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Oceans and climate change adaptation: tracking international law and policy developments and challenges

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Climate change threatens the conservation of marine biodiversity, the sustainable use of marine resources, and the human rights of all people, especially those communities that depend on the marine environment for their livelihoods and culture. Sustained, coordinated and ambitious adaptation action is urgently needed. However, adaptation obligations and commitments for the oceans and the ocean economy have largely been addressed within traditionally siloed international regimes. This paper tracks these obligations and commitments by reviewing agreements, decisions and recommendations adopted under five main streams of international law and policy development: climate change, the law of the sea, fisheries and aquaculture, nature conservation, and human rights. The paper focuses on the obligations and commitments of States in two important areas: supporting the resilience of marine ecosystems; and facilitating the adaptation of the fisheries and aquaculture sectors, as representative economic sectors that contribute to food security and sustainable and traditional livelihoods. Through the assessment and review of relevant material, trends, synergies, and challenges have been identified. The paper highlights the evolving content of international law and policy on ocean-based adaptation to climate change. It identifies promising avenues for strengthening the coordination and coherence of ocean-based adaptation, including through the use of common principles, management tools and coordination mechanisms. It also identifies persistent challenges, including implementation gaps, lack of political will, and the complex conceptualization and implementation of adaptation law. The paper concludes by outlining key developments that could facilitate faster and bolder action by States.

KEYWORDS

climate change, ocean adaptation, ocean-climate nexus, international law, human rights and oceans, marine biodiversity, ecosystem approach, nature-based solutions

1 Introduction

Once ignored in climate change negotiations, the ocean is now firmly positioned within the scope of the climate change regime (Galland et al., 2012; Rochette et al., 2024; SBSTA (Subsidiary Body for Scientific and Technological Advice), 2020; ITLOS (International Tribunal for the Law of the Sea), 2024a). The ocean is recognized as a critical component of the climate system, a significant sink of greenhouse gases, and a promising solution space for climate mitigation and adaptation (Hoegh-Guldberg and Northrop, 2023). At the same time, there is considerable evidence of climate change impacts on the physical and chemical properties of the ocean (including ocean warming, deoxygenation, and acidification) and its living resources, with important adverse effects on human life, health, well-being, and livelihoods, particularly for coastal communities (IPCC (Intergovernmental Panel on Climate Change), 2019; IPCC, 2022a). Some of the climate-induced changes in our oceans are already irreversible. Sustained, coordinated and increasingly ambitious incremental and transformative ocean-based adaptation action is a policy imperative (IPCC (Intergovernmental Panel on Climate Change), 2019: 34).

Adaptation to climate change is a complex, multifaceted and diverse concept. Adaptation actions can support the adjustment of ecosystems or social systems to the impacts of climate change; can aim to reduce exposure or vulnerability to climate risks, strengthen resilience or enhance adaptive capacity; and can include engineered, technological, ecosystem-based, institutional and social measures (Paris Agreement (2015), Art. 7; Noble et al., 2014: 845). Adaptation reaches all sectors of society; has local, transboundary, planetary, and intertemporal dimensions; is embedded in multiple levels of scientific uncertainty; and is deeply intertwined with and exacerbates non-climatic environmental and social pressures (Ara Begum et al., 2022). The climate change regime has shifted the framing of adaptation from "a focus on biophysical vulnerability to the wider social and economic drivers of vulnerability and people's ability to respond" (Noble et al., 2014: 836).

As a result, climate change adaptation law and policy are increasingly intertwined with ocean, biodiversity, and human rights law and policy, demanding coordination, coherence and systemic integration of legal obligations when defining and implementing climate action (Verschuuren, 2022; ITLOS (International Tribunal for the Law of the Sea), 2024a). However, an assessment of the procedural and substantive coherence of international responses to the biodiversity-climate change-people nexus in ocean adaptation is lacking (Morgera and Lennan, 2024). This research article contributes to filling this gap by tracking how ocean-based adaptation is addressed and framed under different streams of international law and policy development (climate change, law of the sea, fisheries and aquaculture, nature conservation, and human rights), assessing their coherence, identifying gaps, highlighting coordination mechanisms, and identifying challenges to systemic integration.

The next section describes the scope of this article and the research methods and materials. The article then summarizes the main ocean-based adaptation obligations, commitments and measures in the climate change regime (section 3), the law of the sea (section 4), initiatives under the Food and Agriculture Organization of the United Nations (FAO) (section 5), the nature conservation regime (section 6) and the human rights regime (section 7). Section 8 critically discusses the findings, and section 9 concludes with future directions.

2 Materials and methods

This article is situated within intersecting complexities. Responses to climate change, including mitigation, adaptation, and loss and damage, are inextricably linked (Paris Agreement, Art. 7(2); IPCC (Intergovernmental Panel on Climate Change), 2019: 34). Adaptation has local, national, regional, and international dimensions (Paris Agreement, Art. 7(2); Nishimura, 2024). Multiple interacting drivers of impacts and responses link climate, ocean, biodiversity, human well-being, lives and livelihoods, including compounding climatic and non-climatic drivers (IPCC (Intergovernmental Panel on Climate Change), 2019). These complexities cannot be fully addressed here, thus the scope of the article has been narrowed in several ways.

First, the research focuses on international law and policy: it identifies, summarizes, and assesses how ocean adaptation has been addressed in key international agreements relevant to the ocean-climate-biodiversity-people nexus. To this end, the agreements and the decisions, recommendations and guidelines adopted by the Conferences of the Parties (COP) and subsidiary and technical bodies were reviewed. Commentaries on these developments supplemented the research.

Second, the study focuses on two related but distinct aspects of adaptation in the ocean context. The first focus is on obligations or policies that facilitate the adjustment of natural marine systems to the expected climate and its impacts, thus enhancing their resilience (IPCC, 2022b: 2898). The second focus is on obligations or policies that support and facilitate the adjustment of human systems to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities (IPCC, 2022b: 2898). In the latter case, the article focuses on fisheries and aquaculture as representative and important societal sectors because of their contribution to food security and sustainable and traditional livelihoods (UNFCCC, Art. 2; *Paris Agreement*, Recital 9, Art. 2.1 (b); United Nations Secretary-General, 2023: 4-5). Focusing on the adaptation of both the natural systems and human systems that depend on the marine environment (albeit limited to aquatic food) allows for the identification of potential policy conflicts arising from the different mandates of specialized international legal regimes.

The article does not address ocean-based mitigation, loss and damage, or responses to other anthropogenic stressors (e.g. plastic pollution, overfishing). The legal implications of, or adaptation to, physical alteration of the coastline due to sea-level rise or extreme weather events, including disaster risk reduction, internal displacement or migration, are also outside the scope of this article (but see: ILC (International Law Commission), 2024;

ILA (International Law Association), 2024; HRC, 2023). Also beyond the review are the roles of the International Maritime Organization (IMO) in addressing adaptive marine geoengineering techniques (VanderZwaag and Mahamah, 2024) and protecting cetaceans from ship strikes and vessel noise in changing ecosystems (Koubrak et al., 2022). Similarly, the article does not cover regional and national laws in detail or policies or initiatives by non-State actors. Governance approaches and challenges in national ocean climate adaptation have been discussed in other papers in Frontiers in Marine Science and elsewhere [Engler, 2024 (Chile); Bai and Li, 2023 (China); Chang et al. (2020); Sultana et al., 2023 (Bangladesh); VanderZwaag et al., 2023 (Canada); Craig, 2022 (USA)]. Challenges faced by regional fisheries management organizations in adapting to changing ecosystems and shifting fish stocks have been well documented (Lennan, 2024; Koubrak and VanderZwaag, 2020; Goodman et al., 2022; Molenaar, 2021; Rayfuse, 2019), while the roles of some key regional biodiversity instruments in addressing climate change adaptation have also been reviewed (Trouwborst, 2022). Miller et al. (2018) review the literature on adaptation to marine climate change impacts.

3 Ocean adaptation in the climate change regime

The ocean was already recognized as part of the climate system and a carbon sink in the United Nations Framework Convention on Climate Change (UNFCCC) (1992) (Art. 1.3 and 4.1.d). Nevertheless, references to it were limited in the early negotiations (Galland et al., 2012). The efforts of several non-governmental organizations and public-private alliances have led to a growing, but still limited, recognition of the ocean-climate nexus in climate change negotiations (Galland et al., 2012; Morgera et al., 2023: 426). The Paris Agreement (2015) represents a particular milestone, by recognizing "the importance of ensuring the integrity of all ecosystems, including oceans" (Preamble) and calling upon States to protect and enhance greenhouse gas sinks and reservoirs, including oceans, coastal and marine ecosystems (*Paris Agreement*, Art. 5; UNFCCC, Art. 4.1.d). Subsequent decisions adopted by the COP to the UNFCCC and the Paris Agreement have further strengthened the integration of oceans into climate negotiations, including by launching annual ocean and climate change dialogues (UNFCCC, 2019a, 2021a); inviting relevant work programs and constituted bodies under the UNFCCC to consider how to integrate and strengthen ocean-based action into their existing mandates and work plans (UNFCCC, 2021a); and inviting State Parties to consider ocean-based action in their national climate goals and implementation (UNFCCC, 2022a: para. 50; UNFCCC, 2022b: para. 79; Dobush et al., 2022; Ricketts and Olutoke, 2024; Rochette et al., 2024).

While several UNFCCC bodies, work programs and initiatives are directly or indirectly relevant to adaptation in oceans, fisheries and aquaculture (e.g. Paris Committee on Capacity Building (UNFCCC, 2023a); Technology Mechanism (UNFCCC, 2022d, 2024a); see: Ma et al., 2024), they have been most explicitly and meaningfully addressed through the global goal on adaptation, the Nairobi Work Program on impacts, vulnerability, and adaptation to climate change, and the ocean and climate change dialogues.

3.1 Ocean adaptation and the global goal on adaptation

The *Paris Agreement* marks a turning point for climate change adaptation. Building on the limited adaptation provisions of the UNFCCC (Art. 4) and several decisions and documents adopted by the COP since 2007 (e.g. UNFCCC, 2007, 2010), the Agreement establishes, for the first time, a global goal on adaptation: to "enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2" (Art. 7.1). It further specifies adaptation obligations for States, including obligations to act, to assist and to cooperate (Nishimura, 2024), outlines principles to guide adaptation action (Art. 7.5), and embeds adaptation in the Agreement's transparency framework (Arts. 7.9-7.12, 7.14, 13, 14) (Suárez Pérez and Kallhauge, 2017; Nishimura, 2024; Orlove, 2022).

The qualitative global goal on adaptation has been further advanced by the United Arab Emirates (UAE) Framework for Global Climate Resilience (UNFCCC, 2023b), which provides guidance on planning and implementing adaptation actions, reviewing overall progress, and enhancing support for adaptation. The UAE Framework requires Parties to meet dimensional targets for the iterative adaptation process (impact, vulnerability, and risk assessment; planning; implementation; and monitoring) by 2030. It further "urges" Parties (and invites non-Party stakeholders) to pursue seven thematic adaptation targets in alignment with other global frameworks. The thematic targets build on the priority areas for adaptation planning and implementation identified in a footnote to the Cancun Agreements (UNFCCC, 2010: para. 14). Three of these are relevant to the scope of this paper, as they explicitly refer to the protection of marine ecosystems, and implicitly to fisheries and aquaculture as food production systems and cultural practices. These thematic targets are:

a. Attaining climate-resilient food and agricultural production and supply and distribution of food, as well as increasing sustainable and regenerative production and equitable access to adequate food and nutrition for all;
b. Reducing climate impacts on ecosystems and biodiversity, and accelerating the use of ecosystem-based adaptation and nature-based solutions, including through their management, enhancement, restoration and conservation and the protection of terrestrial, inland water, mountain, marine and coastal ecosystems;
c. Protecting cultural heritage from the impacts of climate-related risks by developing adaptive strategies for preserving cultural practices and heritage sites and by designing climate-resilient infrastructure, guided by

traditional knowledge, Indigenous Peoples' knowledge and local knowledge systems (UNFCCC, 2023b: paras. 9a), d) and g)).

The UAE-Belém work program 2024–2025 was tasked with identifying and, if necessary, developing indicators and potential quantified elements for both the dimensional and thematic targets (UNFCCC, 2023b: para. 39). The work program is ongoing, and has faced significant challenges, in part due to the number of indicators proposed by States and non-State actors and the complexity of measuring the collective adaptation progress of country-driven and context-specific adaptation processes. Many of the thousands of proposed indicators have been "borrowed", adapted or expanded from those used in other international regimes, including the Kunming-Montreal Global Biodiversity Framework (CBD, 2022) and the Sustainable Development Goals under the 2030 Agenda (UNGA, 2015). In addition to reducing monitoring and reporting burden, the use of common indicators is seen as promoting policy coherence (Adaptation Committee, 2021). At COP 29 (UNFCCC, 2024b), a roadmap and annual dialogue on adaptation were agreed upon. However, it remains to be seen how these will address ocean adaptation and interact with annual ocean dialogues.

3.2 Ocean adaptation in the Nairobi Work Program

In decisions adopted in 2018 and 2019, the Subsidiary Body for Scientific and Technological Advice (SBSTA) prioritized oceans, coastal areas and ecosystems, including mega deltas, coral reefs and mangroves, as a thematic area to be addressed by the Nairobi Work Program on Impacts, Vulnerability, and Adaptation to Climate Change (NWP). Following its knowledge-to-action methodology, the NWP has produced several outputs, often in collaboration with other constituted bodies (e.g. Adaptation Committee, Technological Committee). The NWP is also supported by an ocean expert group, which was established in 2019 and includes representatives from several UN entities and international governmental and non-governmental organizations.

The UNFCCC Secretariat prepared a scoping document synthesizing knowledge gaps and needs for ocean and coastal adaptation (UNFCCC, 2019b), which was further refined and expanded through consultations with the ocean expert group and stakeholder engagement at the 13th NWP focal point forum held in conjunction with the "Blue COP" (2019). The results were summarized in a Policy Brief (UNFCCC, 2020) and Report (UNFCCC, 2021b) identifying best practices, knowledge gaps and needs, and possible collaborative actions. Some key relevant findings and recommendations are highlighted here.

The NWP identified the fragmentation of adaptation responses at all levels as a significant challenge (UNFCCC, 2021b: 18-19). It identified the need to strengthen coordination and synergies between international regimes, but also between international and national actions (combining top-down and bottom-up approaches), between sectoral silos, between public, private, and civil society actors, and between science and policy. Specific collaborative actions to address these needs included mapping existing global agendas and mandates, identifying synergies between different legal frameworks related to oceans and climate change, inventorying initiatives and potential areas of collaboration, and strengthening linkages with relevant processes within and outside the UNFCCC. The NWP also highlighted the importance of implementing ecosystem-based approaches, integrated coastal zone management and marine spatial planning at the subnational, national and transboundary levels (UNFCCC, 2021b: 17).

Nature-based solutions, innovative hybrid adaptation solutions (i.e. combining nature-based and hard technologies) and marine protected areas (MPAs) were highlighted as innovations to protect and restore marine ecosystems and ensure sustainable management and use. Two NWP documents addressed these adaptation solutions: a policy brief on integrating technology and nature-based solutions to strengthen coastal and ocean adaptation (UNFCCC and IUCN, 2022); and a Supplement to the UNFCCC Technical Guidelines for National Adaptation Plan addressing coastal adaptation and nature-based solutions (UNFCCC, 2021c). Ongoing work continues to address identified adaptation needs, including financing and data.

The NWP acknowledged the special vulnerability of the fisheries and aquaculture sector to climate drivers and recognizes mariculture as an innovative adaptation solution (UNFCCC, 2021b: 5, 35), but did not elaborate on their specific adaptation needs or options. In June 2022, the SBSTA updated the priorities of the NWP and added the fisheries and aquaculture sector as a specific topic. However, it was added under the mandate of the theme on "livelihoods and socioeconomic dimensions in relevant sectors such as tourism" (SBSTA, 2022a), rather than the oceans or agriculture and food security themes. This decision is puzzling when considered in the light of the UNFCCC Sharm el-Sheikh joint work on the implementation of climate action on agriculture and food security (UNFCCC, 2022c) and its predecessor, the Koronivia joint work on agriculture and food security (UNFCCC, 2017). While the negotiations and discussions under these two UNFCCC initiatives have undoubtedly focused on land-based food production, fisheries (included in the FAO's definition of agriculture, FAO (Food and Agriculture Organization of the United Nations), 1945: art. I) and the blue economy have been on the radar and highlighted as possible future topics (Rioux et al., 2023: 7; Ma et al., 2024: 23).

3.3 The ocean and climate change dialogue

The climate-ocean nexus agenda was strengthened by the 2019 "Blue COP" (although not without struggle; see: IISD (International Institute for Sustainable Development), 2019). The Chile-Madrid Time for Action mandated the SBSTA Chair to convene a dialogue on oceans and climate change to consider how to strengthen action on mitigation and adaptation in this context (UNFCCC, 2019a: para. 31). Although initially established as a one-off event, COP26 decided to make the dialogue an annual event (UNFCCC, 2021a:

para. 61). With these decisions, the ocean became part of the formal UNFCCC negotiations (Ricketts and Olutoke, 2024) providing "a dedicated space for Parties and observers to discuss how to take ocean-based climate action to the next level under the convention" and the Paris Agreement (Rochette et al., 2024: 4). Despite a weak mandate, lack of actionable recommendations, and low participation by State Parties (Rochette et al., 2024), the dialogues have helped to raise the visibility of the ocean-climate nexus in the UNFCCC.

At the time of writing, four dialogues have taken place (SBSTA, 2021, 2022b, 2023, 2024). The first two dialogues served as a general forum for the exchange of views on the ocean-climate nexus. Subsequent dialogues have focused on specific topics to enable a "deep dive" into the best ocean solutions (Rochette et al., 2024). The 2023 and 2024 Dialogues addressed four specific themes: restoration of coastal ecosystems (including blue carbon); fisheries and food security; conservation of marine biodiversity and coastal resilience; and technology needs for ocean-climate action, including finance links. Key messages and recommendations emerging from these dialogues that are relevant to ocean-based adaptation include:

- Strengthening research and systematic observation and understanding of the multiple benefits of marine biodiversity and coastal ecosystems;
- Increasing cooperation and synergies within the UNFCCC and across other global frameworks;
- Conserving, protecting and restoring coastal and ocean ecosystems, including blue carbon habitats, for their benefits for mitigation and adaptation of ecosystems and human systems.
- Integrating gender-responsive, and rights- and ecosystem-based action that takes into account vulnerable coastal and marine communities.
- Recognizing the key role of marine protected areas (MPAs) and other area-based measures in protecting ecosystems, as well as the important contributions of integrated management, marine spatial planning, community-led conservation, community-based fisheries, spatial planning, integration of marine technologies and nature-based solutions.
- Increasing ambition of adaptation actions at the national level through climate-smart planning, including by addressing ocean adaptation in nationally determined contributions and national adaptation plans;
- Integrating aquatic food climate solutions into national and international processes, using a systems/ecosystem-based approach, and managing fisheries using an ecosystem approach;
- Increasing finance, support access to finance (especially for coastal communities), and provide cross-cutting support for ocean-based climate action;
- Adopting a whole-of-society approach to ocean-based climate action and governance.

4 Climate change adaptation in the law of the sea regime

The regime complex of the law of the sea comprises the United Nations Convention on the Law of the Sea (1982) (LOSC) and several implementing and related global and regional agreements. Of particular relevance to this article are the United Nations Fish Stocks Agreement (1995) (UNFSA) and the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ Agreement) (2023), although the latter is not yet in force.

Recognizing the fragmented nature of the law of the sea regime, the UN General Assembly (UNGA) requested the Secretary-General to establish an "effective, transparent and regular inter-agency coordination mechanism on oceans and coastal areas within the United Nations system" (UNGA, 2002). In response to this request, and building on earlier initiatives, the Secretary-General established UN-Oceans in 2003. The Secretariats of several nature conservation agreements (see section 5), FAO, and the Office of the UN High Commissioner for Human Rights are members of UN-Oceans. The UNFCCC Secretariat became a member in 2018.

The LOSC and UNFSA were negotiated at a time when the impacts of climate change on the marine environment were not widely understood or part of the public discourse. It is therefore not surprising that neither instrument contains references to climate change. Nevertheless, the framework nature of the LOSC and the broad and flexible obligations under both treaties allow, and even require, the consideration of climate change. A recent non-binding but authoritative Advisory Opinion of the International Tribunal for the Law of the Sea (ITLOS (International Tribunal for the Law of the Sea), 2024a) clarified the obligations under the LOSC for both mitigation and adaptation to climate change. With regard to adaptation, the Tribunal interpreted the obligation in Article 192 of the LOSC broadly and concluded that States Parties to the Convention have specific obligations to protect and preserve the marine environment from climate change impacts and ocean acidification [paras. 388, 441(4)(b)]. The ITLOS noted that external rules of international law, including the UNFCCC and the Paris Agreement, can inform the content of the obligation in Article 192 and shape the type of measures that may be implemented (para. 388).

Several obligations under UNFSA can be interpreted and applied to address the impacts of climate change on straddling and highly migratory stocks. For example, States shall assess the impact of fishing, other human activities and environmental factors on target stocks, species belonging to the same ecosystem or associated with or dependent upon the target stocks [Art. 5(d)]; protect biodiversity in the marine environment [Art. 5(g)]; collect and share information on environmental factors affecting stock abundance, oceanographic and ecological studies [Annex I, Art. 3.2 (c)]; apply the precautionary approach (Art. 6); and adopt conservation and management measures on an emergency basis if a natural phenomenon has a significant adverse impact on the status of fish stocks (Art. 6.7) (see also: Engler, 2020).

The recent BBNJ Agreement is the first law of the sea global treaty that explicitly recognizes the importance of addressing climate change impacts on the marine environment, building ecosystem resilience, and maintaining and restoring ecosystem integrity (Preamble, Art. 7(h); Roberts, 2024, 158). The Agreement has the potential to strengthen adaptation actions for the marine environment once it enters into force, although the pace and extent of progress will depend on the political will and leadership of State Parties. For example, climate change will need to be taken into account when establishing MPAs and other area-based management measures (Art. 17(c); Annex I), when conducting environmental impact assessments and strategic environmental assessments (Arts. 1(6), 27 and 39), and in capacity building and marine technology transfer (Annex II).

Climate considerations in the law of the sea regime have also been advanced by multilateral policies and guidelines. Of particular relevance are the annual UNGA resolutions on the oceans and the law of the sea and on sustainable fisheries; the outcome documents of the UN Ocean Conferences; the reports of the UN Informal Consultation Process; and the outcome of the UNFSA Review Process (see also: Molenaar, 2021; Lennan, 2024).

4.1 UN General Assembly resolutions on oceans and sustainable fisheries

The annual UNGA resolutions on oceans and the law of the sea first referred to the impacts of climate change on the oceans in 2006, stressing the importance of improving scientific understanding of the ocean-atmosphere interface (UNGA, 2006a). Similarly, the UNGA resolution on sustainable fisheries first mentioned climate change in 2007, to welcome FAO studies on climate change and fisheries, including adaptation options (UNGA, 2007a: Preamble). Since then, the UNGA has strengthened references to climate change in both resolutions, expressing concern about the observed and projected impacts of climate change and ocean acidification on the marine environment, coastal States (especially small island developing States), coastal communities, sustainable fisheries, and food security (e.g. UNGA, 2024a: paras. 195-196, 206, 207; UNGA, 2024b: paras. 12, 13). Both resolutions have encouraged States, directly or through relevant organizations or arrangements, to urgently strengthen scientific knowledge on the impacts of climate change and ocean acidification on the marine environment (UNGA, 2024a: paras. 197, 211, 298).

The goal of achieving resilient oceans, resilient coastal communities, and resilient food systems is explicitly stated (e.g. UNGA, 2024a: paras. 188, 189, 208, 212, 278). The resolution on oceans expresses concern for particularly vulnerable habitats and blue carbon ecosystems, including coral reefs, polar ecosystems, mangroves, tidal marshes and seagrasses, as well as plankton and other organisms with calcareous exoskeletons (UNGA, 2024a: paras. 210, 212, 275-279). It calls on States, individually or in collaboration with relevant international organizations and bodies, to "develop ways and means of adaptation, taking into account, as appropriate, the precautionary approach and ecosystem approaches" (para. 211). Blue carbon is highlighted for its mitigation and adaptation benefits (para. 212).

The resolution on sustainable fisheries encourages States to develop and implement adaptive fisheries management strategies directly or through subregional, regional or global organizations or arrangements (UNGA, 2024b: paras. 215, 258). Three specific adaptation measures or strategies are highlighted: the implementation of an ecosystem approach (para. 215); the protection of vulnerable ecosystems, especially those that are likely to better withstand the impacts of climate change (para. 232); and sustainable aquaculture development strategies, especially for developing countries (para. 264).

Both resolutions highlight the particular vulnerability of developing countries, especially small island developing States and least developed countries, and urge States to strengthen capacity building and technology transfer (UNGA, 2024a: para. 22; UNGA, 2024b: para. 18).

4.2 UN ocean conferences

In 2017 and 2022, the UN convened high-level conferences to support the implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development (UNGA, 2015). Each of these conferences has resulted in a multilateral declaration subsequently endorsed by the UNGA: "Our Ocean, Our Future: Call for Action" (UNGA, 2017a) and "Our Ocean, Our Future, Our Responsibility" (UNGA, 2022a). While the declarations address ocean governance in the context of multiple challenges, they express particular concern about the impacts of climate change on the marine environment, affirming that "climate change is one of the greatest challenges of our time" (UNGA, 2022a: para. 5).

Both Declarations refer to the need to adapt to climate change. In 2017, the UNGA called on States (and other relevant stakeholders) to develop and implement effective adaptation and mitigation measures to increase and support ocean and coastal resilience, and to address other harmful impacts of climate change on the ocean and coastal and blue carbon ecosystems. The 2022 Declaration reaffirms these commitments and adds some specificity. First, the Declaration refers not only to the development and implementation of measures to mitigate and adapt to climate change but also to avert, minimize, and address loss and damage. Second, it provides examples of such measures, including multi-hazard early warning systems, nature-based solutions, and ecosystem-based approaches, including for carbon sequestration (blue carbon) (para. 13.g). The Declaration also recognizes the role of sustainable fisheries and sustainable aquaculture in resilient food systems (para. 13.c).

4.3 The UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea

The UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea (the Consultative Process) has resulted in

further exchanges of views and ideas on how to address the impacts of climate change on the marine environment. The Consultative Process has addressed ocean acidification (UNGA, 2013), the effects of climate change on the marine environment (UNGA, 2017b), and sea level rise and its impacts (UNGA, 2021). Climate considerations have also been included in other sessions, including on the role of seafood in food security (2014), new marine technologies (2013), and oceans as a source of sustainable food (2024). While the outcomes of the Consultative Process do not reflect international commitments, the views expressed by States contribute to the effective negotiation of UNGA resolutions and the identification of emerging issues in the law of the sea. States have highlighted the importance of adapting to the impacts of ocean acidification by improving scientific knowledge; reducing the impacts of other stressors; using tools such as environmental impact assessments, marine protected areas, marine spatial planning and ecosystem management; and improving fisheries management (UNGA, 2013). States have also emphasized the need to enhance adaptation and build the resilience of coastal communities, strengthen capacity, provide financial resources, and promote the conservation and sustainable use of blue carbon ecosystems (UNGA, 2017b: 7-8).

4.4 The UNFSA Review Conference

The *United Nations Fish Stocks Agreement* (United Nations Fish Stocks Agreement, 1995), an implementing agreement of the LOSC, addresses the international obligation to cooperate in the conservation and sustainable use of straddling and highly migratory fish stocks, including through regional fisheries management organizations or arrangements (RFMO/As). The impacts of climate change on straddling and highly migratory fish stocks and on collaborative management arrangements have been addressed mainly through the UNFSA Review Conference, which opened in 2006 and was subsequently suspended and resumed in 2010, 2016 and 2023. Also relevant are the annual Informal Consultations of the Parties, which serve as a preparatory meeting for the Review Conference and also address specific issues arising from the Agreement's implementation.

In the more than 15 years since the Review Conference opened, there has been growing recognition of the impacts of climate change and the need for the fisheries sector to adapt. While the outcome of the 2006 Review Conference did not refer to climate change, it has been increasingly addressed in the resumed sessions. The Review Conference has reaffirmed the importance of the Paris Agreement, the 2030 Agenda and other policy instruments. It has recommended that States, individually and collectively through RFMO/As, adopt *inter alia* the following measures:

- Strengthen efforts to study and address the adverse impacts of climate change and ocean acidification on marine ecosystems;
- Explore ways to incorporate the consideration of the adverse impacts of climate change and ocean acidification, and their uncertainties into decision-making processes for the adoption of conservation and management measures, in line with the precautionary approach;
- Collaborate with diverse organizations and stakeholders to conduct research on the impacts and risks of climate change on straddling and highly migratory fish stocks, and identify options for reducing these risks and promoting the health and resilience of marine ecosystems;
- Encourage participation in the UNFCCC Ocean and Climate Dialogues; and contribute to capacity-building for developing States (UNFSA, 2023: Annex).

The Review Conference's contribution to strengthening the ocean-climate nexus has been hampered by difficult negotiations. Indeed, the "vast majority" (UNFSA, 2023: para. 140) of delegates at the resumed Review Conference in 2023 supported stronger language to address climate change mitigation and adaptation, but consensus could not be reached (IISD, 2023). For example, there was no agreement to include recommendations to study the impacts of climate change on fishing activities or to assess the institutional challenges that RFMOs may face in adapting to climate change (IISD, 2023). The 2023 Review Conference also failed to reach a consensus on including references to other recent developments, including references to the BBNJ Agreement and the Kunming-Montreal Global Biodiversity Framework (CBD, 2022) and its ambitious target to protect 30 per cent of marine and coastal areas. The stated reason for the objections was that "biodiversity and climate change adaptation and mitigation did not fall within the competence of regional fisheries management organizations and arrangements" (UNFSA, 2023: para. 140).

The most recent Informal Consultation of the States Parties to UNFSA focused on sustainable fisheries management in the face of climate change (UNFSA, 2024: Annex 1). A key message of this meeting, as summarized by the Chair, is that modern fisheries management tools and approaches (including adaptive management, precautionary and ecosystem approaches, and the protection of marine biodiversity), if effectively implemented, are an important means of mitigating the impacts of climate change on fisheries. However, the Informal Consultation also noted that further efforts are needed in several areas, including addressing the socio-economic, gender-related, and cultural impacts of climate change on fishers and coastal communities; strengthening scientific knowledge; sharing best practices; improving compliance; addressing the allocation of fishing opportunities; and integrating fisheries into climate change discussions. Participants noted that several international fora are already addressing fisheries in the context of climate change, but stressed the need to move discussions beyond high-level principles to practical guidance on implementation.

5 Adaptation initiatives under the Food and Agriculture Organization

As a specialized agency of the UN, FAO's mandate is to collect, analyze, interpret and disseminate information on nutrition, food and agriculture, including fisheries and aquaculture (Food and

Agriculture Organization of the United Nations (FAO), 1945: Art. I). The latter are mainly addressed by the Committee on Fisheries (COFI) and the Department of Fisheries and Aquaculture. Together, they play a critical role in the progressive development of international law and policy, including a role in treaty-making, the development of non-binding but influential international standards, and the provision of technical assistance to States and regional bodies (Lennan, 2024; Molenaar, 2021).

References to climate change were already included in the 1995 Code of Conduct for Responsible Fisheries, which calls on States to promote, *inter alia*, research on the effects of climatic or environmental changes on fish stocks and aquatic ecosystems (FAO, 1995: paras. 7.12, 12.5). The need to address the impacts of climate change on fisheries and aquaculture emerged again in 2007, when the Committee on Fisheries supported a proposal for FAO to undertake a scoping study to identify key issues related to climate change and fisheries and to initiate a discussion on how the fisheries sector can adapt to climate change (COFI, 2007: 12). Several outputs have been produced by FAO in response to this and other COFI requests (see Molenaar, 2021; Lennan, 2024). They include normative instruments, strategic instruments, and outcomes for technical assistance.

FAO has not yet produced a dedicated technical guideline on fisheries, aquaculture and climate change (Molenaar, 2021: 274-275). However, explicit references to adaptation are made in several policy documents, including the 2014 Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) (FAO, 2015a); the 2021 Declaration on Sustainable Fisheries (FAO, 2021b), and the 2024 Guidelines for Sustainable Aquaculture (GSA) (COFI, 2024b).

The SSF Guidelines make specific recommendations in the context of the differentiated impacts of climate change on SSF. The SSF Guidelines also recognize that the ability of fishing communities to adapt to climate change is linked to the protection of biodiversity and ecosystems, and call for the adoption of integrated and holistic approaches to address climate change and other human-induced and non-fisheries issues (FAO, 2015a: para 9.3).

In the 2021 Declaration on Sustainable Fisheries, States express their support for the implementation of integrated and coordinated multi-sectoral, evidence-based and ecosystem-based management approaches, as well as temporal and spatial planning to effectively address increasing external pressures, including climate change.

The GSA recognizes the need to transition towards climate-resilient practices in aquaculture and to enhance its mitigation potential. The GSA calls on States to develop adaptation and mitigation strategies, enhance national capacities for risk and vulnerability assessments, establish early warning systems, promote the adoption of best management practices, develop and adopt improved farming systems with greater adaptive capacity (including through genetic improvement), and develop and adopt climate-proofing innovations.

Adaptation to climate change has been integrated into FAO's core strategies (FAO, 2021a; FAO, 2022a; FAO, 2023). The Blue Transformation Roadmap (FAO, 2022b), which outlines the vision for FAO's work on aquatic food systems, prioritizes adaptation to climate change in each of its three pillars (sustainable aquaculture, sustainable fisheries and sustainable value chains), together with biodiversity conservation and human rights considerations. FAO has developed a draft set of actions for climate-resilient fisheries and aquaculture (COFI, 2024a) outlining its ongoing and future efforts in support of the Blue Transformation Roadmap.

Several FAO knowledge products aim to inform policy and build technical capacity for climate-smart fisheries and aquaculture (Angioni et al., 2023). They include technical reports on knowledge synthesis and projections of climate change impacts on fisheries and aquaculture (Barange et al., 2018; Blanchard and Novaglio, 2024), tracking adaptation efforts (FAO, 2017a), methodologies for climate vulnerability and risk assessment (FAO, 2015b; Comte, 2021), integrating of agrifood systems into climate change instruments (FAO, 2016; Brugère and De Young, 2020), guidelines to integrate human rights-based approaches to social disaster risk reduction and climate change action in small-scale fisheries (Cook et al., 2021), methods to assess the costs and benefits of adaptation options (Watkiss et al., 2019), and online resources (e.g. FAO, 2017b). Particularly noteworthy is a technical report providing guidance on adaptive management of fisheries in response to climate change (Bahri et al., 2021; see also Lennan, 2024). The report identifies fundamental principles for adaptive fisheries management systems: effective, participatory, precautionary, and adaptive (Bahri et al., 2021: 9-17). Building on case studies, the report identifies good practice adaptation measures, including, *inter alia*, enhanced monitoring programs through community-based approaches, early warning systems, flexible and adaptable fishing seasons, tradable fishing rights, relocation, diversification, and insurance schemes (Bahri et al., 2021: 23).

6 Ocean adaptation under nature conservation and biodiversity agreements

Ocean adaptation to climate change has been primarily advanced to varying extents under four global agreements. The roles of three main nature conservation agreements are first discussed: the Convention on the Conservation of Migratory Species of Wild Animals (1979) (CMS); the Convention on Wetlands of International Importance especially as Waterfowl Habitat (1971) (Ramsar); and the Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) (World Heritage Convention). How the broader Convention on Biological Diversity (1992) (CBD) has addressed ocean adaptation is subsequently highlighted. Climate adaptation under the *Climate adaptation under the Convention on International Trade in Endangered Species* (CITES) (1973), is not discussed since the narrow focus of CITES implementation has been on trade controls for listed endangered and threatened species (Clark, 2022; Tyrrell and Clark, 2014; Natural Resources Defense Council

et al., 2012; CITES, n.d.a) with no resolutions (CITES, (n.d.b.)) or active decisions (CITES, (n.d.c.)) regarding climate change.

6.1 Convention on Migratory Species

While the Convention itself, adopted in 1979, does not specifically mention climate change, the Convention does provide a framework for facilitating adaptive management to protect migratory species, including marine species, that cross one or more national jurisdictional boundaries (Trouwborst, 2012, 2024). For endangered migratory species listed under Appendix I, Range State Parties are required by Article III of the Convention to endeavor to provide various protections relevant to ocean adaptation including: to conserve and where feasible to restore habitats; to prevent, remove, minimize or compensate for the adverse effects of activities or obstacles that seriously impede or prevent migrations; and to prevent, reduce or control factors that are endangering or likely to further endanger the species. For species listed under Appendix II as having an unfavorable conservation status requiring international agreements for their conservation and management or having a conservation status that would significantly benefit from international cooperation, Article IV of the Convention encourages Parties to conclude agreements to benefit the species. Article V sets out guidelines for what elements should be included in agreements. Many of the elements are relevant to ocean climate adaptation including: research into the ecology and population dynamics of migratory species; conservation and restoration of habitats; maintenance of a network of suitable habitats taking into account migration routes; elimination to the maximum extent possible of activities and obstacles hindering or impeding migration; and the exchange of information on substantial threats to migratory species.

Two provisions of the Convention have been identified as potentially hindering climate adaptation efforts. One is the definition of "favorable conservation status", a key conservation objective under the Convention. Under Article I(1)(c)(4), one of the factors in determining a favorable status is that "the distribution and abundance of the migratory species approach historic coverage…" A focus on historical coverage would ignore ongoing and anticipated distributional shifts (Trouwborst, 2012). A second provision is the definition of "range" under Article I(1)(f)which employs the present tense. Thus, Range States include states where a given species is presently found but would exclude those states where the same species is predicted to occur in the future due to climate change. The status of Range State is important as it determines the possibility of joining relevant CMS daughter instruments but also invokes the obligations to strictly protect Appendix I listed species (Trouwborst, 2012).

Addressing ocean climate change adaptation under the convention framework has occurred on two main fronts, through resolutions and decisions of the COP. Resolutions have been issued to address climate change specifically but also to advance protection of migratory species from renewable energy technologies including offshore wind projects. Various resolutions on climate change and migratory species were adopted beginning at the COP 8 in 2005 with a repealing and consolidation of the resolutions occurring at COP 12 in 2017 and a further revised version of the Climate Change and Migratory Species Resolution being adopted at COP 14 in 2024 (UNEP/CMS, 2024a).

Resolution 12.21 (Rev. COP 14) encourages a long list of general actions relating to ocean climate change adaptation, which are set out in Annex 1. They include, among others: preparing adaptation action plans for CMS-listed species considered to be most vulnerable to climate change; identifying and prioritizing areas currently experiencing climate impacts that are most important to migratory species; ensuring ecological connectivity between sites to aid species dispersal and colonization when distributions shift; considering the designation of seasonal protected areas; expanding existing protected area networks to cover locations for potential colonization; undertaking vulnerability assessments for listed species; developing an understanding of migration routes and how they are changing; and subjecting major climate adaptation or mitigation projects to strategic environmental assessments and environmental impact assessments which consider impacts on migratory species. The Resolution also encourages various forms of cooperation including promotion of synergies on climate change actions amongst the CMS family of instruments and the strengthening of synergies with the Secretariats of other international environmental instruments and arrangements.

Resolution 12.21 (Rev. COP 14) also agreed on how the definition of "favorable conservation status" could be interpreted in light of climate change. Paragraph 10 of the Resolution suggests a climate friendly interpretation whereby taking conservation action beyond the historic range of species in order to ensure a favorable conservation status in the face of climate-induced range shifts would be considered compatible with, and may be required in order to meet, the objectives and the obligations of Parties under the Convention. The Resolution also encouraged the governing bodies of relevant CMS instruments to also approve the interpretation.

Specific CMS resolutions have also been adopted calling for various adaptation responses to protect migratory species from renewable energy projects. For example, Resolution 11.27 on Renewable Energy and Migratory Species, adopted in 2014 and revised in 2017, urges Parties and encourages non-Parties to implement an endorsed guidance document, Renewable Energy Technologies and Migratory Species: Guidelines for Sustainable Development (UNEP/CMS, 2014). The guidance document calls for the application of strategic environmental assessments and environmental impact assessment procedures when planning the use of renewable energy technologies and avoiding existing protected areas and other sites important to migratory species. It also suggests various adaptation measures in the construction and operation of ocean energy and wind energy projects. The Renewable Energy Resolution urges Parties to give priority attention to the possible impacts of ocean energy technology on migratory species from increased noise and electromagnetic field disturbances, especially during construction work in coastal habitats.

At COP 14, Parties through Resolution 14.1 adopted the Samarkand Strategic Plan for Migratory Species 2024–2032 which includes two targets especially relevant to ocean climate adaptation (UNEP/CMS, 2024b). Target 3.2 calls for significantly reducing by 2032 the direct mortality of migratory species caused by human-made infrastructure to levels that are not harmful to species' viability. Target 3.4 calls for reducing by 2032 the impact of climate change on migratory species and their habitats through mitigation and adaptation, including through nature-based solutions, and/or ecosystem-based approaches and disaster risk reduction actions, while minimizing negative and fostering positive impacts on biodiversity.

CMS COP decisions have also been relevant to ocean climate change adaptation. For example, at COP 14, among five decisions regarding climate change and migratory species (UNEP/CMS, 2024c), Parties are required under Decision 14.211 to incorporate the impacts of climate change on migratory species and their conservation in national adaptation plans, to develop and implement adaptation plans for migratory species and to place increased emphasis on the need for international cooperation to maintain and improve the connectivity of migration routes. Under Decision 14.214, the Scientific Council is asked to identify species having a high probability of changing their migration routes as a result of climate change and the connectivity options available to them. The Council is further charged with providing advice on how climate change work under the CMS could interact with implementation of the Kunming-Montreal Global Biodiversity Framework and the Paris Agreement. The Council is also requested to re-establish its Climate Change Working Group for the next triennium and to develop the Working Group's terms of reference.

Tracking how climate adaptation has been addressed under CMS subsidiary instruments, seven agreements (CMS, (n.d.a.)) and 19 memoranda of understanding (CMS, (n.d.b.)) with many covering marine species, is beyond the scope of this paper. However, substantial reviews of climate adaptation under the CMS daughter instruments are available (Caddell, 2024; Trouwborst, 2012).

A major limitation in CMS implementation of climate change related initiatives continues to be the limited number of Convention Parties and lack of regional participants. The Convention has 133 Parties (CMS, (n.d.c)) with no North American Parties and scant East Asian participation (for example not China and Japan). The Russian Federation with its vast offshore areas is also not a Party.

6.2 Convention on Wetlands

The Convention on Wetlands, commonly referred to as the Ramsar Convention because of its adoption in 1971 in the Iranian city of Ramsar (Ramsar Secretariat, 2016), provides a framework for protecting coastal wetlands important for both climate mitigation and adaptation purposes. Not only are saltmarshes, mangroves and seagrass beds powerful blue carbon sinks mitigating climate change, but coastal wetlands also serve climate adaptation functions including protection from storm surges and floods, drought buffering and provision of important habitats for species being stressed by climate change (Convention on Wetlands, 2021).

Adopted before climate change became a global concern, the Convention includes only general commitments by Parties for conserving wetlands (Ramsar Secretariat, 2016). Those commitments include: designating at least one wetland on the List of Wetlands of International Importance (Article 2(4)); promoting the conservation of wetlands on the List through national planning with a goal of achieving "wise use" (Article 3 (1)); tracking and reporting on ecological changes to listed wetlands due to technological development, pollution or due to human interference (Article 3(2)); establishing nature reserves on wetlands whether listed or not (Article 4(1)); and consulting with other Parties regarding implementation of the Convention especially in case of transboundary wetlands (Article 5). Wetlands are defined broadly under Article 1(1) to include areas of marsh, fen, peatland or water, whether fresh, brackish or salt water and marine waters to the depth of which at low tide do not exceed six meters. Pursuant to Article 2(1), Parties may choose to include islands or bodies of marine waters deeper than six meters when designating wetlands in the Ramsar List.

Consideration of climate change adaptation has been advanced primarily through various resolutions (Convention on Wetlands, 2023). Resolution X.24 on climate change and wetlands, adopted at COP 10 in 2008, recognizes the important climate adaptation roles of wetlands, such as enabling organisms to adapt to climate change by providing corridors and flyways along which they can move and attenuating flooding disasters, and urges Parties to maintain the ecological character of wetlands in the face of climate driven changes and societal responses. Resolution XI.14 on climate change and wetlands: implications for the Ramsar Convention, adopted at COP 11 in 2012, urges Parties among other things to improve the ecological character of wetlands and to promote the ability of wetlands to contribute to nature-based climate change adaptation. At COP 12 in 2015 Resolution XII.2 adopted The Ramsar Strategic Plan 2016–2024 which includes Target 12 calling for progress in restoring degraded wetlands with priority to wetlands relevant to biodiversity conservation, disaster risk reduction, livelihoods and/or climate change mitigation and adaptation. COP 13 in 2018 adopted Resolution XIII.15 which encourages Parties to incorporate the knowledge and practices of Indigenous peoples and local communities on climate change adaptation into management plans for wetlands, while Resolution XIII.14 encourages Parties to apply ecosystem-based and integrated management approaches to managing blue carbon ecosystems. Resolution XIV.17 on the protection, conservation, restoration, sustainable use and management of wetland ecosystems in addressing climate change, adopted at COP 14 in 2022, encourages Parties in their plans and strategies to deploy wetland-focused nature-based solutions or ecosystem-based approaches to address climate change.

Climate adaptation has also been addressed in publications by the Convention's Scientific and Technical Review Panel. Briefing Note 10 highlights the importance of wetland restoration for climate change resilience (Fennessey and Lei, 2018). Technical

Report 5 offers a framework for assessing the vulnerability of wetlands to climate change (Gitay et al., 2011). Technical Report 12 provides guidance on how wetland conservation can contribute to meeting targets of the Kunming-Montreal Global Biodiversity Framework including Target 8 on minimizing the impact of climate change and ocean acidification on biodiversity and increasing its resilience through mitigation, adaptation and disaster reduction actions (Convention on Wetlands, 2024). The Report recommends including targets and polices for wetland protection and restoration in National Biodiversity Strategies and Action Plans as well as in national climate mitigation and adaptation plans.

6.3 World Heritage Convention

Ocean climate adaptation currents also flow from the World Heritage Convention (Lyman et al., 2024). Adopted in 1972, the Convention calls on Parties to identify and propose listing of not only cultural sites but also natural sites of outstanding universal value on the World Heritage List, and Parties are obligated to ensure the protection, conservation and transmission to future generations of those cultural and natural heritage areas. The World Heritage List includes 51 marine sites (UNESCO, 2025a) such as Australia's Great Barrier Reef, the Belize Barrier Reef System, the Wadden Sea, and Papahānaumokuākea in Hawaii (UNESCO, 2025b).

While the impacts of climate change on World Heritage were considered in a climate change report (UNESCO World Heritage Center, 2007) and a policy document (UNESCO World Heritage Center, 2008), both adopted in 2007, two later climate-related publications have continued to place the spotlight on the roles of natural world heritage sites in addressing climate change. A Practical Guide to Climate Change Adaptation for Natural World Cultural Heritage Sites, published in 2014 (UNESCO World Heritage Center, 2014), provides guidelines to managers of natural heritage sites on how to factor climate change into management and action planning. It encourages adaptation planning involving various steps including: assessing the site to understand its sensitivity and vulnerability to climate change; assessing the capacity to adapt; considering adaptation options; analyzing different climate change scenarios; selecting and prioritizing actions; implementing the plan; and monitoring and evaluating the plan.

A Policy Document on Climate Action for World Heritage, adopted in 2023 (UNESCO, 2023), provides high-level guidance on enhancing the protection and conservation of heritage of outstanding universal value through climate action measures including climate adaptation efforts. The Policy sets a climate adaptation goal: By 2030, State Parties should establish and develop at the international, national and local levels, and implement at the site level, as appropriate, robust climate adaptation frameworks for their cultural, natural and mixed heritage, to be integrated in their national adaptation plans, as appropriate, that can demonstrate measurable progress on monitoring of climate hazards, assessing and reducing climate risks and vulnerabilities, and in doing so enhancing adaptative capacity and building climate resilience for all World Heritage properties (UNESCO, 2023: 7-8).

The Policy suggests various climate change adaptation actions including addressing non-climate threats and pressures in order to build resilience to climate change; designing adaptation responses based on the knowledge of Indigenous peoples and local communities; and recognizing World Heritage in national adaptation frameworks and other national policies for climate action. The Policy flags issues requiring further dialogue, such as whether a property should be inscribed on the List of World Heritage while knowing that its potential outstanding universal value may disappear due to climate change impacts and whether a property should be inscribed on the List of World Heritage in Danger or deleted from that List due to impacts beyond site control of the concerned State Party. The Policy encourages the World Heritage Committee to ensure the basic documents of the World Heritage system, such as Operational Guidelines and the Resource Manuals, adequately address climate change.

6.4 Convention on Biological Diversity

While the previous conventions protect specific species or habitats, the Convention on Biological Diversity (CBD) establishes obligations to conserve and sustainable use of terrestrial, coastal and marine biological diversity, including genetic, species and ecosystem diversity. Although the Convention does not specifically mention climate change even though being adopted in the same year as the UNFCCC in 1992, the Convention has provided a framework for addressing climate change including ocean adaptation through various general provisions (Prip, 2024). For example, the Convention requires Parties to: cooperate with each other and competent international organizations in addressing the conservation and sustainable use of biological diversity (Article 5); identify, monitor and manage activities which have or are likely to have significant adverse impacts on biological diversity (Articles 7(c) and 8(l)); establish a system of protected areas (Article 8(a)); restore degraded ecosystems and promote the recovery of threatened species (Article 8(f)); respect and preserve the knowledge, innovations and practices of Indigenous and local communities (Article 8(j)); and introduce biodiversity inclusive environmental impact assessment and strategic environmental assessment procedures (Article 14).

Specifically addressing the roles of biodiversity in mitigating and adapting to climate change has occurred under the CBD on three main fronts. The main avenue has been through specific Conference of the Party decisions on biodiversity and climate change adopted at each COP beginning at COP 7 in 2004 (Decision VII/15) through COP 16 in 2024 (Decision 16/22). A common theme among the decisions is the need to capitalize on the beneficial synergies between biodiversity conservation and climate mitigation and adaptation and the need for ecosystem-based approaches. Decision 14/5 adopted at COP 14 in 2018, advanced consideration of climate change adaptation in particular through

the adoption of voluntary guidelines for the design of effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction. The guidelines, attached as an annex to the Decision, encourage the application of key principles in planning climate adaptation and disaster reduction interventions, such as the precautionary approach, inclusivity and equity and adaptive management, and suggest stepwise approaches to designing and implementing effective ecosystem-based adaptation. Those steps include understanding the social-ecological system; assessing vulnerabilities and risks; identifying adaptation options; prioritizing and selecting ecosystem-based adaption options; designing and implementing a project plan; and monitoring and evaluation of the adaptation interventions.

A second avenue for addressing climate change and biodiversity has been through the setting of biodiversity goals and targets with the most recent directions to be achieved by 2030 set out in Kunming-Montreal Global Biodiversity Framework adopted through Decision 15/4 in December 2022. The Framework establishes a specific Target 8 for addressing climate change which is to "minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, including through nature-based solutions and/or ecosystem-based approaches while minimizing negative and fostering positive impacts of climate action on biodiversity". Other targets are also relevant to ocean adaptation, in particular: Target 1, ensuring all areas are under participatory integrated biodiversity inclusive spatial planning and/or effective management processes addressing land and sea use change; Target 2, ensuring at least 30 percent of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration; Target 3, ensuring at least 30 percent of terrestrial, inland water, and of coastal marine areas, especially areas of particular importance for biodiversity and ecosystem services are effectively conserved and managed through ecologically representative well-connected and equitably governed systems of protected areas and other effective area-based conservation measures; and Target 11, restoring, maintaining and enhancing nature's contributions to people including ecosystem functions and services through nature-based solutions and/or ecosystem-based approaches.

A third route for addressing the biodiversity and climate change nexus is through CBD technical reports. For example, Report No. 93, published in 2019, expands on the management implications of the voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and offers supplemental guidance on how the guidelines might be applied in specific sectors/areas including to marine spatial planning (Secretariat of the CBD, 2019). Technical report No. 85 published in 2016, provides a synthesis of experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction which includes case studies on protection and rehabilitation of degraded mangroves in the Sundarbans along the coasts of India and Bangladesh and a project exploring coastal resilience to climate change in Cameroon, Fiji and Tanzania (Lo, 2016).

7 Ocean adaptation in the human rights regime

Climate change and biodiversity loss threaten the full enjoyment of human rights, including the rights to life, health, food, a clean, healthy and sustainable environment, land and natural resources for Indigenous peoples, peasants and rural people, and self-determination (Danish Institute for Human Rights, 2024; Bennett et al., 2024). While international human rights treaties, including *inter alia* the *Universal Declaration of Human Rights* (UNGA (United Nations General Assembly), 1948), the International Covenant on Civil and Political Rights (1966) and the International Covenant on Economic, Social and Cultural Rights (1966), do not mention climate change or biodiversity, human rights bodies have addressed the implications of environmental degradation in general, and of climate change in particular, since at least 2008. Since then, there has been substantial and growing recognition of the interrelationship between human rights, on the one hand, and climate change and biodiversity loss, on the other. These links are now explicit in treaties and political declarations calling for human rights-based approaches to environmental and climate change action (e.g.: UNFCCC: Article 6(a); Paris Agreement: Preamble and Article 12; CBD: Art. 8(j); UN Resolution on the Right to a Clean, Healthy and Sustainable Environment (UNGA, 2022b); UAE Framework for Global Climate Resilience (UNFCCC, 2023b: para. 13); Kunming-Montreal Framework (CBD, 2022: para. 7(g)).

The content of States' human rights obligations has been progressively clarified by human rights tribunals and treaty bodies, special rapporteurs and academia (e.g. HRC, 2016, 2017, 2018a; UNGA, 2019, 2024c; Human Rights Committee, 2022; Knox, 2014; Rajamani, 2018; Atapattu, 2015). Human rights bodies have made clear that the duty to protect against interference with human rights applies to environmental degradation that harms human rights (Knox, 2014: 221) and to harmful impacts of climate change (Human Rights Council (HRC), 2009). Consequently, States have an obligation under human rights law to ensure the protection of individuals under their jurisdiction from human rights violations resulting from climate change or environmental degradation (Human Rights Committee, 2022: para 7.7; HRC, 2016: 17), including by implementing adequate adaptation measures (Human Rights Committee, 2022: para. 8.12) and adopting legal and institutional frameworks to assist those within their jurisdiction to adapt to the unavoidable effects of climate change (Human Rights Committee, 2022, para. 8.12). States are also obliged to respect, protect and consider their respective obligations on human rights when taking mitigation or adaptation measures (HRC, 2016: 20). The Framework Principles on Human Rights and the Environment (HRC, 2018) set out the basic obligations of States under human rights law as they relate to the enjoyment of a safe, clean, healthy and sustainable environment, including procedural and substantive obligations and obligations to vulnerable groups (HRC, 2016, 2017).

While these developments are not specific for the ocean, they apply to ocean-based climate change adaptation and mitigation. Recently, two documents have significantly contributed to clarifying

the content of human-rights based approaches to the conservation and sustainable use of the ocean and its resources. The Special Rapporteur on Human Rights and Environment issued the report "The Ocean and Human Rights" (HRC, 2024b), which was followed by a resolution on oceans and human rights adopted by the Human Rights Council (HRC, 2025). While these documents do not focus exclusively on climate change, they highlight the linkages between ocean and climate action, including the benefits of sustainable ocean management for climate governance and vice versa. Importantly the Human Rights Council decided to remain seized of the matter (HRC, 2025, para. 12), opening up opportunities for further clarification of human rights law in this context.

The Human Rights Council acknowledges the "urgency" of a human rights-based approach to ocean governance in addressing climate change (HRC, 2025). Both the Special Rapporteur and the Human Rights Council call upon States to incorporate a human rights-based approach in all relevant international negotiations and conferences relating to the oceans, including the UNFCCC, as well as national and local policies (HRC, 2025, paras. 5(a) and 6(a)). Implementing human rights-based approaches can inspire better ocean governance, promote sustainable development within planetary boundaries, and protect humanity and marine species (HRC, 2024b). These documents, and other human rights instruments, have provided further guidance on what such a human rights-based approach requires of States and other duty-bearers.

7.1 Procedural obligations

The Human Rights Council emphasizes the importance of participation, inclusion, transparency and accountability in the management of marine natural resources (HRC, 2025, para. 11). Procedural obligations are recognized as preconditions for the protection and enjoyment of other human rights. These include: a) collecting and disseminating information on the causes and consequences of climate change, including on biodiversity; b) undertaking comprehensive environmental and human rights impact assessments prior to authorizing and implementing activities, including responses to climate change, that might harm the ocean or coastal areas, or the right holders connected to them; c) providing for and facilitating public participation in decisions on climate adaptation; and d) providing for effective remedies (HRC, 2016: 13-16; HRC, 2018: Framework Principles 6-10; HRC, 2017; UNGA, 2024c; HRC, 2024b: para. 100(b),(l); HRC, 2025, Preamble, para. 5). Access to information and effective participation in decision-making are particularly important for marginalized and vulnerable groups including rural populations, peasants, small-scale farmers and fishers, Indigenous Peoples and local communities (UNGA, 2024c; HRC, 2025, para. 5(c)).

7.2 Substantive obligations

States have an obligation to establish, maintain and strengthen effective legal and institutional frameworks and to adopt substantive, non-discriminatory and non-regressive standards to regulate the activities of public and private actors to prevent, reduce and remedy harm to marine biodiversity and ecosystems (HRC, 2025, paras. 5(d)(g); HRC, 2018: Framework Principles 11-13; HRC, 2016: 17). States must promote sustainable ocean practices and prevent further severe and irreversible damage, including by protecting marine areas effectively, implementing the precautionary principle and ecosystem-based approaches, and prioritizing the restoration of ocean and coastal ecosystems (HRC, 2024b: 20-22; HRC, 2025, paras. 5(h) and 6(a)).

The Special Rapporteur on Human Rights and Environment calls on states to prioritize nature-based adaptation actions to maintain and enhance ecosystem services and to accelerate and scale up actions to strengthen the resilience and adaptive capacity of food systems and people's livelihoods (UNGA, 2019: 23; HRC, 2024b: 20).

States are also required to cooperate effectively with other States in establishing, maintaining and enforcing effective international legal frameworks to prevent, reduce and remedy transboundary and global environmental harms that interfere with the full enjoyment of human rights, and to advance the protection, conservation and remediation of the ocean and coastal areas (HRC, 2018: Framework Principle 13; HRC, 2025, para. 6(d)(e)).

Fisheries and aquaculture have been explicitly addressed in human rights documents, particularly those addressing the right to food in the context of climate change (e.g. HRC, 2024b; United Nations Secretary-General, 2023). Recommendations include:

- Transitioning to food systems that operate on the basis of natural processes, such as ecosystem-based fisheries and aquaculture management;
- Ensuring that climate change mitigation and adaptation projects do not adversely affect human rights, including the right to food;
- Increasing climate finance for adaptation measures and those to address loss and damage, including food system transformation, and making international climate financing accessible to local and national organizations to benefit those who are most adversely affected by climate change and food insecurity;
- Considering food systems transformation as an integral part of climate change mitigation and adaptation when formulating UNFCCC outcomes and decisions.
- Controlling and monitoring effectively industrialized fisheries (HRC, 2024a:21) and exercising "great caution around aquaculture" (HRC, 2024b: 21).

7.3 Obligations to vulnerable groups

States have heightened duties to members of certain groups that are most vulnerable to, or at particular risk from, climate change, including women, children, Indigenous peoples and traditional

communities (HRC, 2018: Framework Principles 14, 15). These heightened obligations are both procedural and substantive. Procedurally, States should assess the impacts of climate change and the impacts of mitigation and adaptation measures on vulnerable communities, including by collecting disaggregated data and implementing the Akwé: Kon Voluntary Guidelines [CBD, 2004; HRC, 2025, para. 6(h)]. They are also required to provide accessible information to vulnerable groups; and ensure early and meaningful participation in climate decision-making. Substantively, States should ensure that their laws and policies take into account the vulnerability of parts of the population to climate change and the barriers they face to exercising their human rights related to the environment. They must also ensure that, when establishing and implementing measures (including conservation measures and responses to climate change) they protect and respect the rights of Indigenous Peoples and non-Indigenous Peoples whose way of life depends directly on ecosystems (HRC, 2017), consistent with the UN Declaration on the Rights of Indigenous Peoples (UNGA, 2007b) and the UN Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNGA, 2018).

Obligations relating to vulnerable groups in the ocean context, including climate action, have been raised in particular for small-scale fishers and farmers, fish workers including women, and Indigenous peoples, given their dependence and cultural connections with ocean resources and often exacerbated vulnerability resulting from past and ongoing marginalization (UNGA, 2020). The Human Rights Committee has held in the context of climate adaptation that the right to privacy, family and home requires the protection of healthy ecosystems for Indigenous communities who depend on fish and marine resources for their subsistence and livelihoods, and that such a failure to protect is also a violation of the right to culture (Human Rights Committee, 2022: paras 8.9 - 8.14). In her report on Oceans and Human Rights, the Special Rapporteur also highlights obligations for the protection and special consideration of vulnerable and marginalized groups, emphasizing intersectionality (HRC, 2024b: 21).

To strengthen the adaptive capacity of these vulnerable groups, States are required, *inter alia*, to:

a. Respect, protect, and fulfil the rights of rural populations, peasants, small-scale farmers and fishers, and Indigenous peoples to access, own, use and manage land, territories and resources, including through the full implementation of the SSF Guidelines, and securing preferential access and co-management of coastal areas and resources [United Nations Secretary-General, 2023; HRC, 2024a, b: para. 100(e)];
b. Ensure their meaningful and effective participation in climate action [United Nations Secretary-General, 2023; HRC, 2024a, b: para. 100(e)];
c. Respect the right to contribute to the design and implementation of national and local climate change adaptation and mitigation policies [UNGA, 2018: Art. 18(3)];
d. Integrate the use of practices and traditional knowledge [UNGA, 2018, Art. 18(3); HRC, 2024a, b: para. 100(k)(j)(n)];
e. Increase investments to improve sustainable livelihoods and resilience, and increase climate financing for adaptation measures for, inter alia, *sustainable* use of ocean resources [United Nations Secretary-General, 2023; HRC, 2024b: para. 100(n)];
f. Increase investment in enhancing women's sustainable livelihoods and resilience and promoting their adaptive capacity, including for those working in fisheries (UNGA, 2022c: 23);
g. Provide adequate training (UNGA, 2018: Art. 25).

8 Discussion

Tracking relevant decisions and commitments on ocean adaptation reveals a tangled web of obligations, principles, instruments and institutional arrangements that already address the ocean-climate change-biodiversity-people nexus, to varying degrees. While the linkages may have been latent in earlier instruments and negotiations, they were explicitly recognized in the mid-2000s (e.g., by the CBD in 2004, the law of the sea regime in 2006-2007; Ramsar Convention in 2007; and human rights bodies in 2009) and increasingly integrated into agreements, strategies and policies in subsequent decades. This recognition coincides with the increasing attention to adaptation in the climate change regime, starting with the 2007 Bali Agreement, and its evolving conceptualization (Verschuuren, 2022; Orlove, 2022; Khan and Roberts, 2013). The explicit recognition, in the Paris Agreement, of the need to respect, promote and consider obligations on human rights and the importance of ensuring the integrity of all ecosystems, including oceans, is just one milestone in an ongoing process of understanding climate action, and climate adaptation in particular, as a holistic response to a complex problem.

Several commonalities offer promising avenues for strengthening coordination and coherence, but persistent challenges were also identified.

8.1 Commonalities and synergies

The obligations and commitments under the different legal regimes reveal several common principles or approaches, management tools and implementation mechanisms that can serve as conceptual and practical entry points for coordination and integration that bridge siloed legal regimes.

8.1.1 Following key principles and approaches

Legal regimes emphasize the need to adapt to climate change by implementing well-recognized approaches and principles which, if properly implemented, also contribute to the conservation and restoration of biodiversity, the resilience of ecological and social systems, and the protection of human rights, in particular of communities that depend on marine resources for their livelihoods and culture. These include the precautionary principle

or approach, the ecosystem or ecosystem-based approach, the principle of participation, and sustainable development.

The precautionary approach is recognized as a relevant principle in several binding and non-binding international instruments, which "has initiated a trend towards making this approach part of customary international law" (ITLOS (International Tribunal for the Law of the Sea), 2024a: para. 213). The principle or approach is explicitly recognized in the UNFSA, the BBNJ Agreement, the UNFCCC, the Paris Agreement, and the Preamble to the CBD, and implicitly in the LOSC. In the specific context of climate change, the ITLOS Advisory Opinion stated that the protection and preservation of the marine environment from the threats of climate change and ocean acidification requires the implementation of a precautionary approach [ITLOS (International Tribunal for the Law of the Sea), 2024a: paras. 213, 242, 361, 418, 425-426, 434, 441(4)].

The application of the precautionary approach in adaptation and disaster risk reduction planning is explicitly called for by the CBD (e.g. Decision 14/5) and UNGA (e.g. UNGA, 2024a, para 211). It is also identified as one of the fundamental principles of climate-adaptive fisheries management (Bahri et al., 2021). The human rights regime, in turn, also requires States to take precautionary measures to protect against environmental degradation causing harm to human rights, particularly when there is a threat of serious or irreversible damage [HRC, 2018, 2024a: 20; HRC, 2025, para. 5(h)].

The ecosystem approach and the ecosystem-based approach, often addressed together with nature-based solutions, are also recognized as key means to ensure nature-positive and equitable adaptation to climate change. Accelerating the use of ecosystem-based adaptation and nature-based solutions is a target in the UAE Framework for Global Climate Resilience, the Kunming-Montreal Global Biodiversity Framework (CBD, 2022: Target 8) and the Samarkand Strategic Plan for Migratory Species 2024-2032 (UNEP/CMS, 2024b: Target 3.4). Ecosystem-based adaptation and nature-based solutions are also emphasized by the NWP, the Ramsar Convention (Resolutions XIII.14 and XIV.17), the CBD (CBD Decision 14/5) and the Special Rapporteur on Human Rights and Environment (UNGA, 2019: 23).

Several guidelines for the establishment and implementation of nature-based solutions have been issued by different organizations, including a supplement to the UNFCCC Technical Guidelines for National Adaptation Plans (UNFCCC, 2021c), guidelines on integrating technology and nature-based solutions for coastal and marine adaptation (UNFCCC and IUCN, 2022), voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction (Secretariat of the CBD, 2019), and synthesis of experiences and best practices (Lo, 2016).

The ecosystem approach is also emphasized for fisheries management. The UNFSA Review Conference and the UNGA resolutions on oceans and sustainable fisheries recognize the importance of an ecosystem approach in developing ways and means to adapt and enhance the resilience of marine ecosystems (e.g. UNFSA, 2023: 30; UNGA, 2024b: para. 215). Ecosystem-based fisheries management is seen as an approach "that works with natural processes" and can contribute to transforming food systems to enhance food security and climate resilience (United Nations Secretary-General, 2023: 14).

The obligation of States to provide for and facilitate participation in decision-making is also widely recognized in the ocean context. Inclusive governance, ocean literacy and capacity building are emphasized as necessary for equitable ocean governance (UNFCCC, 2019b; UNGA, 2017a, 2022a; UNFSA, 2023). This is consistent with the procedural rights to a safe, clean and healthy environment, including the ocean [HRC, 2018: Framework Principle 15; HRC, 2024b: para. 100(e); HRC, 2025, 5 (c), (j)], even if not framed as such.

Particular attention has been given to the obligation to provide for early, meaningful and effective participation to Indigenous Peoples, local communities, small-scale fishers, youth, women, and other vulnerable local groups in ocean-based climate decision-making and climate adaptation initiatives, including through the integration of Indigenous and local knowledge into decision-making (UNFCCC, 2019b; SBSTA, 2021, 2022b, 2023, 2024a). The SSF Guidelines call for full and effective consultation with fishing communities in the development of mitigation and adaptation strategies, with particular attention to vulnerable and marginalized groups. Participatory governance, with explicit references to the participation of women and youth, is also recognized in the GSA, although not explicitly in the context of climate adaptation.

Sustainable development is another principle that has the potential to organize ocean-based adaptation in a way that takes into account and respects the obligations and commitments arising from different currents of international law. The Paris Agreement places adaptation in the context of sustainable development (Article 7.1). The link is also highlighted in the international regimes in this study, which call for taking into account, and seeking synergies with, the 2030 Agenda and the Sustainable Development Goals, in particular Goal 13 (UNGA, 2015).

8.1.2 Applying adaptive management tools

Several management tools are consistently mentioned in all regimes to facilitate ocean-based adaptation to climate change. As noted above, nature-based solutions are mentioned in all regimes in close connection with ecosystem-based approaches. In particular, the conservation and restoration of blue carbon are identified as actions that strengthen and enhance the resilience of people and nature while contributing to climate change mitigation.

All legal regimes recognize the contribution of well-designed area-based management tools to ecological integrity and ecological and social resilience. These include the designation of marine protected areas (e.g. UNGA, 2024a, 43; HRC, 2024a; CBD, 2022: Target 3) and marine spatial planning and integrated coastal zone management (e.g. UNFCCC, 2020; FAO, 2015a: 13; Ramar Resolution XIII.14; CBD, 2022: Target 1).

Other cross-cutting management tools include environmental impact assessments, strategic environmental assessments and risk and vulnerability assessments. Vulnerability assessments are a key

component of the dimensional targets for the iterative adaptation cycle in the UAE Framework for Global Climate Resilience. The need for vulnerability or risk assessments that include climate change is also highlighted for the aquaculture and fisheries sectors (COFI, 2024b; FAO, 2015b; Comte, 2021) and for threatened species (UNEP/CMS, 2024a).

An impact assessment of projects or activities is required under the LOSC, the CBD and human rights law (LOSC, Art. 206; CBD, Art. 14; HRC, 2025: 5), including for adaptation measures (ITLOS (International Tribunal for the Law of the Sea), 2024a). While the LOSC does not require (but also does not preclude) an assessment of social or human rights impacts (ITLOS (International Tribunal for the Law of the Sea), 2024a), such an assessment is required under human rights law and is consistent with the calls for comprehensive and holistic assessments of climate change impacts and of the measures to address climate change.

There is widespread agreement that management must be adaptive and flexible to respond to uncertainty and change. Adaptive management has been called for in particular in fisheries management (e.g. UNGA, 2024b; Bahri et al., 2021), but also in other contexts (e.g. UNFCCC, 2023b, para. 9g); UNFCCC, 2019b; CBD, Decision 14/5). Flexible management measures, such as seasonal protected areas, flexible fishing seasons and tradable fishing rights have also been highlighted (e.g. UNEP/CMS, 2024a; Bahri et al., 2021).

8.1.3 Encouraging regime coordination and cooperation

The legal regimes in this study have identified, and to some extent taken advantage of, opportunities to improve coordination through various implementation mechanisms. First, there is an opportunity to deliberately build synergies by aligning and referencing goals and targets in international strategic frameworks: the UAE Framework for Global Climate Resilience, the Kunming-Montreal Global Biodiversity Framework, Sustainable Development Goals, and the Samarkand and Strategic Plan for Migratory Species. This has been a particular focus of the UAE-Belém work program, but other initiatives have also sought to explore these synergies (e.g. Ramsar, Technical Report 12). Synergies can also be built at the regional or national level through explicit coordination of the implementation mechanisms under each regime: nationally determined contributions, national adaptation plans, national adaptation communications, national biodiversity strategies and plans, adaptation plans for migratory species, and other climate adaptation plans.

8.2 Challenges

Several challenges remain in coordinating and integrating international obligations and commitments for ocean-based adaptation action. These include getting full acceptance of international agreements and instruments, overcoming fragmentation and ensuring cross-regime cooperation, clarifying the content and increasing the ambition of ocean-based adaptation obligations, and closing the implementation gap.

8.2.1 Getting full acceptance of international agreements and instruments

A first obstacle is the inconsistent membership of States in international agreements, which affects potential cross-regime cooperation and integrated interpretation and implementation of relevant international obligations. One example is the limited ratification of the CMS, which may affect coordinated and climate-smart strategies for the conservation and recovery of marine migratory species. For areas beyond national jurisdiction, the BBNJ Agreement has yet to enter into force and its membership is likely to be patchy in the early years. Shifting global politics, including the announced withdrawal of the United States of America from the *Paris Agreement* [White House, 2025: s. 3(a)], further contribute to an uncertain and unstable law and policy framework, undermining efforts to mitigate and adapt to climate change, including finance and capacity-building.

8.2.2 Overcoming fragmentation and ensuring cross-regime cooperation

Cross-regime cooperation is also hampered by the lack of an international oversight body with the authority to make integrated decisions or recommendations on ocean management (HRC, 2024a). There have been several efforts to consider ocean issues in a more integrated manner, both generally and in the context of climate change. In addition to the UNGA, coordinated action on ocean is being sought through: the UN Open-ended Informal Consultative Process; the NWP Ocean Expert Group; the Ocean and Climate Change Dialogue; UN-Oceans; the UN Ocean Conference, and the Regional Fishery Body Secretariats' Network. Each of these bodies or initiatives has a different mandate and, despite some overlap, different membership. These efforts have counter-intuitively led to further fragmentation of the ocean institutional framework.

Overcoming fragmentation through integrated interpretation and implementation of international law also faces resistance from at least some States that seek to maintain siloed deliberations on sectoral issues. For example, in the proceedings for advisory opinions on climate change and international law at the International Tribunal for the Law of the Sea and the International Court of Justice, several States contended that climate change treaties are *lex specialis*, meaning that the treaties effectively set the ceiling for states responsibilities for climate change mitigation and adaptation. Similarly, some UNFSA Parties participating at the Review Conference opposed stronger language on the links between fisheries, climate change and biodiversity.

8.2.3 Clarifying the content and increasing ambition of ocean-based adaptation obligations

A further challenge is the general nature of the obligations to adapt or facilitate the adaptation of marine systems and human systems dependent on the marine environment, which are arguably insufficient

to achieve the required "coordinated sustained and increasingly ambitious adaptation actions (sic)" (IPCC (Intergovernmental Panel on Climate Change), 2019: 34) to address the climate crisis. This is in part a challenge common to international adaptation obligations (Nishimura, 2024), which must balance the need for global action with the sovereignty of States to adopt country-driven and context-specific solutions. The framework nature of the LOSC and the nature of its obligations to protect the marine environment, including from the impacts of climate change (obligations of conduct, obligations of due diligence, qualified obligations) also contribute to legal obligations whose content cannot be "easily be described in precise terms" (ITLOS, 2011: 43; ITLOS, 2024b: 4-8; Roberts, 2024: 160). Bennett et al. (2024) have argued that the recognition of a human right to a healthy (ocean) environment contributes to clarifying the minimum content of States' obligations under international biodiversity and climate change law and the law of the sea.

The "open texture" of some concepts contributes to implementation uncertainties. For example, and despite the cross-cutting calls for taking a precautionary approach, challenging questions for its implementation include: what level of threat should trigger adaptive precautionary actions (Hartzel-Nichols, 2014)? how strong should precautionary measures be (Vanderzwaag, 2013)? should the risks raised by ocean climate adaptation projects be weighed against the risks of climate change impacts (OECD, 2023)? when is an adaptive management approach (learn by doing) appropriate (IUCN, 2007)?

Similarly, the ecosystem approach is referred to differently in legal regimes: the law of the sea regime uses the term ecosystem approach or approaches, while the climate and nature conservation regimes most often use the term "ecosystem-based approaches", closely linked to nature-based solutions. This apparent distinction is most likely due to the law of the sea regime's sectoral (and arguably more limited) understanding and implementation of the ecosystem approach (UNGA, 2006b: Part A), but may also reflect a deeper normative dissonance (de Lucia, 2015).

Additionally, the ambition of States' commitments to climate change adaptation is inconsistent with the scale and urgency of the climate crisis. While there is remarkable common ground across legal regimes to address the ocean-climate-biodiversity-people nexus, this common ground is based on long-standing principles and tools for ocean conservation and fisheries management that have so far been insufficient to halt ocean degradation. While States have understandably focused on synergistic relationships, as evidenced by the widespread endorsement of nature-based solutions and blue carbon, they have for the most part not addressed conflicts of objectives, mandates, or practices. However, addressing these conflicts will be essential for the adoption of integrated ocean-based adaptation solutions, especially as climate change impacts intensify.

Tensions are already evident in the international instruments discussed in this article. For example, the Special Rapporteur on the Environment calls for effective control and monitoring of industrialized fisheries, prioritizing biodiversity conversation and small-fisher communities' rights (HRC, 2024a: para. 100(g); see also HRC, 2024b). However, State Parties to UNFSA have made limited and difficult progress in prioritizing biodiversity conservation objectives. Attention to the particular situation of subsistence, small-scale and artisanal fisheries and fishworkers, as well as Indigenous peoples in developing States, has only recently been addressed by the UNFSA Parties, despite the explicit requirement of Articles 5 and 24 (see UNFSA, 2023: 46; UNFSA, 2024; Engler, 2020). Similarly, while aquaculture is promoted as a climate adaptation solution with mitigation co-benefits (e.g. FAO, 2022b), the human rights regime calls for states to exercise "great caution" around aquaculture due to threats to humans and the environment [HRC, 2024b: 101(d)].

8.2.4 Closing the implementation gap

While this article does not address regional or national efforts towards ocean-based adaptation to climate change, there is evidence of insufficient implementation of adaptation solutions and limited evidence of demonstrated success (Miller et al., 2018; Bahri et al., 2021: 27). Factors hindering effective implementation include persistent knowledge gaps, lack of and unequal access to technology, lack of long-term and consistent funding and financial support, and insufficient capacity-building efforts (UNFCCC, 2019b) despite efforts by FAO and other international organizations. The adaptation finance gap has been well documented in general (UNEP (United Nations Environmental Programme), 2024), for ocean action (Ocean & Climate Platform, 2024), and for fisheries and aquaculture (FAO, 2024). It was also highlighted in the NWP, the Ocean and Climate Change Dialogues, and the Human Rights Council [HRC, 2025, para. 5(k)(l)].

Effective implementation is also hampered by the lack of international mechanisms to hold states accountable for meeting their commitments and obligations. Some mechanisms have been established, including the global stock take under the Paris Agreement or the performance reviews of RFMOs encouraged by the UNFSA Review Conference. Other existing mechanisms could strengthen State accountability by focusing on ocean and ocean-based action, as encouraged by the Human Rights Council (HRC, 2025: 6; Bennett et al., 2024). A cross-cutting accountability mechanism would contribute to the systemic integration of ocean-related commitments and obligations under international law. Further attention to the independent responsibilities of non-state actors, including business enterprises, may also be an important piece of the puzzle (Seck, 2023).

9 Conclusions

Ocean-based adaptation to climate change is being addressed by the entangled currents of several different international regimes. This article has tracked these normative currents by mapping the efforts undertaken in each regime, identifying commonalities that can be built upon, and identifying challenges that need to be addressed. The efforts in this article need to be complemented and expanded by a more focused analysis of the issues discussed and

by the inclusion of others that could not be addressed due to space constraints.

Several developments may drive bolder and holistic action on ocean-based adaptation. First, the ongoing process of selecting indicators for dimensional and thematic targets under the UAE Framework on Global Climate Resilience may provide ocean-specific and clear targets to drive collective action. Second, the entry into force of the BBNJ Agreement and the subsequent work of its COP may provide internationally accepted standards and recommended best practices and procedures that can help clarify the content of states' obligations to protect the marine environment, including from climate change.

Third, the Advisory Opinions of the International Court of Justice and the Inter-American Court of Human Rights will be issued later in 2025 or 2026, joining the ITLOS Advisory Opinion issued in May 2024. While the ITLOS Advisory Opinion may be considered underwhelming in its treatment of ocean-based adaptation, the three opinions together offer a unique opportunity to delineate the role of each international regime, individually and collectively, in addressing climate change adaptation in the ocean context. Finally, the growing use of climate litigation may help to clarify the content of legal obligations for ocean-based climate change adaptation and hold states accountable.

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Conflict of interest

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