Activities (UNEP/CMS/COP12/Inf.11).

Section V-XI of the CMS guideline advise covering the following activities: military and civil high-powered sonar, shipping and vessel traffic, seismic surveys, construction work, offshore platforms, playback and sound exposure experiments, pingers, and other noise-generating activities. Moreover, "identification of other activities having an impact in the region accompanied by the analysis and review of potential cumulative or synergistic impacts" (p.13) is recommended.

In the Technical Support Information, potential for cumulative effects is highlighted as an important point of consideration for assessment. It is stated that the introduction of new anthropogenic noise should be assessed in consideration with other already occurring stressors in the habitat, such as other noise sources, chemical pollutants, or physical disturbance, among others.

- CMS Family Guidelines with Technical Support Information document(s) could be one way for CMS to provide Parties with guidance on including migratory species in CEAs. Since CEA methodologies and data considerations tend to be technical, this is the area in which Parties could benefit most from guidance. In this format, specific documents or sections could for example differentiate marine migratory species, terrestrial migratory species and avian migratory species, or provide guidance for different levels (from local to transboundary) of CEAs.

3.3.1 IUCN Guidelines

In 2024, the International Union for Conservation of Nature and Natural Resources (IUCN) in collaboration with The Biodiversity Consultancy published the report Guidance on biodiversity cumulative impact assessment for wind and solar developments and associated infrastructure (Bennun et al., 2024). According to the report, the guidance is focused on biodiversity and wind and solar development, aimed primarily at government planners and project developers. The report applies approaches for government-led CIA, project-level CIA, and addresses existing CIA challenges.

This report, though focused on wind and solar energy infrastructure development, provides a brief but comprehensive overview of current approaches and associated challenges to CEA, including in the marine environment. Chapter 3, in particular, can provide guidance to CMS Parties, as it describes updated key steps for undertaking CEAs, provided that clear objectives and terminology have been defined in the scoping phase.

The six steps outlined cover the following information:

(1) Set spatial and temporal boundaries for cumulative impact assessment
(2) Identify valued environmental components
(3) Determine valued environmental components trends, targets, and thresholds
(4) Define approach for apportioning allowable impacts on valued environmental components among future projects
(5) Stakeholder engagement
(6) Data sharing and dissemination

This stepwise approach forms a good basis to guide CEA, but CMS could build on it to make it applicable for migratory species:

- Provide descriptions of CMS-listed species and their habitats as VECs

- Provide information on trends, targets and thresholds for those species
- Provide measures for allowable impacts
- Stakeholder engagement
- Make data on species and habitats that can be fed into a CEA accessible

Additionally, Chapter 4 outlines some of the major technical approaches to threshold setting, one of the major issues in CEA. Threshold setting is especially relevant to marine migratory species, as there is increased complexity and uncertainty in determining the exposure to effects due to their vast ranges.

These guidelines are a good fit for CMS to use and potentially build on, as they incorporate a strong focus on biodiversity and to the Kunming-Montreal Global Biodiversity Framework.

3.3.2 JPI Oceans

In 2024, JPI Oceans published the *Cumulative effects assessment in the marine environment: a common handbook*. The handbook contains some methods, tools and examples taken from scientific and grey literature on how to conduct CEAs in the marine environment.

3.3.3 ICES

In early 2025, the ICES Working Group on Cumulative Effects Assessment Approaches in Management (WGCEAM) published a scientific report on the development a common framework for cumulative assessments to be applied in the context of ecosystem-based management (ICES, 2025). The framework is based on identifying and prioritizing pressures that would need to be addressed by management measures, based on the vulnerability of the ecosystem components to those pressures (JPI Oceans, 2024).

The framework draws on existing status assessments, such as the MFSD, providing more weight to the VECs found to be in poor condition. This framework is different from existing status assessments in that the vulnerabilities of each VEC to potential effects are based on the prioritisation of key causal relationships and key prevailing pressures. It uses standard risk-based assessment practices, with vulnerability calculated based on the exposure and effect potential. In this framework, exposure is defined as a function of the spatial and temporal overlap between the pressure and the VEC. Effect potential is determined as a function of pressure intensity and the inherent resistance and recovery capacity of the ecosystem component. This information is then integrated into a vulnerability profile which ranks the vulnerabilities of all pressure/VEC combinations occurring in that ecosystem.

This recent ICES report provides detailed guidance on CEA methodologies in the marine environment, though lacks explicit reference to migratory species and their unique challenges and characteristics.

3.3.4 International Association for Impact Assessment

The International Association for Impact Assessment (IAIA) has published a series of international best practice principles, covering a variety of impact assessment in topical areas, sharing best practices for professionals in the field. It consists of 16 documents covering several elements of EIAs. Though there is no separate guidance document on CEAs alone, they are mentioned in the other documents. The most relevant for CEAs, are document *00. Principles of Environmental Impact Assessment Best Practice* and *03. Biodiversity and Ecosystem Services in Impact Assessment.*

In 00. Principles of Environmental Impact Assessment Best Practice, the section 2.5 Operating Principles states:

The EIA process should be applied […] to biophysical impacts and relevant socio-economic factors, including health, culture, gender, lifestyle, age, and ***cumulative effects*** *consistent with the concept and principles of sustainable development;*

In 03. Biodiversity and Ecosystem Services in Impact Assessment 10 principles are presented to guide the assessment of impacts on biodiversity. According to the document, these Principles apply to all stages and types of impact assessment, whether at project or strategic level, and are intended to underpin efforts to achieve sustainable outcomes for biodiversity, ecosystems, and the services they provide. The Principles are stated to be compatible with the objectives of the Convention on Biological Diversity (CBD), the Ramsar Convention, and the Convention on Migratory Species (CMS). The Principles also noted that are intended to align with the performance standards of international finance institutions. Cumulative effects are included throughout the document.

The principles put forward by the IAIA can be a useful tool to help practitioners incorporate cumulative effects in impact assessments, although the guidelines do not provide details on methodologies for CEAs. In the past, IAIA has also given training courses in CEA.

The best practice series also contains other guidelines that might be relevant to CMS, such as *08. Climate Change International Best Practice Principles* and *09. Respecting Indigenous Peoples and Traditional Knowledge.*

3.3.5 OSPAR

OSPAR has reported on cumulative effects since the first Quality Status Report (QSR) in 2000. OSPAR does not provide guidelines on how to conduct CEAs for other parties. However, in its CEMP Guidelines, detailed documentation of the monitoring and assessment methods used by OSPAR for its QSRs and other assessments are provided. In the 'OSPAR CEMP Guideline: Cumulative effects assessment for the QSR 2023 (Bow Tie Analysis)', an extensive explanation of the methods used to assess cumulative effects for OSPAR's Quality Status Reports (QSRs) is provided.

The definition of cumulative effects assessment (CEA) used by OSPAR is based on the definition proposed by Judd et al. (2015): "a systematic procedure for identifying and evaluating the significance of effects from multiple pressures and/or activities on single or multiple receptors". CEA provides management options, by quantifying the overall expected effect caused by multiple pressures and by identifying critical pressures or pressure combinations and vulnerable receptors. The analysis of the causes (source of pressures), pathways, interactions and consequences of these effects on receptors is an essential and integral part of the process.''

In OSPAR's most recent Quality Status Report (2023), the Synthesis Report contained one chapter on cumulative pressures, and each Thematic Assessment (15 in total) contained a section on cumulative effects. As outlined in the CEMP Guidelines, the cumulative effects analyses were structured following the DAPSIR framework, which was adapted from Elliott et al. (2017). This framework examines how multiple drivers (D) lead to multiple human activities (A) which exert multiple pressures (P), causing multiple changes in ecosystem state (S). These state changes have impacts (I) on multiple ecosystem services and the goods and

benefits they provide to society, which in turn influences the drivers of change. Management measures to prevent change or to mitigate the effects of change from these cumulative pressures are also incorporated into the assessment as responses (R). Aside from the section on cumulative pressures, each Thematic Assessment contained a separate brief section outlining key drivers, activities, pressures, state changes, impacts and responses for that theme. The cumulative effects were further analysed following Bow-Tie Analysis method, which established linkages between the causes of change to ecosystem state and the consequences of change. As not all pressures and activities have equal potential to affect ecosystem states, the ODEMM methodology was used to weigh and rank the threat associated with any particular Activity-Pressure combination on any State Changes for each ecological component. The State-Impact linkages were weighted and ranked through literature review, combined with expert judgement for each Thematic Assessment.

Based on the DAPSIR information, the experts assessing biodiversity were able to rank the relative importance of pressures on biodiversity. These rankings were then presented in a holistic way for five of the biodiversity themes assessed (marine birds, marine mammals, fish, benthic habitats, and pelagic habitats) in the form of Sankey diagrams. These diagrams show the estimated contribution of various pressures from human activities on the state of marine ecosystem components and the resulting expected changes in ecosystem service delivery at the North-East Atlantic scale.

From the Thematic Assessments, the biodiversity themed assessments on marine mammals, marine birds, fish, benthic habitats and pelagic habitats, as well as the Human Activities Thematic Assessment and their respective sections on DAPSIR and cumulative effects are most relevant to CMS.

All OSPAR CEMP Guidelines are available here.

3.3.6 International Finance Standards

As reported before in Slootweg (2021), international development banks, often referred to as IFIs, play a significant role funding large infrastructure projects. Slootweg (2021) already summarized the safeguard policies that address biodiversity and migratory species of some of the most prominent IFIs: the International Finance Corporation (IFC), the World Bank, the Inter-American Development Bank (IADB), the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), the African Development Bank (AFDB), the Asian Development Bank (ASDB) and the Asian Infrastructure Investment Bank (AIIB). In this report, the analysis is expanded by zooming in on the specification regarding cumulative effects in those safeguards and other guidelines, which have not been covered before.

IFC & World Bank

On CEAs, the IFC has published the Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (IFC, 2013). Though targeted at the private sector, the handbook provides clear and useful overviews of the elements and considerations in CEAs in relation to IFC's safeguards, including some consideration of migratory species. "Interference with migratory routes or wildlife movement" is named as an example of a cumulative impact (p.15).

Appendix I contains examples of indicators for assessing incremental project impacts and cumulative impacts. They also provide a Standard Annotated ToR for a Rapid Cumulative Impact Assessment (RCIA) in Appendix 3 for companies to use.

Other than the handbook, IFC and the World Bank have developed CEAs and sector specific guidelines for several hydropower projects, such as Sample Guidelines: Cumulative Environmental Impact Assessment for Hydropower Projects in Turkey and Cumulative Impact Assessment and Management of Renewable Energy Development in the Sekong River Basin, Lao People's Democratic Republic.

Asian Development Bank (ASDB)

The ASDB provides Environmental Assessment Guidelines, in particular Chapter XVI. Cumulative Effects Assessment in Environmental Assessment. However, these guidelines are quite broad, outlining a general process but not specific elements on migratory or marine species. In this document, migratory species are mentioned as a factor to determining the spatial boundaries of the assessment. Cumulative effects are also integrated in their Environmental Safeguards.

Inter-American Development Bank

The IDB produced the Practical Guide for Cumulative Impact Assessment and Management in Latin America and the Caribbean. The guide suggests practical approaches on how to do a CEA and recommends how to respond to the challenges faced by the CEA processes in Latin America. It covers:

- Basic concepts;
- Why cumulative impact assessments are necessary in Latin America and the Caribbean, the limitations of the "project-by-project" approach of the EIA, as well as the legal and regulatory framework for CEAs in the region;
- The main elements of CEA, as well as the differences between CEA, EIA and SEA along with the tools available for CEAs;
- Basic steps for carrying out a CEA, including advice for professionals, and examples of good practices applicable to the Latin American context;
- Challenges faced by CEA professionals, especially in the Latin American context;
- Guidelines for preparing terms of reference for CEA implementation and a non-exhaustive summary of the regulatory requirements for CEAs in some Latin American countries.

Migratory species, marine or otherwise, are not a major element in this guide. The blocking of migratory routes and wildlife movements by construction of infrastructure, as well as the blocking of the migration of fish due to cascading hydroelectric development projects are given as one of the examples of cumulative impacts. Migratory species are also mentioned as example on how to set spatial boundaries based on VECs, noting that migration trajectories should be taken into account. Marine ecosystems are pointed out as one of the common VECs.

European Bank for Reconstruction and Development (EBRD)

The report by Slootweg (2021) already highlighted that migratory species are mentioned in the EBRD's Environmental and Social Policy (2019). The EBRD Performance Requirements

make repeated and explicit reference to cumulative effects. Though it does not constitute specific guidance on how to assess cumulative effects, these performance standards make the consideration of cumulative effects as part of EIA mandatory.

African Development Bank (AFDB)

The African Development Bank does not provide specific guidelines for CEA, but cumulative effects are mentioned in their Environmental and Social Assessment Procedures and Environmental and Social Assessment Guidelines that inform EIA and SEA.

Asian Infrastructure Investment Bank (AIIB)

Cumulative impacts are considered for the categorization of the project, and clients can be requested by the AIIB to conduct a CEA or other type of assessment. Cumulative effects are further mentioned in the Environmental and Social Framework as being part of EIA (AIIB, 2024). Cumulative effects are also mentioned in the context of biodiversity consideration, including interference with migratory routes or wildlife movement.

3.4 Examples from each region

Europe

EU

The assessment of the cumulative effects from human activities at sea and on land is a requirement of the Marine Strategy Framework Directive (MSFD). However, no EU-wide guidance document on how to conduct CEAs could be identified. However, in 2019, the European Environment Agency performed its first spatial assessment of multiple pressures from human activities and their combined effects covering the North-East Atlantic Ocean, the Baltic Sea, the Mediterranean Sea and the Black Sea. It made use of the indicative list of ecosystem elements and human activities along with their associated anthropogenic pressures in Annex III of the MSFD. Notable is that the assessment focused on potential cumulative effects, stating that the realized cumulative effects depend on local characteristics and timing. In summary, the CEA consisted of (1) mapping human activities, (2) describing their pressures in a spatial context, (3) mapping ecological elements, (4) describing their sensitivity to the set of pressures, and (5) combining the information to establish the connections needed to inform management. The detailed assessment steps are described in Appendix C of the full assessment report, but do not differ significantly from the general process previously described (Korpinen et al., 2019). It is worth highlighting that the weight of effects was primarily informed by expert judgement. Moreover, the authors noted incomplete knowledge on synergistic and antagonistic effects in Europe's seas, therefore choosing to consider combined effects rather than cumulative ones. Lastly, on the EU level, there is also the European Maritime Spatial Planning Platform, which is a database of tools and resources, including papers and projects related to CEA and MSP.

CEAF

Slootweg (2021) noted the establishment of a Common Environmental Assessment Framework (CEAF) to facilitate cumulative assessments of impact of large-scale deployment of offshore wind power across Europe. At the time of his report, only one participating country (UK) reported on this topic, which rendered CEAF status and its relation to EIA and SEA regulations unclear. This report followed up on developments regarding the CEAF, which is presented further below.

In a Political Declaration made by North Sea energy ministers on energy cooperation between North Sea countries in June 2016, government officials agreed to start the development of a common framework for reporting on cumulative impacts of offshore renewable energy. This initiative became known as the Common Environmental Assessment Framework (CEAF) (The Common Environmental Assessment Framework, 2019) (Figure 3). Led by the Dutch Government, Belgium, Denmark, Germany, France, Norway and the UK (including Scotland), the countries collaborated to develop the CEAF. The developed framework was tested in 2018-2019 in an SEA project on North Sea Energy (SEANSE).

As part of the development, a report was compiled to provide an inventory and assessment of models and methods used for describing, quantifying and assessing cumulative impacts of offshore wind farms on (populations of) a number of selected receptor species, including the CMS listed harbour porpoise (*Phocoena phocoena*) and red-throated diver (*Gavia stellata*) (Van Oostveen, 2018).

The CEAF itself was based on the OSPAR Cumulative Effect Approach for QSR 2023. Following the inventory, it was proposed to use representative species, for example the harbour porpoise, as the VECs to assess cumulative effects. These VECs are then used as

the baseline for the CEA's spatial scale. For the assessment step of the CEA, the CEAF refers to the inventory report, which details the available methods for each VEC and evaluates their applicability.

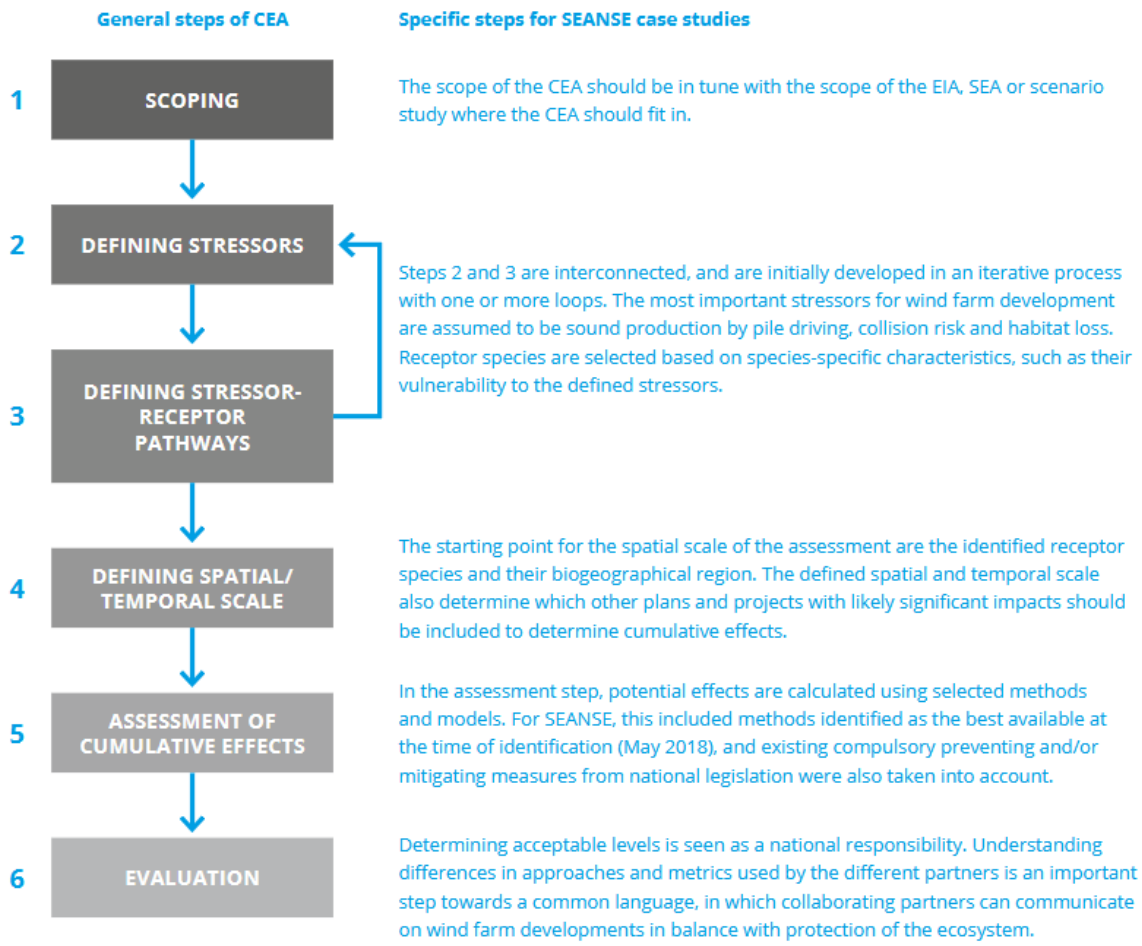

Figure 3. The general approach from the CEAF to conduct a CEA (SEANSE, 2020).

The CEAF was applied in case studies in the Netherlands, Germany and Scotland. They were then evaluated and resulted in recommendations for improvement in future applications.

Data availability was a key point in the SEANSE project, which resulted in the establishment of the SEANSE data portal to facilitate the sharing of transboundary MSP knowledge, and the identification of data gaps and solutions.

The CEAF has no formal or legal basis and is in line with EU and OSPAR regulations. Parties are free to use the framework and instruments. However, CEAF Parties are responsible for aligning the framework with their national legislation and policy if they apply it in national projects.

UK

In the UK, the consideration of cumulative effects in decision-making is a legal obligation at both regional and national scales and informs the management of human activities in the marine environment (Willsteed et al., 2024). Though legislation and policies clearly indicate the requirement to consider cumulative effects on the environment, the approach that can or should be taken is not defined, as this is context specific.

A report by Willsteed et al. (2024) outlines an evaluation of CEA methodologies to support marine planning in the UK. It investigates the suitability of existing CEA methodologies, through a literature review, interviews with practitioners, and assessment of CEA methodologies with the aim of adopting a consistent and coherent approach to incorporate CEA into marine planning.

The report contains a longlist and shortlist of CEA methodologies. The shortlist was evaluated according to a set of criteria such as association with an organization, available methodology, possibility of validating outputs, and geographical and temporal scale (Figure 4). The authors point out that each approach has its strengths and weaknesses, and the suitability of one approach over another depends on the user's needs. To this end, a clearly defined CEA question is essential to guide the choice of the most appropriate approach for a given need. An overview like the one provided in this report can help practitioners or policymakers identify suitable methodologies and understand their limitations.

Table 5. Summary of relative strengths and weaknesses of shortlisted CEA approaches against criteria amenable to scoring, where dark grey (1) = strong, and light grey (4) = weak (see Table 4). Black cells are those where no supporting information was available or identified over the course of the study.

	Associated organisation	Evidence of application	Method-ology available?	Exogenous factors	Can outputs be validated?	Geographical scale/s	Temporal feature	Flexibility	Portability	Adaptability	Evidence of effectiveness	Usability	Communication
SYMPHONY	1	1	1	1	1	2	4	1	1	1	1	2	1
BalticCAT	2	2	4	2	4	2	3	-	-	-	-	-	-
HELCOM BSI II	1	1	1	1	1	2	3	1	1	1	1	2	1
PROTECT BALTIC	1	4	1	4	1	2	4	-	-	-	-	-	-
ADRIPLAN	2	2	1	4	1	2	4	1	1	1	2	2	1
CUMULEO	2	2	1	4	3	1	4	1	1	1	3	3	2
ODEMM/ AQUACROSS	3	1	1	4	3	2	4	1	1	1	2	3	2
SIMCelt	3	2	1	3	1	2	3	1	1	1	3	3	1
SCARIM	3	2	1	4	3	2	4	1	1	1	3	3	2
OSPAR CEA	1	1	1	4	3	2	4	1	1	1	2	3	2
Shetland	3	2	1	4	1	2	4	1	1	1	2	2	1
MSPACE	3	4	4	1	4	2	2	3	2	-	-	-	-
MARXAN	3	1	1	1	2	1	1	1	1	1	1	3	2
HFI	3	2	1	4	1	1	4	3	3	3	3	2	1
Lonsdale *et al* (2020)	3	3	1	4	2	1	4	1	2	1	3	3	2

Figure 4. Evaluation of shortlisted CEA methodologies (Willsteed et al., 2024).

The implementation of meaningful CEA remains challenging due to a range of conceptual and scientific uncertainties, as well as evolving policy topics. The key to progress is to adopt a consistent, coherent, and scientifically robust approach to CEA, but one which can continue to be refined as data and analytical methods improve (Willsteed et al., 2024).

Ireland

The Environmental Protection Agency (EPA) in Ireland has published *Good practice guidance on Cumulative Effects Assessments in SEA* (EPA (Ireland), 2020). It is not legally required, but provides pragmatic guidance for conducting CEAs, based on a list of key CEA tasks with in-depth descriptions to guide implementation (Figure 5). The guidance also includes a checklist which can be used by anyone involved in SEA and CEA, and if used early in the process, for instance at the scoping stage, could help ensure that SEA effectively considers cumulative effects.

Table 3.1 CEA tasks at each SEA stage (key tasks are numbered and shaded in grey)

SEA stages	CEA tasks
Screening	Consider likely significant cumulative effects during screening.
Scoping and consultation	Task 1. Identify receptors. 'Scope in' plan impacts that, alone, might be insignificant but cumulatively would be significant (for instance, climate change). This may require consultation beyond usual stakeholders.
Plan description	–
Objectives, indicators and targets	Task 2. Identify limits/thresholds/standards. These will be used during impact assessment (task 4) to determine the significance of the cumulative impacts.
Existing and likely future environment	Task 3. Describe the 'current state of the environment and likely evolution thereof without implementation of the plan' (SEA Directive Annex Ib), including changes due to other plans, programmes, projects and general trends. This will then be considered cumulatively with the plan's impacts at task 4.
Alternatives	–
Impact assessment: likely significant effects of the plan	Task 4. Assess the impacts of the plan plus those of other actions (from task 3). Compare these against the limits/thresholds (from task 2) to determine significance.
Mitigation measures	Task 5. Mitigate significant cumulative impacts. This is likely to require additional discussion with other stakeholders.
Environmental report	Describe cumulative impacts, uncertainties inherent in the assessment of cumulative impacts, and how the uncertainties have been managed
Monitoring	Task 6. Monitor for significant cumulative impacts. In the future, review monitoring findings to inform identification of key cumulative effects issues at next cycle of plan making and SEA/CEA.

Figure 5. Guidance on CEA approach (EPA (Ireland), 2020).

North America

USA and Canada[1]

The Environmental Protection Agency (EPA) in the USA is currently developing an Interim Framework for Advancing Consideration of Cumulative Impacts, of which an extensive draft is already available. The document describes goals and principles that provide a shared point of reference for the EPA when considering cumulative impacts in EPA decisions. The framework is primarily aimed at EPA programs and practitioners in the USA and does not provide detailed instructions. Nevertheless, it contains useful summaries and overviews for international context. Regarding how CEAs are undertaken, the report presents a conceptual model, adaptable to different regulatory contexts, for incorporating cumulative effects in decisions (see Figure 6).

[1] Though the USA and Canada are both not a CMS Party at time of writing, these countries played an important role in the establishment of EIA and CEA, and were therefor considered for this report.

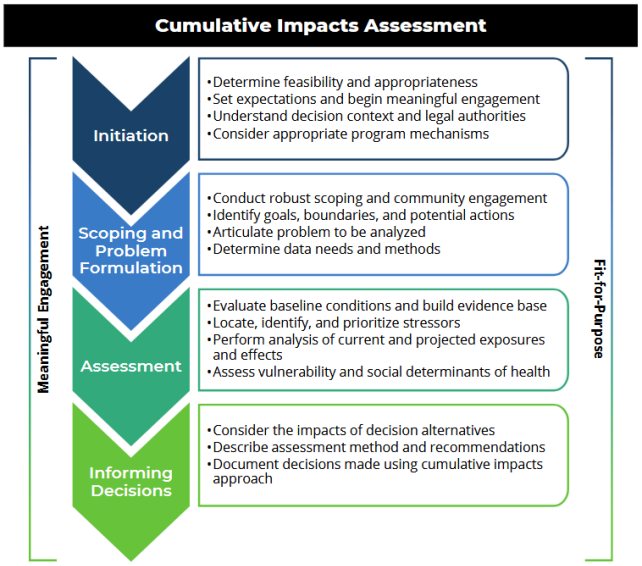

Figure 6. Proposed general structure for cumulative impact assessments (EPA (USA), 2024).

Appendix A on Tools and Reports for Evaluating Tribal Exposures could also be of interest to CMS. It provides some guidance on assessing cumulative effects in the unique context of indigenous peoples. Overall, the framework includes more of a health and community perspective, rather than focusing on environmental VECs only.

Canada provides an international example of progressing cumulative effects assessment within SEA, with guidance available to support practitioners and those requiring CEA within SEA (Willsteed et al., 2024). The Canadian Government's website provides a multitude of guidance document for impact assessments, including the Policy Framework for Assessing Cumulative Effects, which details the general requirements and approach for assessing the cumulative effects of designated projects under the Canadian Impact Assessment Act. Furthermore, guidance documents are provided for incorporating indigenous knowledge and collaborations with indigenous communities, public participation, and monitoring.

Africa

South Africa

The South African Government has published an information document on CEA as part of its information series on integrated environmental management (DEAT, 2004). A disclaimer states that the document is not intended as a guideline document or legal advice, but rather a reference text.

The report provides useful background information on types of cumulative effects and a selection of methods to conduct CEAs. It also provides a summary of steps to be addressed in evaluating cumulative effects in the EIA process, which correspond with those included in the guidelines described below. The report concludes that priority should be given to the development of guidelines to facilitate the incorporation of cumulative effects into EIA and SEA processes, with special consideration for how developing countries deal with the issue of cumulative effects. Data requirements, the lack of infrastructure and expertise as well as cost implications obstruct the widespread application of CEA in developing countries.

General guidelines for CEAs in South Africa can be found in "Guideline 5: Assessment of Alternatives and Impacts in support of the Environmental Impact Assessment Regulations"

(DEAT, 2006), which outlines general steps to follow when assessing cumulative effects, but do not make any recommendations regarding methodologies. The steps are:

a) Determining the extent of cumulative impacts, including:

- Identifying potentially significant cumulative impacts associated with the proposed activity;
- establishing the geographic scope of the assessment;
- identifying other activities affecting the environmental resources of the area; and
- defining the goals of the assessment.

b) Describing the affected environment, including:

- characterising the identified environmental resources in terms of their response to change and capacity to withstand stress;
- characterising the stresses affecting these environmental resources and their relation to regulatory thresholds; and
- defining a baseline condition that provides a measuring point for the environmental resources that will be impacted on.

c) Assessment of cumulative impacts, including:

- identifying the important cause-and-impact relationships between proposed activity and the environmental resources;
- determining of the magnitude and significance of cumulative impacts; and
- modifying or adding alternatives to avoid, minimize or mitigate significant cumulative impacts.

Oceania

New Zealand

Addressing cumulative effects in marine management decisions: Guidance states that despite plans, policies, and legislation explicitly requiring that cumulative effects be accounted for in management decision-making, they are in practice not meaningfully addressed in current management practices. This is in part due to the fact that marine and coastal laws, policies, governance institutions, and sectoral frameworks are fragmented across different marine spaces and timescales in New Zealand. Moreover, there has been a continued focus on assessing individual activities and pressures, often in isolation, rather than considering multiple activities, pressures and effects. Another challenge highlighted in the document is the inherent complexity and uncertainty regarding cumulative pressures and effects as well as the associated ecosystem responses. This is compounded by a lack of data and limited understanding of ecological relationships. Enhancing data availability is one of the recommended improvements.

To address these challenges, the guidance document outlines two key principle-based concepts and a four-step framework to guide the assessment of potential cumulative effects of activities. The approach uses ecological principles to identify both stressor and ecosystem responses or states. The two key principle-based concepts are:

- **Ecological and stressor principles**: Ecological principles account for an ecosystem's ability to respond, resist, or adapt to change and the effects and interactions between different stressors. These principles recognise the role of intrinsic ecological dynamics and particular types of species in generating responses. Stressor principles

characterise the stressor regime, whether past, present, or predicted future. These principles focus on the ecosystem elements they impact on and how stressor effects interact. This can inform the ecological and stressor status of an ecosystem, which can indicate the likely response to protective and restorative interventions for maintaining or improving ecosystem health.

- **Ecosystem response footprints** describe the space and time scale of an ecosystem's response to stressors. These footprints are characterised by both ecological and biophysical characteristics of ecosystems and the stressors they face.

To four-step action plan consists of the following steps:

1) Identify where you want to be: determine the aims and objectives for the specific location;
2) Identify what is affecting the location: assess the stressors associated with the activity or management action of interest, using stressor principles;
3) Identify the state of the current ecosystem and how it is responding to the stressors: assess the ecosystem response footprint using ecological principles;
4) Identify the best management approach to achieve step 1.

The guidance document illustrates the application of this action plan in three hypothetical decision-making scenarios in marine management.

In conclusion, key recommendations to environmental managers are to:

1) transition from managing activities and stressors in isolation to focusing on managing ecological responses to cumulative effects
2) ensure assessments of cumulative effects are ecologically relevant and account for the following:
    - ecological resilience and vulnerability
    - ecological connectivity
    - ecological responses to multiple interacting stressors through space and time

Two other documents (one report and the article summary thereof) submitted address understanding cumulative effects from an indigenous Māori perspective. The report usefully:

- Identifies hapū and iwi values and language around cumulative effects management and impacts;
- Identifies the key cumulative effects issues commonly raised in Heretaunga iwi and hapū planning;
- Identify key remedial actions and restoration activities to cumulative effects sought by Heretaunga hapū and iwi to address these issues;
- Present case studies from across Aotearoa and Te Wai Pounamu that identify barriers and potential solutions to the expression of tikanga Māori in current resource management systems.

Its key conclusions are:

- Little research has been undertaken to understand Māori experiences and perceptions of cumulative effects.
- This report presents some of the barriers faced by iwi and hapū across Aotearoa with regards to management of cumulative effects in freshwater, estuarine and marine environments, as well as the potential solutions to overcome these barriers.

- This literature review is only to be used as a guide to understand the general perceptions, issues, and priorities of iwi and hapū regarding cumulative effects of multiple stressors.
- The issues identified in Heretaunga Integrated Environmental Management Plannings (IEMPs) included land use and land management strategies, and compartmentalisation of the natural environment.
- Iwi and hapū sought to mitigate the cumulative effects of various land use and management strategies by improving land management best practices, through various methods such as riparian planting, habitat restoration, and integrating holistic management across the whole ecosystem.
- Compartmentalisation of centralised resource management and governance systems does not recognise the flow-on effects of activities across catchments. Co-governance arrangements for natural resources are one way to ensure Māori values are respected through collaborative decision-making.
- More statutory bodies could be established with greater power to integrate the holistic and integrated co-governance of their taonga and places of cultural significance from a tikanga Māori perspective, allowing for cumulative effects to be better managed.

According to the report, to better manage cumulative effects issues, it is necessary to include:

- Multi-benefit management actions
- Ki uta ki tai (integrated planning / whole systems approach) as an integrated management approach
- Spatially explicit cumulative effects models

Though specific to the New Zealand context, this report provides a good example of understanding cumulative effects from an indigenous perspective and can serve as an example for other Parties seeking to increase understanding and incorporating indigenous peoples and local communities in CEA. The report is not focused on migratory species in the marine environment, but in its coverage of the Māori perspective, and includes a holistic and ecosystem-based approach, which can and should integrate consideration of migratory species in CEA.

The last document is a report covering development decision-support tools for cumulative effects management. Its key recommendations are:

- Decision-support tools must be scientifically robust
- Decision-support tools should have the ability to identify uncertainties
- Access to decision-support tools must be reasonable, in terms of timeliness and cost
- The cost of using a decision-support tool should be proportionate to the value the tool adds to the decision-making process
- Driver-Pressure-State-Impact-Response (DPSIR) framework
    - Decision-support tools need to include pressure, state, and impact to ensure that outputs can be linked to pressures and that impact is made explicit in order for it to be interpreted in the relevant policy framework

The most challenging prerequisites for cumulative effects and the relationship of stressors is the ability to robustly describe the scientific concepts and processes that support decision-making. These include ecological, hydrodynamic, and chemical processes, as well as stressor-environment interactions. In the context of cumulative effects, understanding the

interrelationships among stressors is especially important due to the inherent complexity of these factors. Scientific information gaps or uncertainties identified during this step, may limit the ability to develop decision-support tools for certain applications. However, communicating the scientific concepts and processes related to cumulative effects meaningfully to decision-makers, for example in form of best practice guidance, can provide very effective support.

South and Central America and the Caribbean

Chile

In Chile, the Environmental Impact Assessment System is managed by the Environmental Assessment Service (Servicio de Evaluacion Ambiental or SEA), a decentralized public body with legal personality and its own assets. It provides exclusive and technical guidance for EIA and is responsible for standardizing the criteria, requirements, conditions, background, certificates, procedures, and technical requirements.

The document *Criterio De Evaluación En El Seia: Metodologías Para La Evaluación De Impactos Acumulativos Y Sinérgicos En El SEIA* (Assessment Criteria in SEIA: Methodologies For Assessing Cumulative And Synergistic Impacts On The SEIA)[2] provides over 300 pages of background information on undertaking CEAs in Chile (SEA, 2023). It proposes methodological approaches for the prediction and assessment of cumulative and synergistic impacts on the environment, providing guidelines to do so. It builds on previous reports and applies to all projects submitted to the SEA. In accordance with the provisions of Article 81d) of Law No. 19.300 and Decree No.40, the document aims to explain and technically relate the concepts of synergistic effect, synergistic impact and cumulative impact, as well as establish a general methodology for CEAs.

Cumulative effects must be analyzed in EIAs and, in some cases, Environmental Impact Declarations (DIAs) when a risk of significant impacts is identified. Projects must consider interactions with existing and planned projects with environmental approval.

1. Methodological Approach (Three Steps):
    - Step 1: Define the project's areas of influence and relevant environmental components.
    - Step 2: Identify potential cumulative and synergistic effects by evaluating overlapping impacts from past, present, and future projects.
    - Step 3: Assess the significance of cumulative impacts using criteria from Article 11 of Law No. 19.300 and SEIA regulations.
2. Integration with Land-Use Planning & Environmental Limits:
    - Consider the carrying capacity and environmental thresholds to prevent exceeding acceptable pollution or resource use levels.
    - Use spatial and temporal overlap analysis to determine the most critical impact periods.
3. Monitoring and Adaptive Management:
    - Projects must implement a follow-up plan to monitor relevant environmental variables.
    - Adaptive management is encouraged to allow for adjustments to mitigation measures based on actual impacts.

[2] Machine translation (model: DeepL) was used to translate parts of this document.

4. Application in Specific Sectors:
    - Includes examples such as aquaculture, wind farms, hydropower projects, and urban expansion where cumulative effects are a concern.

Regarding migratory species, the SEIA mandates that companies share data on species movement and impact assessments from previously approved projects to improve cumulative impact evaluations.

Asia

India

The National Centre for Sustainable Coastal Management (NCSCM) has introduced the Assessment of Cumulative Coastal Environmental Impacts (ACCES). This initiative aims to create comprehensive guidelines to evaluate the cumulative impacts of past, present, and future coastal developments. The goal is to ensure sustainable development while preserving coastal ecosystems, but these guidelines have not been published yet.

Philippines

The Environmental Management Bureau (EMB) of the Philippine Department of Environment and Natural Resources provides the policy and guidelines for EIA assessments, including the assessment of cumulative effects. EIAs are governed under the Philippine Environmental Impact Statement System (PEISS), established under Presidential Decree No. 1586 in 1978, and overseen by the EMB. Though the Philippine Government does not appear to have separate guidance on CEAs, the assessment of cumulative effects is mentioned as part of their EIA guidelines (EMB, 2007).

In 2024, the EMB published the “Interim guidelines for environmental compliance certificate (ECC) under the Philippine Environmental Impact Statement System (PEISS) for offshore wind energy (OSW) projects” (DENR Administrative Order 2024-02). Cumulative effects are mentioned in several places in the document. For example, Section 2 states that the EMB shall evaluate all individual OSW projects and associated works as well as possible cumulative impacts. For the pre-development stage, it is further mentioned that the Department of Environment alongside developers have to undertake a CEA for the development, construction and operation stage of OSW projects. It emphasizes that this analysis involves all effects of multiple actions on the environment and determines mitigation measures. Environmental Impact Statements require the inclusion of residual and cumulative impacts assessments. Additionally, Annex 3 states that if two or more OSWs are developed in the same body of water, the DOE, together with developers, will undertake an analysis of cumulative environmental effects. Effects on migration patterns are explicitly mentioned as points to take into consideration in EIA studies and Environmental Impact Statements. There are additional guidelines for projects applying for an ECC within or with Close Proximity to Protected Areas or RAMSAR Sites (DENR Memorandum Order 2023-01).

4. Discussion

The aim of this report was to provide an exploratory overview of the way CEAs are currently undertaken by CMS Parties (and some non-Parties), their relevance to migratory species and where further guidance may be needed. It found that while there are many different methods for undertaking CEAs, most share common characteristics and steps, which were summarized herein. Each of these general steps has its corresponding challenges and best practices. However, most of the discourse in academic and grey literature is focused on how to conduct a robust assessment of cumulative effects. This is due to the many decisions involved in CEAs that influence the outcome of an assessment, for example, the different levels at which CEAs can be undertaken. Challenges to improve CEA are multidimensional and cover bureaucratic, practical and scientific fields (Willsteed et al., 2018). Some of the key challenges across the whole CEA process are a persistent lack of knowledge on how cumulative effects interact, a lack of data availability, sharing, and access, as well as an inconsistency in definitions of cumulative effects and appropriate methods. There is a lot of information on possible CEA approaches and methodologies available. However, a key gap is the lack of knowledge on the extent to which these guidelines and methods are actually implemented by Parties, and whether they have the intended effect. Moreover, there is high variability across geographic regions regarding the extent to which CEAs are included in national legislation and policy. In the countries where CEA has already been included in legislation and policy, developing guidance as well as implementing and monitoring CEA approaches should be the focus. However, in the countries where CEA is not included in national legislation or policy, this should be the main priority. Parties that do not have national guidelines on CEAs can draw from the international standards and guidelines presented in this report. This cannot replace CEA legislation and national policy, but it can inform it or provide a substitute during development of national guidelines.

Migratory species in particular were found to be largely absent from CEAs. However, some policies and guidelines included reference to migratory routes or negative impacts on migratory species populations as examples of VECs. For migratory species, particularly marine migratory species, it is a challenge to gather information on cumulative effects they are exposed to along their migration routes, as these routes cross jurisdictions and is highly changeable and dynamic.

CMS does not need to develop new CEA terminologies, methodologies or guidelines, but up to this point, migratory species have been largely excluded from consideration. By connecting Parties and Range States, CMS is in an excellent position to address this issue and make the consideration of migratory species more explicit in legislation and policy. CMS also has the capacity to provide technical guidance on species-specific data, knowledge, and information – helping to make existing resources more useful by integrating a migratory species perspective. While CEAs should be conducted at different levels, but CMS can focus its attentions on transboundary CEAs, especially those involving migratory species that require collaboration between Parties. CMS can also assist Parties in incorporating migratory species into CEAs on a national or local level.

Though this report provides a robust overview of current CEA practices, their relevance to marine migratory species and the need for guidance for marine mammals, it was subject to several limitations that should be taken into consideration when interpreting the results.

Firstly, only two Party responded one of which provided very limited information on CEA, allowing for a very limited scope of analysis. To help fill this gap, literature and other documents were analysed. However, due to limited scope and capacity, the overview is not

exhaustive and cannot fully substitute for Party responses. For example, mainly English language sources were included. The author was dependent on machine translations for the documents only available in other languages, which can contain inaccuracies. Additionally, not all 133 CMS Parties could be given equal consideration in this report, due to limited capacity. As a result, some regions, particularly those with English-Speaking countries and a longer history of CEA practice (North America, Oceania, Europe), are better represented than others (South and Central America, Africa, Asia). However, based on the information available from the sources consulted, the author attempted to find a balance and represent all regions in this report as effectively as possible, in order to provide a global overview of the status of CEA among CMS Parties. Nonetheless, engaging countries in these regions remains crucial, both to share existing CEA practices and to support the development of such practices where they are still lacking.

Secondly, this report primarily focused on environmental cumulative effects. However, inclusion of social aspects and effects, especially consulting and engaging with stakeholders, including indigenous peoples and local communities, is necessary to just and effective EIA or SEA processes. The submission from New Zealand, as well as some other guidelines, provided guidance on how social aspects, such as the knowledge and experiences of indigenous peoples, can be incorporated in the assessment of cumulative effects. Nonetheless, future work within CMS can look further into including social effects related to migratory species in CEAs.

The legislative aspect of CEA, i.e. to what extent it is covered in national legislation, was not a major focus in this report. A brief overview was given on differences between geographic regions, but future research should look further into how Parties have included CEAs in their national legislation, which could yield new recommendations.

The literature review, which provided useful insights into the current state of CEA practice and remaining challenges, was not systematic, which could have resulted in the review being more subjective and less rigorous. Performing a full systematic literature review and policy analysis for all 133 CMS Parties was outside the scope of this report. Focusing on the marine environment narrowed the scope even further, though there were still too many results to conduct a systemic review. On the other hand, using search terms to narrow it down to migratory species or marine mammals yielded too few results. Performing more targeted systematic literature reviews can be valuable, for example, to identify suitable methods for each of the steps of the CEA process as it applies to migratory species. Considering the large body of academic literature on CEAs, as well as the growing number of guidelines developed by industry and other organizations, a more systemic approach to the literature review and analysis could yield more detailed insights and provide a better understanding of the state-of-the-art in CEAs. Another direction for future analysis would be to compare CEA statements (or CEA sections of EIA statements) to assess the implementation of CEA legislation and guidance, as this is a persistent knowledge gap.

The research for this report started by focusing on marine mammals specifically. However, as described in the methods, it was soon discovered that this was too narrow a scope and yielded too few results. Therefore, scope was broadened by focusing on the general aspect of marine environment and marine migratory species and did not develop guidance for marine mammals. The recommendations made, however, provide new ideas for the development of guidance by CMS, which can include marine mammals.

5. Conclusion

The literature review and policy document analysis in this report have shown that CEAs are undertaken in many CMS Parties, either on their own or as part of broader EIA or SEA processes. Many different definitions of cumulative effects are used, as are many methodologies for conducting CEAs. Despite the variety of approaches, common characteristics could be identified. For each of the steps in the generalized CEA process, the key best practices and challenges were highlighted. Additionally, the presence of CEAs in international standards and guidelines was examined, which yielded additional insights in best practices, as well as example guidelines for CEAs that could be relevant to CMS Parties. The recommendations below are based on the findings in this report and provide future directions for CMS to improve the inclusion of migratory species in CEA. Overall, CMS can address the absence of migratory species consideration in CEAs by providing technical and legislative guidance, as well as facilitate data and information gathering, analysis and sharing.

6. Recommendations

The recommendations below do not fully address all gaps and challenges identified in the report, as they focus only on areas where CMS and its Parties have a mandate and can contribute.

(1) Terminology and methodology

- Parties should establish common guidelines or standards for undertaking CEA, including when and how migratory species should be assessed.
    - Specifically, Parties should give guidance on appropriate methodologies for assessing cumulative effects for migratory species, for example in the form of a technical guidance document.
    - Where unique challenges exist or appear in undertaking CEAs, such as for marine migratory species, Parties should develop specific CEA guidance for particular migratory species groups.
- Parties should share any existing guidelines and standards that provide guidance for including and assessing migratory species in CEAs.
- Parties should determine a common terminology for CEAs, including a definition of cumulative effects, cumulative effects assessment and other key terms.

(2) Legislation and policy

- Parties that have not incorporated CEA into legislation can learn from Parties that have already implemented CEA in national legislation, and should develop a national policy on undertaking CEAs, with particular attention to migratory species.
- Parties that have included CEA in their national legislation are encouraged to provide capacity-building materials and support the development of CEA legislation and policy in countries that have not yet done so, paying particular attention to migratory species.

(3) Implementation

- Parties that have already incorporated CEA into national legislation should assess the extent to which CEAs are implemented, and evaluate and, where necessary, improve the assessment of migratory species in CEAs.

- Parties should monitor implementation of CEA in national policy and practice, especially the inclusion of migratory species and any challenges hindering implementation.

(4) Research

- Parties should address the lack of understanding of cumulate effects assessment by researching the interactions between pressures and receptors, in particular the non-linear (e.g. antagonistic, synergistic, additive) ways in which cumulative effects manifest.
- Parties should conduct research on the legislation, policy and methods employed to undertake CEA by all 133 CMS Parties to give detailed insights into regional challenges, gaps in legislation and policy, and the inclusion of migratory species in CEAs, and share this research with other Parties.
- In order to expand on this report, which is primarily concerned with CEAs in the marine environment, Parties should conduct research into CEAs in unique or specific environments, ecosystems or habitats relevant to migratory species.
- Parties should research technological advances in CEA methods and data collection, including but not limited to artificial intelligence and machine learning approaches to support CEAs.

(5) Data and information sharing

- To alleviate the burden of collecting data and the challenges of data scarcity, Parties should share data and information needed to inform CEAs, including but not limited to species data (population, rates, migratory routes), baseline ecosystem and habitat data, thresholds, pressures, sources and effects, particularly if it relates to CMS Appendix I and II listed species.
    - As a first step, Parties that are Range States to the same species and Parties that have a common border should share regional data on migratory species, and local and regional CEAs that have been and will be conducted.
- Parties should monitor the status and condition of vulnerable ecosystem components (VECs) over time, particularly those that relate to migratory species, and share this data to inform other and future CEAs, to help maintain a favourable conservation status for migratory species.

(6) Reporting

- Parties should provide information on how they undertake CEAs, including but not limited to adding a question specifically on CEAs as part of the existing EIA and SEA section in the National Report questionnaire. This can be used to assess the current state and, thereafter, progress in incorporating migratory species in CEAs as part of EIAs and SEAs and implementation of actions.

(7) Collaboration

- To move away from a siloed approach to CEA and build on the work already undertaken by other institutions, Parties should consult with industry, academia and other Parties to keep informed of state-of-the-art practices, and incorporate fragmented information on a strategic or government-led level.
- Parties should collaborate with organizations such as the International Council for the Exploration of the Sea (ICES) and IUCN to engage in current and future developments

of CEA guidelines and promote the explicit inclusion of migratory species therein, and monitor and participate in the implementation thereof.

References

AIIB. (2024). *Environmental and Social Framework.* https://www.aiib.org/en/policies-strategies/framework-agreements/environmental-social-framework.html

African Development Bank. (2001). *Environmental and Social Assessment Procedures for African Development Bank's Public Sector Operations.* https://www.afdb.org/en/documents/document/environmental-and-social-assessment-procedures-17092

Arikan, E., Dieterle, G., Bouzaher, A., Ceribasi, I.H., Kaya, D.E., Nishimura, S., Karamullaoglu, U., Aktekin, B. (2012). *Sample guidelines : cumulative environmental impact assessment for hydropower projects in Turkey.* World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/946301468309844309/sample-guidelines-cumulative-environmental-impact-assessment-for-hydropower-projects-in-turkey

ASDB. (2003). *Environmental Assessment Guidelines.* https://www.adb.org/documents/adb-environmental-assessment-guidelines

Barry, E.S., Merkebu, J. & Varpio, L. (2022). State-of-the-art literature review methodology: A six-step approach for knowledge synthesis. *Perspectives on Medical Education, 11*, 281-288. https://doi.org/10.1007/s40037-022-00725-9

Bennun, L., Fletcher, C., Cook, A., Wilson, D., Jobson, B., Asante-Owusu, R., Dakmejian, A., & Liu, Q. (2024). Guidance on biodiversity cumulative impact assessment for wind and solar developments and associated infrastructure. Gland, Switzerland: IUCN, and Cambridge, UK: The Biodiversity Consultancy. https://doi.org/10.2305/EHGE6100

Blakley, J. & Russell, J. (2019). Trends, Issues and Insights in Cumulative Effects Assessment: A Review of International Academic Literature 2008-2018. *Journal of Environmental Planning and Management*, *65*(2), 186-215. https://doi.org/10.1080/09640568.2021.1882408

Bulmer, R. & Flowers, G. (2024). *Addressing cumulative effects in marine management decisions.* Sustainable Seas Challenge. https://www.sustainableseaschallenge.co.nz/tools-and-resources/addressing-cumulative-effects-in-marine-management-decisions/

CIEEM. (2018). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.3.* Chartered Institute of Ecology and Environmental Management, Winchester. https://cieem.net/resource/guidelines-for-ecological-impact-assessment-ecia/

CMS. (2017). Resolution 12.14 Adverse Impacts of Anthropogenic Noise on Cetaceans and Other Migratory Species. https://www.cms.int/en/document/adverse-impacts-anthropogenic-noise-cetaceans-and-other-migratory-species-0

DEAT. (2006). *Guideline 5: Assessment of Alternatives and Impacts in support of the Environmental Impact Assessment Regulations*. Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT. (2004). *Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7*. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

Duinker, P.N., Burbidge, E.L., Boardley, S.R. & Greig, L.A. (2013). Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice. *Environmental Reviews*, *21*(1), 40-52. https://doi.org/10.1139/er-2012-0035

EBRD. (2019). *Environmental and Social Policy.* https://www.ebrd.com/home/who-we-are/ebrd-values/ebrd-environmental-social-sustainability/reports-and-policies/performance-requirements.html

Elliott, M., Burdon, D., Atkins, J.P., Borja, A., Cormier, R., de Jonge, V. N., & Turner, R.K. (2017). "And DAPSIR begat DAPSI (W) (R) (M)!" - A unifying framework for marine environmental management. *Marine Pollution Bulletin, 118*(1-2), 27-40. https://doi.org/10.1016/j.marpolbul.2017.03.049

EMB. (2007). *Revised Procedural Manual for DENR Administrative Order No.30 series of 2003. https://eia.emb.gov.ph/wp-content/uploads/2020/07/Revised-Procedural-Manual-DAO-03-30.pdf*

EPA (USA). (2024). *Interim Framework for Advancing Consideration of Cumulative Impacts.* https://www.epa.gov/cumulative-impacts/interim-framework-advancing-consideration-cumulative-impacts

EPA (Ireland). (2020). *Good Practice Guidance on Cumulative Effects Assessment in Strategic Environmental Assessment*. https://www.epa.ie/publications/monitoring--assessment/assessment/strategic-environmental-assessment/good-practice-guidance-on-cumulative-effects-assessment-in-sea.php

Foley, M.M., Mease, L.A., Martone, R.G., Prahler, E.E., Morrison, T.H., Murray, C.C. & Wojcik, D. (2017). The challenges and opportunities in cumulative effects assessment. *Environmental Impact Assessment Review*, *62*, 122-134. https://doi.org/10.1016/j.eiar.2016.06.008

Giles, H. & Lundquist, C. (2023). *Developing decision-support tools for cumulative effects management.* Sustainable Seas Challenge. https://www.sustainableseaschallenge.co.nz/our-research/spatially-explicit-cumulative-effects-tools/

Government of Canada. (2023). *Policy Framework for Assessing Cumulative Effects under the Impact Assessment Act.* https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/policy-framework-assessing-cumulative-effects-under-impact-assessment-act.html

Hague, E.L., Sparling, C.E., Morris, C., Vaughan, D., Walker, R., Culloch, R.M., Lyndon, A.R., Fernandes, T.F. & McWhinnie, L.H. (2022). Same Space, Different Standards: A Review of Cumulative Effects Assessment Practice for Marine Mammals. *Frontiers in Marine Science, 9*. https://doi.org/10.3389/fmars.2022.822467

Halpern, B. S. & Fujita, R. (2013). Assumptions, challenges, and future directions in cumulative impact analysis. *Ecosphere, 4*(10), 1–11. https://doi.org/10.1890/ES13-00181.1

Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S.,

Madin, E.M.P., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R., & Watson, R. (2008). A global map of human impact on marine ecosystems. *Science, 319*(5865), 948-952. http://dx.doi.org/10.1126/science.1149345

Hammar, L., Molander, S., Pålsson, J., Crona, J.S., Carneiro, G., Johansson, T., Hume, D., Kågesten, C., Mattsson, D., Törnqvist, O., Zillén, L., Mattsson, M., Bergström, U., Perry, D., Caldow, C. & Andersen, J.H. (2020). Cumulative impact assessment for ecosystem-based marine spatial planning. *Science of the Total Environment, 734,* 139024. https://doi.org/10.1016/j.scitotenv.2020.139024

Hayden, M., Lundquist, C. & Kainamu, A. (2023). *Hapū and iwi perceptions of cumulative effects: towards supporting kaitiakitanga.* Sustainable Seas Challenge. https://www.sustainableseaschallenge.co.nz/our-research/spatially-explicit-cumulative-effects-tools/

Hayden, M. (July 13, 2023). *Understanding cumulative effects from a te ao Māori perspective.* Sustainable Seas Challenge. https://www.sustainableseaschallenge.co.nz/news-and-events/news/understanding-cumulative-effects-from-a-te-ao-m%C4%81ori-perspective/

IAIA. (no date). *Cumulative Effects Assessment and Management.* https://www.iaia.org/wiki-details.php?ID=9

IAIA. (1999). *00. Principles of Environmental Assessment Best Practice.* https://www.iaia.org/best-practice.php

IAIA. (2018). *03. Biodiversity and Ecosystem Services in Impact Assessment.* https://www.iaia.org/best-practice.php

ICES. (2025). Working Group on Cumulative Effects Assessment Approaches in Management (WGCEAM; outputs from 2024 meeting). *ICES Scientific Reports,* 7(16). https://doi.org/10.17895/ices.pub.28322693

IEMA. (2024). *Implementing the Mitigation Hierarchy from Concept to Construction. https://www.iema.net/media/oone2qce/iema-mitigation-in-eia-guidance-final.pdf*

IFC. (2013). *Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets.* https://www.ifc.org/en/insights-reports/2013/publications-handbook-cumulativeimpactassessment#:~:text=This%20Good%20Practice%20Handbook%20on%20Cumulative%20Impact%20Assessment,them%20in%20the%20effective%20design%20and%20implementation%20

Jones, F.C. (2016). Cumulative effects assessment: theoretical underpinnings and big problems. *Environmental Reviews, 24*(2), 187-204. https://doi.org/10.1139/er-2015-0073

JPI Oceans. (2024). *A common handbook: Cumulative effects assessment in the marine environment.* JPI Oceans Knowledge Hub on Cumulative effects of human activities in the marine environment. https://dx.doi.org/10.48470/77

Judd, A.D., Backhaus, T., & Goodsir, F. (2015). An effective set of principles for practical implementation of marine cumulative effects assessment. *Environmental Science & Policy, 54*, 254-262. https://doi.org/10.1016/j.envsci.2015.07.008

Korpinen, S. & Andersen, J.H. (2016). A Global Review of Cumulative Pressure and Impact Assessments in Marine Environments. *Frontiers in Marine Science, 3*(153). https://doi.org/10.3389/fmars.2016.00153

Korpinen, S., Klančnik, K., Peterlin, M., Nurmi, M., Laamanen, L., Zupančič, G., Popit, A., Murray, C., Harvey, T., Andersen, J.H., Zenetos, A., Stein, U., Tunesi, L., Abhold, K., Piet, G., Kallenbach, E., Agnesi, S., Bolman, B., Vaughan, D., Reker, J. & Royo Gelabert, E. (2019). Multiple pressures and their combined effects in Europe's seas. ETC/ICM Technical Report 4/2019: European Topic Centre on Inland, Coastal and Marine waters, 164 pp. https://www.eionet.europa.eu/etcs/etc-icm/products/etc-icm-reports/etc-icm-report-4-2019-multiple-pressures-and-their-combined-effects-in-europes-seas

NCSCM. (no date). *Assessment of Cumulative Coastal Environmental Impacts (ACCES).* https://ncscm.res.in/assessment-of-cumulative-coastal-environmental-impacts-acces/

Olagunju, A., Odame Appiah, D., Porto Silva Cavalcanti, P. M., Durning, B., Tejeda González, J. C., MacLean, J., Morgan, R. & Nelson, R. (2021). "Chapter 2: Cumulative effects assessment requirements in selected developed and developing countries". In Handbook of Cumulative Impact Assessment. Cheltenham, UK: Edward Elgar Publishing. https://doi.org/10.4337/9781783474028.00012

OSPAR. (2023). *CEMP Guideline: Cumulative effects assessment for the QSR 2023 (Bow Tie Analysis)*. https://www.ospar.org/work-areas/cross-cutting-issues/cemp

OSPAR. (2023). *Quality status Report.* https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/

Prideaux, G. (2017). *Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities.* Convention on Migratory Species of Wild Animals, Bonn. https://www.cms.int/en/document/technical-support-information-cms-family-guidelines-environmental-impact-assessment-marine

Rojas-Nazar, U., Hewitt, J., Pilditch, C. & Cornelisen, C. (2023*). Managing cumulative effects in the marine environment – research roundup.* Sustainable Seas National Science Challenge. https://www.sustainableseaschallenge.co.nz/tools-and-resources/managing-cumulative-effects-in-the-marine-environment/

Roudgarmi, P. (2018). Cumulative Effects Assessment (CEA), A Review. *Journal of Environmental Assessment Policy and Management, 20*(02). http://dx.doi.org/10.1142/S1464333218500084

SEA. (2024). *Criterio De Evaluación En El Seia: Metodologías Para La Consideración De Los Impactos Acumulativos Y Sinérgicos.* Primera edición, Santiago, Chile. https://www.sea.gob.cl/documentacion/guias-y-criterios/criterio-de-evaluacion-en-el-seia-metodologias-para-la

SEANSE. (2020). *Strategic Environmental Assessment on North Sea energy as an aid for Maritime Spatial Planning.* https://rijkswaterstaat.sitearchief.nl/?subsite=northseaportal#archive

Simeoni, C., Furlan, E., Pham, H.V., Critto, A., de Juan, S., Trégarot, E., Cornet, C.C., Meesters, E., Fonseca, C., Botelho, A.Z., Krausej, T., N'Guetta, A., Cordova, F.E., Faillerd, P. & Marcomini, A. (2023). Evaluating the combined effect of climate and

anthropogenic stressors on marine coastal ecosystems: Insights from a systematic review of cumulative impact assessment approaches. *Science of the Total Environment, 861,* 160687. https://doi.org/10.1016/j.scitotenv.2022.160687

Slootweg, R. (2021). *Linear infrastructure and migratory species the role of impact assessment and landscape approaches.* https://www.cms.int/en/document/linear-infrastructure-and-migratory-species-role-impact-assessment-and-landscape-approaches

Sukhera, J. (2022). Narrative Reviews: Flexible, Rigorous, and Practical. *Journal of Graduate Medical Education, 14*(4), 414-417. https://doi.org/10.4300/JGME-D-22-00480.1

The Common Environmental Assessment Framework CEAF. (2019). https://rijkswaterstaat.sitearchief.nl/?subsite=northseaportal#archive

Van Oostveen, M., Sierdsma, F., Kwakkel, J., Van Mastrigt, A. (2018). *Inventory and assessment of models and methods used for describing, quantifying and assessing cumulative effects of offshore wind farm.* Rijkswaterstaat. https://rijkswaterstaat.sitearchief.nl/?subsite=northseaportal#archive

Willsteed, E.A., Collin, S. & Koehler, L. (2024). *Cumulative effects assessments to support marine plan development.* JNCC Report 768 (Project Report), JNCC, Peterborough. https://hub.jncc.gov.uk/assets/ad2730d3-493e-438c-981d-66d1dd25a8c5

UNECE. (2023). *Seventh review of implementation of the Convention on Environmental Impact Assessment in a Transboundary Context* (UNECE/MP.EIA/2023/9). ece_mp.eia_2023_9_e.pdf

UNEP-WCMC. (2023). *Analysis of CMS National Reports to COP14*. UNEP-WCMC, Cambridge.

World Bank. (2023). *Cumulative Impact Assessment and Management of Renewable Energy Development in the Sekong River Basin, Lao People's Democratic Republic.* https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099503101032312065

Zamora, J.C.P., Quintero, J.D., Scott-Brown, M. (2022). *Practical Guide for Cumulative Impact Assessment and Management in Latin America and the Caribbean*. IDB Invest. https://www.idbinvest.org/en/publications/practical-guide-cumulative-impact-assessment-and-management-latin-america-and