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**Analysis of global and regional policy instruments and governance
mechanisms related to the protection and sustainable management
of coral reefs**

Note by the secretariat

Summary

The annex to the present note sets out an analysis of global and regional policy instruments and governance mechanisms related to the protection and sustainable management of coral reefs, as requested by the United Nations Environment Assembly of the United Nations Environment Programme in its resolution 2/12 on sustainable coral reefs management (UNEP/EA.2/Res.12). The analysis was prepared by the United Nations Environment Programme in collaboration with the International Coral Reef Initiative and Duke University and with the guidance and support of an advisory committee made up of 23 experts nominated by 14 member States. It encompasses 232 international policy instruments directly or indirectly supporting the conservation and sustainable management of coral reef ecosystems and/or addressing anthropogenic drivers of change in those ecosystems. Recommendations for action by member States are set out both in the analysis and in the accompanying report of the Executive Director on progress in the implementation of resolution 2/12 (UNEP/EA.4/23). The annex is presented without formal editing.

* UNEP/EA.4/1/Rev.1.

Annex

Analysis of global and regional policy instruments and governance mechanisms related to the protection and sustainable management of coral reefs

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Abbreviations/Acronyms

BPOA	Barbados Programme of Action
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CMS	Convention on Migratory Species
COBSEA	Coordinating Body on the Seas of East Asia
CoP	Conference of the Parties
CTI	Coral Triangle Initiative
DFI	Development Finance Institute
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GPA	Global Program of Action for the Protection of the Marine Environment from Land-based Activities
ICRI	International Coral Reef Initiative
ICT	Information and Communications Technology
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated fishing
LME	Large Marine Ecosystem
MARPOL	International Convention for the Prevention of Pollution from Ships
MEA	Multilateral Environmental Agreement
MPA	Marine Protected Area
NBSAP	National Biodiversity Strategy and Action Plan
NCTF	National Conservation Trust Fund for Natural Resources
POP	Persistent Organic Pollutant
SAP	Strategic Action Programme
SDG	Sustainable Development Goal
SES	Socio-Ecological Systems
SIDS	Small Island Developing States
SPREP	South Pacific Regional Environment Program
SSF	Small-Scale Fisheries
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea

UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
UNEP- WCMC	UN Environment World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
VMS	Vessel Monitoring System
WSSD	World Summit on Sustainable Development
WWF	World Wide Fund for Nature

Summary

Rationale for the Analysis

Warm-water coral reef ecosystems worldwide have undergone rapid and accelerating changes over recent decades. This has been driven by increasing concentrations of greenhouse gases in the atmosphere and subsequent sea surface temperature increases, as well as multiple other pressures associated with human activity. The Intergovernmental Panel on Climate Change projected in 2018 that the world's coral reefs will decline by a further 70 to 90 percent with a 1.5 degree Celsius increase in the global mean temperature from pre-industrial levels (with losses greater than 99 percent with a 2 degree Celsius increase). This pattern is not expected to be uniform and some reefs may be more resilient than others to such stress, while others may be degraded at a lower global mean temperature increase. For these reasons, the Intergovernmental Panel on Climate Change states with high confidence that coral reefs are one of the world's most vulnerable marine ecosystems to climate change.

Additional anthropogenic drivers of coral reef change, such as overfishing and pollution, affect a large portion of the world's reefs. In addition to causing widespread reef degradation, these locally-generated drivers reduce the resilience of coral reefs to climate change, exacerbating the response of coral ecosystems to elevated sea surface temperatures. Reductions in the cumulative impacts of multiple locally-generated stressors can help enhance the integrity and resilience of coral reef ecosystems in the face of bleaching events.

The international community has committed on numerous occasions to coordinated policy responses to the changes observed and projected in coral reef ecosystems. Even as many states work to translate these commitments into local action, the intensity of the drivers of change and the estimated rates of change in coral reef ecosystems have only increased. Mindful of this challenge, in 2016 the United Nations Environment Assembly passed Resolution 2/12 Sustainable Coral Reef Management, reiterating the need for international cooperation for the protection of coral reef ecosystems, and calling for national governments to prioritize this effort, drawing upon technical and financial support from donors when necessary. Specifically, the resolution called on the United Nations Environment Program, in cooperation with the International Coral Reef Initiative and other relevant organizations and partners, to prepare an analysis of global and regional policy instruments and governance mechanisms related to the protection and sustainable management of coral reefs.

The design of the current body of international policy was assessed in comparison to the intensifying anthropogenic drivers of change affecting coral reefs. The analysis focused on gaps in the design of international instruments to address the drivers, including the governance mechanisms they created, and possible options for addressing these gaps. As a first step, the written agreements of relevant global and regional instruments were identified and compiled into an inventory that served as the data set for analysis. The content of the written agreements describing these instruments was then analyzed to identify the commitments made in each document, and assess any gaps between these commitments and the various drivers of change, the strength of these commitments, and the governance mechanisms established to deliver them.

Summary of Key Findings

The current body of international instruments related to coral reefs is vast and broad, with commitments corresponding to almost every anthropogenic driver of change in coral reef ecosystems. There are at least 232 international instruments considered to directly or indirectly support conservation and sustainable management of coral reef ecosystems, and/or address common anthropogenic drivers of change in these systems. This body of international coral reef-related instruments has developed incrementally since the 1960s, and includes 150 global instruments, of which 29 are legal instruments (i.e. binding), under which most of the rest are 'nested' as voluntary instruments (i.e. non-binding). In addition, there are 82 regional instruments, 44 of which are legal. This includes a total of 32 Regional Seas instruments. The body of international reef-related instruments includes

at least 591 discrete commitments to address the wide range of anthropogenic drivers of change in coral reef ecosystems.

This international policy framework includes a large number of targets to achieve specific outcomes relevant to coral reef ecosystems or the anthropogenic drivers of change affecting them. The instruments include 79 discrete global targets that are time-bound and measurable (14 percent of which have expired), as well as 59 regional targets. More than half (53 percent) of these are found in just nine instruments: the Global Program of Action for the Protection of the Marine Environment from Land-based Activities, the Convention on Biological Diversity Strategic Action Plan 2011-2020, the Paris Agreement and the 2030 Agenda for Sustainable Development (global instruments); the Coral Triangle Initiative Regional Action Plan, the Secretariat of the Pacific Regional Environment Program Action Plan 2011-2015, Bay of Bengal Strategic Action Program, Arafura Timor Seas Strategic Action Program and the Western Indian Ocean Strategic Action Program (regional instruments). Taken together, the international reef-related instruments provide a comprehensive if broad set of measurable, global targets to address most of the anthropogenic drivers of change in coral reef ecosystems. For example, these targets include commitments to hold the increase in the global average temperature to well below 2 degrees above pre-industrial levels; to end overfishing and illegal fishing and effectively regulate harvesting; to prevent and reduce marine pollution of all kinds; to conserve at least 10 percent of coastal and marine areas; and the now overdue Aichi target 10 to minimize the multiple anthropogenic pressures on coral reefs by 2015, so as to maintain their integrity and functioning.

This broad body of international reef-related instruments is focused on action by states, who have the primary responsibility for some 75 percent of the commitments. Within this body of international instruments, the United Nations Convention on the Law of the Sea treaty provides the legal framework within which all activities in the oceans and seas must be carried out, and establishes the rights and commitments of States within different maritime zones. In the territorial sea, coastal states exercise sovereignty over their natural resources. In the exclusive economic zone, coastal states have the sovereign rights to explore, exploit, conserve and manage natural resources, whether living or non-living. On the continental shelf, coastal states exercise sovereign rights for the purpose of exploring it and exploiting its natural resources, which consist of the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species. In both the exclusive economic zone and on the continental shelf, coastal States also have jurisdiction with regard to marine scientific research. The United Nations Convention on the Law of the Sea treaty also establishes the general obligation for states to protect and preserve the marine environment.

By virtue of the maritime zones established under the United Nations Convention on the Law of the Sea Treaty, some 85 percent of the world's warm-water coral reefs are under the jurisdiction of 25 countries. These 'coral reef states' essentially function as quasi-trustees of the world's warm-water reefs.

The majority (over 85 percent) of international reef-related policy commitments are planning and process-oriented. These focus on various forms of planning that states should or are required to conduct in order to develop rules and responses to locally-generated anthropogenic pressures on coral reef ecosystems. Some of the most common objectives of the commitments include: (i) stabilizing atmospheric concentrations of greenhouse gases and reducing emissions, while supporting adaptation in developing states and particularly SIDS; (ii) regulating harvesting of fish resources to conserve and manage stocks at targeted levels through science-based limits and measure to protect associated ecosystems, with a priority on support to small-scale fisheries; (iii) conducting integrated planning processes to prevent, reduce and control various sources of ocean pollution, together with environmental impact assessments and particularly an emphasis on waste treatment capabilities; (iv) regulating oil pollution from offshore oil and gas extraction, as well as shipping; and (v) addressing physical restructuring of the coastline together with multiple anthropogenic pressures on coral reef ecosystems or coastal and marine ecosystems more broadly, typically through area-based planning and regulation, such as integrated coastal zone management and marine spatial planning, and networks of marine protected areas.

While the breadth of international coral reef-related instruments is vast, the ‘depth’ is less so – i.e. the nature of the commitments by states are quite general, and largely voluntary. Many of the commitments are focused on “marine and coastal ecosystems” in general or on the various economic sectors of human activity that may driver changes in coral reef ecosystems, rather than on coral reef ecosystems themselves. These commitments are nonetheless applicable to coral reefs even if not focused on them. For the majority of these broad commitments (52 percent), the ‘strength’ or robustness of the commitment could be considered weak (i.e. the commitment is not required, and contained in a voluntary instrument), while only 17 percent were considered as strong (i.e. required, in a binding instrument). Of course, simply because the strength of a commitment is characterized as the weakest possible, does not mean that it would not be met by states or deliver impact, but simply that the requirement upon states to do so is relatively weak.

Although states have the primary responsibility to deliver the vast majority of the international commitments, relatively few governance mechanisms have been established by the instruments to support them to do so. The efficiency of the international instruments depends upon the mechanisms through which they function, such as enforcement mechanisms and financing mechanisms. Of the 591 reef-related commitments, only 13 percent were linked to references of enforcement mechanisms. Of these, one sixth were commitments in the United Nations Convention on the Law of the Sea treaty. These typically require states to ‘adopt and enforce’ the measures needed to deliver the commitments in the instrument, and in some cases the global, legal instruments require states to report to the conferences of the parties to monitor progress. In addition to the United Nations Convention on the Law of the Sea, another third of the reef-related commitments matched to references of enforcement were contained in Regional Seas instruments. With relatively few enforcement mechanisms or penalties specified in the body of international reef-related instruments, many states may not have incentive to comply with commitments, particularly in low and lower-middle-income economies with competing demands for scarce public resources. Hence, more of the instruments emphasize ‘the carrot’ rather than ‘the stick’, i.e. economic incentives rather than penalties and enforcement.

Most of the instruments are not linked to financial mechanisms to help fund the associated costs, presenting a challenge for the many low-income and lower-middle-income states with responsibility for delivering reef-related commitments. Of the 591 reef-related commitments, roughly 25 percent make reference to financing provisions or mechanisms. The proportion is much higher among commitments related to climate change. However, few of these references actually describe the establishment or enhancement of financial mechanisms, but rather most can be characterized as general calls for developed states and development finance institutions to provide additional financing as needed to support delivery by developing states. The few financial mechanisms created by the reef-related international instruments were established in response to global, binding conventions such as the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change and the Stockholm Convention. These mechanisms share common features that include: (i) generation of new and additional resources, (ii) provision of financing on a grant or concessional basis, (iii) governance by the Conference of the Parties, and (iv) operation by a development finance institution, e.g. the Global Environment Facility.

Coordination across the 232 international reef-related policy instruments and the 591 commitments they contain presents a particular challenge. Few mechanisms have been established or designated by the instruments to explicitly promote coordination, though in practice financial mechanisms may contribute to this. The state-centric nature of the commitments requires flexibility for governments to craft locally-appropriate responses, with focus on integrated national and in some cases regional-level planning processes. However, given both global targets to reduce anthropogenic pressures on reefs and differentiated capacity to address them across states with jurisdiction over reefs, coordination of efforts at regional and global levels will likely be required.

Conclusions and Recommended Action

While most of the world’s warm-water coral reef ecosystems are under the jurisdiction of just twenty-five states, the existential threat to these systems is globally widespread, beyond the reach of any one state or other entity. The Paris Agreement is the primary international instrument for responding to climate change, aiming to

hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (at which a further 70 to 90 percent of the world's coral reefs are projected to decline). Achieving this target depends on voluntary, non-binding actions by states.

Because the effects of multiple anthropogenic drivers of change on coral reef ecosystems are cumulative, efforts to address the locally-generated drivers can enhance the integrity and resilience of these ecosystems in the face of climate change. For example, heat-stress induced bleaching is a stress response in corals, the impacts of which may be exacerbated by localized stresses (e.g. extraction of reef fish, input of pollutants, physical loss, etc.). As such, commitments aiming to address locally-generated drivers of change in coral reef ecosystems have become even more urgent as the climate changes.

Given the urgency, this analysis attempts to answer the question: what role can international policy play in helping states to address the locally-generated anthropogenic drivers of change in coral reef ecosystems, in order to enhance their resilience and potential for survival in the face of globally-widespread climate change? To answer this question, an analysis was conducted of the design of international reef-related instruments. The results of the analysis suggest that instruments have been broadly designed to address the known drivers of change. However, given the ecological outcomes measured (e.g. continued decline in reefs and a projected acceleration in this decline under climate change), the key gap is assumed to be in the effectiveness of delivery at the national level (given that an estimated 85 percent of warm-water coral reefs are under the jurisdiction of 25 states). Potential pathways for international policy to help enhance national-level delivery have been identified on the basis of this assumption.

This analysis identifies at least four potential pathways by which international policy responses can help coral reef states address local drivers of reef loss and enhance coral reef resilience (and potential for survival) in the face of climate change. These potential pathways provide distinct but not mutually exclusive strategic approaches to support discussion and agreement on a way forward by the Environment Assembly. Given the large body of international reef-related instruments and commitments that already exists for almost all known locally-generated drivers, all potential pathways entail accelerating delivery of existing commitments (i.e. implementation). This may be further augmented by revising the existing policy and governance framework with a view to strengthen it, and/or establishing new instruments or mechanisms. ***Business as usual, which could be considered a fifth distinct potential pathway, is not a viable option for sustainable coral reef management.***

1. ***Option One: Maintain the current international reef-related policy framework as designed, but with a focus on accelerated implementation at the national level.*** This would be based on a renewed commitment from states to address drivers of change in coral reef ecosystems, and could include the following actions:
 - i. conducting *analysis or review of reef-related policies at the national and sub-national level*, drawing on the analytical framework and methods used for this analysis, to assess the extent to which current international commitments have been translated into national policy, strategic and institutional frameworks. This would enable identification of gaps, including a self-audit by states of national policies to deliver the current commitments in international instruments; and
 - ii. states develop *integrated implementation plans* for delivering the international commitments, with an emphasis on supporting national and sub-national implementation of policies, analyzing, articulating and taking into account the social and economic benefits from implementation, utilizing existing management tools, and identifying any technical and financial support needed.
2. ***Option Two: Strengthen the existing international policy framework.*** In addition to efforts towards accelerated implementation, the current policy framework may be further revised to strengthen mechanisms and incentives for states to implement their commitments. This could also include ensuring that the mandate and means of relevant international organizations enable them to effectively assist states to accelerate implementation. The following actions may be considered:

- i. the United Nations Environment Assembly could *invite states to ratify those global, binding international policy instruments* where further support is needed, and to report regularly on progress toward national delivery of international commitment;
 - ii. *regional policy instruments may be amended*, including to expand the mandate of existing mechanisms such as Regional Seas Conventions and Action Plans and associated instruments;
 - iii. states participating in the International Coral Reef Initiative may task it with an expanded role e.g. in relation to *monitoring progress* in implementing international commitments at the national level;
 - iv. development finance institutions, such as the World Bank, regional development banks and infrastructure investment banks may adopt ‘*coral reef safeguards*’, e.g. coral reef-specific guidance for implementation of the existing environmental safeguards applying to all projects that they finance, ensuring consideration of potential impacts on coral reef ecosystems; and
 - v. states could agree on *a new global coral reef target*, that would be quantifiable and ambitious in order to address the various drivers, as part of the post-2020 global biodiversity framework following the Aichi targets.
- 3. Option Three: Introduce new international instruments and/or governance mechanisms.** Options one and two focus on the existing international body of policy. This may be further augmented through the introduction of new instruments and/or mechanisms addressing key challenges and gaps. As mentioned previously, existing commitments are largely considered to be ‘weak’ in terms of the requirements placed on states, and mechanisms to support delivery are often missing. This suggests an option for either a new global legal instrument focused solely on coral reefs, and/or a new international mechanism to support national-level implementation of reef-related commitments. Options include the following:
- i. states agree on *a new global instrument specific to coral reefs*, for example a treaty or convention on coral reefs, with specific targets for different drivers of change and governance mechanisms to support delivery (including monitoring and reporting);
 - ii. states agree on *a new instrument nested under an existing or emerging instrument* (such as a target and associated plan specifically on coral reefs in the post-2020 global biodiversity framework under the Convention on Biological Diversity, specific instruments in the context of the 2030 Agenda for Sustainable Development and/or under the United Nations Framework Convention on Climate Change; and/or
 - iii. states agree to create *a new mechanism* to support national-level delivery of existing reef-related policy commitments, including a new financing mechanism specifically for coral reef ecosystems, such as a global fund for coral reefs (e.g. a ‘Coral Environment Fund’) to provide grant or concessional financing to low-income states to advance progress towards existing targets and international policy commitments, and/or a new global monitoring and reporting mechanism, e.g. in the form of a coral reef commission or forum under the United Nations.
- 4. Option Four (consolidated from the three previous): Rapid support to states for policy implementation, i.e. “the coral reef-state solution”.** Importantly, the three options described above are not mutually exclusive, and could be combined into various packages. As one example, a fourth option is presented, consolidating from the three pathways above, to focus on policy delivery in the relatively small states with jurisdiction over the world’s warm-water coral reefs (e.g. 85 percent of these reefs are under the jurisdiction of twenty-five states), including the following actions:
- i. coral reef states conduct *a self-audit of national policies* to deliver the current commitments in international instruments and develop implementation plans for policy delivery, identifying any technical and financial support needed;
 - ii. states may create *a new overarching international monitoring group* (e.g. a ‘coral reef policy observatory’), or task the International Coral Reef Initiative with the role (in consultation and cooperation with competent international organizations), to be responsible for monitoring progress in implementing international commitments at the national level in coral reef states; and

- iii. states agree to create *a new financing mechanism* specifically for coral reef ecosystems, such as a global fund for coral reefs to provide grant or concessional financing to low-income and lower-middle-income coral reef states through an existing institution such as the Global Environment Facility.

Considerations in advancing along a pathway (as described above or some combination of them, as illustrated by the example in the fourth option) depends upon the nature of the main constraint on states' delivery of international instruments. For example, reefs may not be prioritized in national agendas because they are lost among all of the other commitments and objectives in the current body of international reef-related instruments. If national prioritization is the main constraint, then perhaps a new international instrument may be introduced to help strengthen states' efforts, or reef-specific commitments could be featured prominently in a new treaty. If capacity to effectively translate internationally adopted provisions into national action is a primary constraint, a new mechanism and/or strengthening of existing instruments to accelerate delivery may be considered.

Addressing human and financial capacity challenges is crucial, irrespective of what coral reef policy pathway is pursued. Limited capacity is a key obstacle to meeting international reef-related commitments in many countries, including in particular Least Developed Countries, Small Island Developing States and other developing countries. Efforts to build capacity that supports effective coral reef policy development and implementation at international as well as national levels need to be strengthened. In this regard, it should be noted that mobilization of additional resources and providing for exchange of information, experiences and lessons learned are among one of the biggest advantages associated with adoption of international instruments.

A new financial mechanism to provide additional resources could help states fill the capacity gap. The urgent need to increase and diversify funding for coral reefs has been recognized. A new financing mechanism specifically for coral reef ecosystems, such as a global fund providing grant, concessional and/or investment financing to advance progress towards international targets and commitments, could deliver significant socio-economic and marine biodiversity benefits, and is a key pillar of the third and fourth pathways identified above.

Because coral reefs are transboundary and a global priority, international policy continues to be a critical tool for sustainable coral reef management. Most coral reefs are under national jurisdiction and while it is difficult to characterize them as global public goods as a basis for collective action, they do have characteristics of common pool resources (or quasi-public goods). Interdependence on a shared resource is typically the rationale for collective action and new investment. There is also a rationale for collective action for a 'common concern of humankind'. Such a shared concern, even if not a shared resource, can be a basis for collective action and was part of the rationale for the Convention on Biological Diversity. More specifically, a common concern of humankind can be a rationale for international cooperation and aid to lower income states, under whose jurisdiction much of the warm-water coral reefs are located. The pathways and actions proposed are not mutually exclusive, and should be seen as part of a package to meet relevant Sustainable Development Goals. As the post-2020 global biodiversity framework is developed, and the 2020 ocean conference approaches to assess the status of implementation of SDG 14, these options or some combination of them would likely be a central piece of any coordinated action by states.

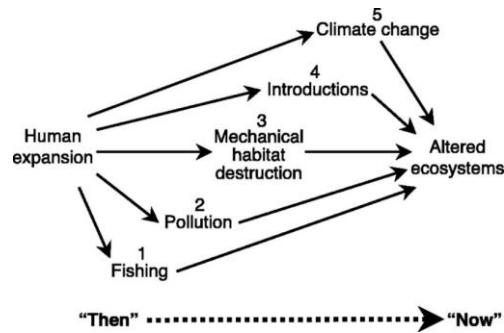
I. Introduction: Rationale for the Analysis

1.1 Overview of the recent and projected human-driven changes in coral reef ecosystems

Concern over the relatively rapid and accelerating changes in the structure and functioning of coral reef ecosystems around the world has featured prominently in the news in recent months and years, with 2018 declared as the third International Year of the Reef by the International Coral Reef Initiative.^{i, ii, iii, iv} For example, in 2016 the northern third of Australia's Great Barrier Reef (as well as other countries, like the Maldives)^v experienced an unprecedented loss of corals after a marine heatwave and global bleaching event, transforming the ecological functioning of 29 percent of the 3,863 reefs comprising the world's largest coral reef system.^{vi} While such bleaching events have become more frequent in recent decades,^{vii} the most recent global scientific assessment of the status of coral reef ecosystems occurred in 2008 – estimating that 19 percent of the world's coral reefs had been heavily degraded over the preceding century, another 15 percent were considered to be under imminent threat of loss under the next 10 to 20 years, and another 20 percent were under threat of loss in 20 to 40 years.^{viii} At regional scales, a number of studies have estimated a similar extent of coral loss. For example in the Caribbean, a meta-analysis showed that average hard coral cover on reefs across the entire Caribbean basin was reduced by 80 percent between 1977 and 2001, and particularly after the bleaching event of 2005.^{ix, x} Another multi-decade time-series analysis of coral cover for 88 Caribbean locations shows an average decline of 53 percent between 1970-83 and 1999-2011.^{xi} Similarly, in the Indo-Pacific region, analysis of a coral cover database of over 6,000 surveys of 2,667 coral reefs performed between 1968 and 2004 showed an estimated annual coral cover loss of approximately 1 percent over the period from 1983 to 2003, and 2 percent between 1997 and 2003, though the status of reefs in the Pacific islands was considered healthy in 2011 (amid signs of future decline).^{xii, xiii} More recent analyses show relatively stable average live coral cover with high variability across locations and species in the Pacific region.^{xiv} Another recent report shows an increasing trend in Western Indian Ocean coral mortality due to bleaching events, with up to 30-50 percent due to the 1998 event and up to 10 percent due to the 2016 event.^{xv} Lastly, over 2,000 surveys conducted over a 27-year period (1985 – 2012) on 214 reefs along the Great Barrier Reef showed a loss of over 50 percent of initial coral cover.^{xvi}

The changes in coral reef ecosystems over the last century have been driven by the same types of human activity intensifying throughout the oceans and along coasts with the advent of industrial fishing and the rapid expansion of coastal development and population growth (see Figure 1 below).^{xvii, xviii, xix} As one of the first human drivers of change in ocean ecosystems, overfishing was followed by pollution from largely land-based sources that increased significantly from pre-industrial levels, for example with anthropogenic inputs of nitrogen and phosphorus into estuarine and coastal ecosystems more than doubling during the 20th century and scientifically-reported low-oxygen zones in coastal waters increasing exponentially between the 1960s and 2008.^{xx, xxi, xxii} Coastal development has also grown exponentially over the 20th century as the global population generally migrated towards the ocean, with the coastal zone now home to an estimated 38 percent of the worldwide population.^{xxiii, xxiv, xxv} By 2011 the combination of these drivers was suggested to threaten more than 60 percent of the world's reefs.^{xxvi}

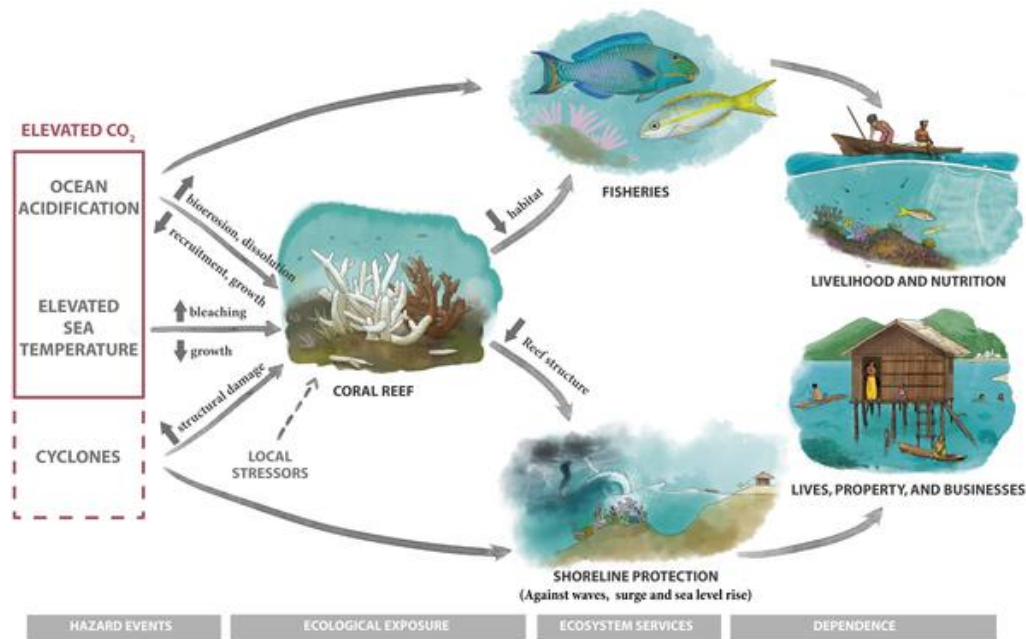
Figure 1. Historical sequence of human disturbances affecting coastal ecosystems



Source: Jackson et al. 2001, illustrating a historical sequence of human disturbances affecting coastal ecosystems, beginning with fishing (step 1), with steps 2 – 5 likely varying in order in different cases.

On top of these local human drivers of change in coral reef ecosystems, climate change is projected to further alter ecosystem functions and services throughout the oceans.^{xxvii} Since the pre-industrial era, anthropogenic emissions of greenhouse gases have driven large increases in atmospheric concentrations of carbon dioxide, methane and nitrous oxide, and are extremely likely to have been the dominant cause of warming observed since the mid-20th century.^{xxviii} These increasing concentrations put shallow, warm-water coral reef ecosystems at risk from two key stresses or pressures: (i) elevated sea surface temperature (that can cause coral bleaching and related mortality) and (ii) ocean acidification, while climate change also affects local drivers (e.g. land use patterns and sources of pollution) (Figure 2).^{xxix}

Figure 2. Conceptual diagram linking stresses related to increased concentrations of atmospheric carbon dioxide to coral reef ecosystems and the services they provide



Source: Pendleton et al. 2016.

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) states with high confidence that coral reefs are one of the marine ecosystems most vulnerable to the changes resulting from increased concentrations of greenhouse gases in the atmosphere (notably sea surface temperature increases and ocean acidification).^{xxx} According to the IPCC Global Warming of 1.5 Degrees C special report in 2018, the world's coral reefs are projected to decline by a further 70 to 90 percent with a 1.5 degree Celsius increase in the global mean temperature from pre-industrial levels (the level targeted in the Paris Agreement), with larger loss

(greater than 99 percent) with a 2 degree Celsius increase.^{xxxii} However, this pattern of degradation is not expected to be uniform, and certainly, some coral reefs may prove more resilient than others to such stress.^{xxxii, xxxiii} At the same time, some reef ecosystems may be degraded at global mean temperature increases even below 1.5 degree Celsius, as widespread coral bleaching has already been occurring globally since 2014 with a global increase of 0.9 °C.^{xxxiv, xxxv} Such projections led the International Society for Reef Studies, an association of coral reef scientists and managers, to issue a consensus statement in October 2015 calling on nations to keep the average global temperature increase to less than two degrees Celsius in the short-term, and less than 1.5 degrees Celsius in the long-term, relative to the pre-industrial period, in order to prevent global collapse of coral reef ecosystems.^{xxxvi} Such a collapse would threaten a range of services that coral reef ecosystems provide to people (as one of the world's most productive marine ecosystems), e.g. tourism and recreation, coastal protection, support for fisheries, etc., providing global economic benefits estimated in 2003 to be on the order of US\$29 billion annually.^{xxxvii} More recent analyses show that Mesoamerica and the Coral Triangle regions also derive multi-billion dollar annual economic benefits from coral reef ecosystems: US\$34.6 and \$36.7 billion, respectively.^{xxxviii}

Coral reef ecosystems are affected simultaneously by climate change and multiple local anthropogenic drivers of change. Because these are not isolated they often result in a positive feedback loop and cumulative impacts.^{xxxix} Additionally, different types of drivers may interact in a given coral reef ecosystem, and where such interactions occur, combined with ecological complexity, negative impacts on coral reef ecosystems may happen sooner and be more severe than previously thought.^{xl} For example, local drivers of change such as overfishing may reduce the resilience of reef ecosystems to impacts from the global driver of increasing emissions of greenhouse gases in the atmosphere, and in turn impacts from this global driver exacerbate the impacts of overfishing or other local drivers such as destructive fishing, predators, pollution, etc.^{xli, xlii, xliii} For these reasons, states and stakeholders have often emphasized efforts to address the cumulative impacts of multiple anthropogenic drivers in order to enhance the integrity and resilience of coral reef ecosystems in the face of bleaching events (bleaching is a cumulative-stress response where global warming is the most widespread stressor, but which known localized stresses exacerbate).^{xliv, xlv, xlvi, xlvi}

The anthropogenic drivers of change that most commonly combine or contribute to changing coral reef ecosystems are summarized in Table 1 below, from a search of the scientific literature supplemented with relevant grey literature publications and expert elicitation. For specificity, these drivers of change have been deconstructed into: (i) the human activities driving the changes, and (ii) the actual pressures on the coral reef ecosystems caused by these activities, organized according to 'themes' that are analogous to a 'sector'.¹

Table 1. Summary of Key Anthropogenic Drivers of Change in Coral Reef Ecosystems

Theme	Anthropogenic Drivers of Change	
	Activity	Associated Pressures on Coral Reef Ecosystems
Climate change	Activities resulting in emissions of greenhouse gases in the atmosphere	Elevated sea surface temperature causing thermal stress
		Ocean acidification
		Tropical cyclone damage or other extreme events
Production from living resources	Harvesting of living resources by large-scale/industrial operators	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)
		Input of other substances (e.g. synthetic substances such as fishing nets)
		Input of litter (solid waste matter, including micro-sized litter)
		Physical loss (e.g. due to destructive fishing practices)

¹ An 'economic sector' is defined here as a specific area or group of industries in the global economy.

Theme	Anthropogenic Drivers of Change		
	Activity	Associated Pressures on Coral Reef Ecosystems	
	Harvesting of living resources by small-scale and/or subsistence operators	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	
		Input of other substances (e.g. synthetic substances such as fishing nets)	
		Input of litter (solid waste matter, including micro-sized litter)	
		Physical loss (e.g. due to destructive fishing practices)	
	Harvesting of living resources by recreational operators	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	
		Input of other substances (e.g. synthetic substances such as fishing nets)	
		Input of litter (solid waste matter, including micro-sized litter)	
		Physical loss (e.g. due to destructive fishing practices)	
	Hunting and collecting of living resources for other purposes (including 'bioprospecting')	Physical disturbance (temporary or reversible)	
		Physical loss	
	Coastal aquaculture (including 'ranching', seaweed cultivation)	Input of nutrients	
		Input of organic matter	
		Input of microbial pathogens	
		Input of other substances	
		Input or spread of non-indigenous species	
		Reduction in light penetration (i.e. 'shading')	
	Generation of land-based sources of pollution ²	Production and disposal of plastics	Input of litter (solid waste matter, including micro-sized litter)
		Waste treatment and disposal	Input of nutrients
Input of organic matter			
Input of microbial pathogens			
Input of other substances (e.g. noxious, hazardous, or toxic chemicals)			
Sedimentation rate changes			
Urban or industrial activities		Input of other substances (e.g. noxious, hazardous, or toxic chemicals)	
		Input of nutrients	
		Input of organic matter	
		Input of microbial pathogens	
		Sedimentation rate changes	
Agriculture		Input of nutrients	
		Input of organic matter	

² The United Nations Convention on the Law of the Sea treaty defines marine pollution as "the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment or quality for use of the sea water and reduction of amenities."

Theme	Anthropogenic Drivers of Change	
	Activity	Associated Pressures on Coral Reef Ecosystems
		Input of microbial pathogens
		Input of other substances (e.g. noxious, hazardous, or toxic chemicals)
		Sedimentation rate changes
Extraction of non-living resources	Extraction of minerals (e.g. sand, coral mining)	Physical disturbance (temporary or reversible)
		Physical loss
	Extraction of oil and gas (including infrastructure)	Physical disturbance (temporary or reversible)
		Input or spread of non-indigenous species
		Input of other substances (e.g. noxious, hazardous, or toxic chemicals)
	Extraction of water (i.e. desalination)	Underwater noise changes
		Physical disturbance (temporary or reversible)
		Changes to hydrological conditions
Production of energy	Transmission of electricity and communications (cables)	Physical disturbance (temporary or reversible)
	Renewable energy generation (wind, wave and tidal power, or biofuel from algae), including infrastructure*	Physical disturbance (temporary or reversible)
		Physical loss
	Changes to hydrological conditions	
Physical restructuring of the coastline, rivers or seabed	Coastal land claim (e.g. mangrove loss)	Physical disturbance (temporary or reversible)
		Physical loss
		Changes to hydrological conditions
		Sedimentation rate changes
	Canalization and other watercourse modifications	Physical disturbance (temporary or reversible)
		Physical loss
		Changes to hydrological conditions
	Coastal defense and flood protection	Physical disturbance (temporary or reversible)
		Physical loss
		Changes to hydrological conditions
	Restructuring of seabed morphology, including dredging and depositing of materials	Physical disturbance (temporary or reversible)
		Physical loss
		Changes to hydrological conditions
	Tourism and recreation	Tourism and recreation activities (e.g. resulting in anchor use on reefs, vessel groundings, diving and snorkeling)
Physical loss		
Disturbance of species due to human presence		
Input of litter (solid waste matter, including micro-sized litter)		
Input of nutrients		
Input of organic matter		

Theme	Anthropogenic Drivers of Change	
	Activity	Associated Pressures on Coral Reef Ecosystems
	Tourism and recreation infrastructure	Input of other substances (e.g. from sunscreen)
		Physical disturbance (temporary or reversible)
		Physical loss
	Marine biota souvenirs to sell to tourists, exporters	Disturbance of species due to human presence
		Physical disturbance (temporary or reversible)
		Physical loss
Transport	Transport - shipping	Input of other substances (e.g. noxious, hazardous, or toxic chemicals, organic matter)
		Input or spread of non-indigenous species
		Input of organic matter
		Input of litter
		Physical loss
		Underwater noise changes
	Transport - infrastructure	Physical disturbance (temporary or reversible)
		Physical loss
		Input of other substances (e.g. noxious, hazardous, or toxic chemicals)

* List is not exhaustive, particularly for pressures linked to types of activities
Sources: see Annex 1.

1.2 International responses to these changes

On numerous occasions the international community of states has undertaken coordinated responses to the changes observed and projected in coral reef ecosystems, notably in Chapter 17 of the Agenda 21 emerging from the 1992 United Nations Conference on Environment and Development,^{xlviii} the 2002 Plan of Implementation of the World Summit on Sustainable Development,^{xlix} the Aichi Biodiversity Targets adopted by the Conference of the Parties to the Convention on Biological Diversity in 2010,^l the Future We Want outcome document of the United Nations Conference on Sustainable Development in 2012,^{li} and the Sustainable Development Goals (SDGs) in the Agenda 2030 adopted by the United Nations General Assembly in 2015,^{lii} among others. In 2010 the United Nations General Assembly adopted a resolution on coral reefs, urging member states as well as competent international organizations to take action to protect coral reef ecosystems, while a number of General Assembly resolutions on oceans and the law of the sea have also addressed coral reefs.^{liii, liv}

Even as many national governments work to translate this global consensus and political commitment into local action, the intensity of the drivers of change and the estimates of the rates of change in coral reef ecosystems have only increased. Mindful of this challenge, in 2016 the United Nations Environment Assembly passed a resolution reiterating the need for international cooperation for the protection of coral reef ecosystems, and calling for national governments to prioritize this effort, drawing upon technical and financial support from donors when necessary.^{lv} More specifically, the resolution called for the UN Environment, in cooperation with the International Coral Reef Initiative (ICRI) and other relevant organizations and partners, to prepare an analysis of global and regional policy instruments and governance mechanisms related to the protection and sustainable management of coral reefs.^{lvi}

Box 1. United Nations Environment Assembly (UNEA) Resolution 2/12, paragraph 13

“Requests the Executive Director, in cooperation with the International Coral Reef Initiative, other relevant international organizations and other relevant partners to prepare, by 2018, an analysis of global and regional policy instruments and governance mechanisms related to the protection and sustainable management of coral reefs.”

1.3 Objectives of this analysis

This report summarizes the results of an analysis of written documents that describe global and regional policy instruments and governance mechanisms related to the anthropogenic drivers of change in coral reef ecosystems, in response to Resolution 2/12 of the United Nations Environment Assembly (UNEA).³ Specifically, the analysis includes: (i) an assessment of the design of international policy instruments and governance mechanisms in terms of their sectoral scope, legal status, geographic coverage, and strength, and (ii) identification of gaps in the design of the instruments and possible options for addressing these. Essentially, the analysis aims to answer the question: does the international community currently have sufficient public policy instruments to address the anthropogenic drivers of change in coral reef ecosystems, given recent observations and the current state of knowledge? If not, what role could international policy play in helping to address these drivers and conserve and protect coral reef ecosystems, and what policy changes would be needed? The analysis aims to provide answers to these questions and clear recommendations on the way forward, for consideration by UN member states.

This analysis has been carried out in close collaboration with ICRI and under the supervision of a coral reef policy advisory committee. The committee was comprised of coral reef and environmental policy experts nominated by member states in response to a call for nominations sent to members of the Committee of Permanent Representatives to UN Environment in October 2017. Fourteen member states nominated experts to the committee. The committee met in June 2018 to validate the methodology for this analysis, review the list of policy instruments and governance mechanisms to be considered, and provide overall guidance for conducting the analysis. The committee met again in October 2018 to review a first comprehensive draft analysis report and discuss recommended action for consideration by UNEA. The committee also agreed a detailed process for review of the analysis report, including by reviewers nominated by member states (invitation sent to members of the Committee of Permanent Representatives to UN Environment September 2018) as well as by experts from selected agents of international policy, such as the secretariats of multilateral environmental agreements. The results of the analysis were presented to the general meeting of ICRI prior to finalization and submission to UNEA.

³ UNEA Resolution 2/12 (2016).

II. Methods Used in the Analysis

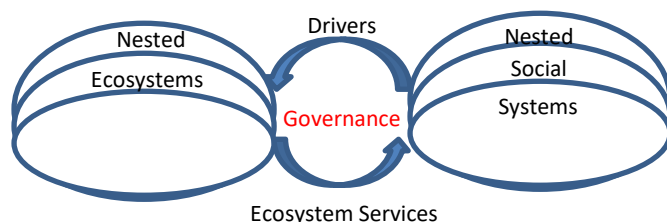
2.1 A Conceptual Framework to Guide the Analysis

The starting point for this analysis is the socio-ecological systems (SES) framework, drawing on the broader research on human-environment interactions.^{lvii} In this framework, social and ecological factors are considered equally important.^{lviii} The changing human condition serves to both directly and indirectly change ecosystems, and in turn changes in ecosystems cause changes in human well-being.^{lix, lx, lxi, lxii} Such a framework can be used to characterize the interaction between society and coral reefs at multiple scales. For example, a given coral reef ecosystem may be impacted by local interactions with social systems such as through fishing, while at the same time being influenced by global interactions with society such as from increased temperatures resulting from anthropogenic greenhouse gas emissions.

The types of impact that social systems have upon coral reef ecosystems are characterized here as different anthropogenic drivers of change, while the benefits these ecosystems provide to humans are characterized as a flow of ecosystem services.^{lxiii} Essentially, the SES conceptual framework provides a mental map to illustrate the interdependent nature of societies and coral reef ecosystems (see Figure 3), where there are multiple anthropogenic drivers of change, each of which may impact coral reef ecosystems through a number of different pathways at multiple scales, which in turn affects the contributions that these systems provide to people (which affects the intensity of the drivers, etc.).^{lxiv, lxv}

Efforts to enhance the benefits that coral reef ecosystems provide to people have often focused on changing the nature and/or intensity of the anthropogenic drivers affecting these systems, through governance.^{lxvi, lxvii, lxviii, lxix, lxx} Governance is defined here as the process of discussing, agreeing on, designing, and implementing informal and formal rules (i.e., procedures, laws) to allow for members in society to have orderly and productive interactions with one another for a specific goal.^{lxxi} Essentially, governance can be considered as the filter by which humans interact with the ecosystems, and broken down for further analysis into components such as instruments and mechanisms (see Box 2 for key terms and definitions).^{lxxii}

Figure 3. Simplified Socio-ecological Systems Framework, including the Concept of Governance



Source: Re-drawn from Ommer et al. (2011)

2.2 Scope of the Analysis

This analysis is conducted from the perspective of the international community of states, and what they can do collectively through public policy instruments to respond to the multiple anthropogenic drivers of change in warm-water coral reef ecosystems described in Table 1, and support coral reef conservation and sustainable management. These international public policy instruments represent an agreement by states to achieve a shared goal. By assembling and reviewing the body of relevant international public policy instruments, the analysis aims to answer the question: have states collectively introduced policy instruments sufficient to address the drivers of change in warm-water coral reef ecosystems, given recent observations and the current state of knowledge? Or are there gaps likely to result in insufficient responses at various levels? Essentially, does the body of international public policy provide sufficient protection for coral reef ecosystems to ensure their sustainability? If the answer is yes, then perhaps the current decline in coral reef ecosystems are more likely correlated to

implementation of the instruments, rather than the instruments themselves. In answering these questions, four key aspects bound the scope of the analysis: instrument definitions, coral reef ecosystems, scale and causal links.

Instrument definitions. The discourse around the term “policy instruments” is broad, with both national and disciplinary variations. This presents definitional challenges and requires that choices are made (see Box 2). The term emerged from the public policy literature as a basic unit of analysis (with public policy itself defined as a particular course of action or inaction pursued by governments, individually or collectively).^{lxxiii, lxxiv} Policy instruments are defined broadly on the basis of this literature, as tools by which governments use power in attempting to ensure support and effect social change (in this case to protect and sustainably manage coral reef ecosystems).^{lxxv} Essentially these are the tools of government to achieve a public policy goal, and typically categorized as either forms of regulation, economic incentives or provision of information.^{lxxvi}

A more specific discourse often involves the legal instruments that codify public policy goals and instruments into law, enforceable by the government. At the international level, these legal instruments are defined as treaties or agreements concluded between states in written form and governed by international law.^{lxxvii} Based on the common usage within the public policy discourse, the terms ‘policy instrument’ and ‘legal instrument’ are not considered here as mutually exclusive, but rather legally enforceable mandates (i.e. legal instruments) are considered here as one form of tool or ‘instrument’ of public policy. Hence, the analysis includes both (i) written agreements between states that are legally binding, and (ii) written agreements between states that are voluntary or non-binding instruments of international public policy’ that affect the protection and sustainable management of coral reefs. This definition allows for a broad consideration of the intentions articulated by governments at the international level to protect and sustainably manage coral reefs, in an effort to as fully address the aim of the UNEA Resolution 2/12 as possible. However to avoid confusion, global and regional policy instruments throughout the text are specified as either ‘legal instruments’ or ‘voluntary instruments’, or simply ‘instruments’.

Box 2. Key terms and definitions

- **Governance:** the process of discussing, agreeing on, designing, and implementing informal and formal rules (i.e., procedures, laws) to allow for members in society to have orderly and productive interactions with one another for a specific goal. This complex concept is broken down here into components such as instruments and mechanisms at various levels, for further analysis.
- **Policy instruments:** tools by which governments use power in attempting to ensure support and effect social change. The term used in UNEA Resolution 2/12, “global and regional policy instruments”, is defined as public policy instruments agreed between two or more states, articulated in written form, some of which are legal instruments that are considered binding upon the states, others of which are voluntary or non-binding agreements. Within instruments, legal instruments contain ‘obligations’ and voluntary instruments contain ‘provisions’, both of which are collectively defined here as ‘commitments’ made by the states, which can be considered as discrete, multi-dimensional variables for analysis.
- **Governance mechanisms:** Many instruments create ‘governance mechanisms’, defined here as organizations or processes to help administer and deliver (i.e. to implement) the instruments. This may include associated funding mechanisms and investments. Essentially, governance mechanisms are defined as the means by which governments deliver the instruments that they have specified, e.g. organizations or funds created for implementation.

Both instruments and mechanisms can be considered as independent variables, affecting the intermediate outcomes (measures of the anthropogenic drivers of change, which are often multi-dimensional variables), which in turn affect the outcome variables that measure the functions of coral reef ecosystems.

Coral reef ecosystems. The analysis considers warm-water coral reef ecosystems predominantly occurring in the shallow, coastal waters of the tropics, between the latitudes of 25° south and 25° north. The analysis excludes cold-water coral ecosystems as they are not ecologically connected to warm-water coral ecosystems, while the

anthropogenic pressures as well as the applicable instruments differ. Such ecosystems may warrant a separate analysis. Additionally, the analysis does not focus on associated ecosystems such as mangroves and seagrass.

Scale. The scale of this analysis is limited to international public policy, i.e. at global and regional levels. Additionally, the scale of the analysis also reflects the scale of the anthropogenic drivers in coral reef ecosystems, which can be distinguished by the level at which they are generated: globally widespread or locally-generated.^{lxxviii} Climate change is considered as globally widespread, while all others could be considered as locally-generated. Reducing locally-generated pressures will give coral reef ecosystems greater opportunities to adapt to the impacts of climate change, given the cumulative effectiveness of multiple drivers of change.^{lxxix, lxxx} For this reason, the analysis focuses particularly on the international policy instruments to address the locally-generated drivers of change in coral reef ecosystems such as harvesting of living resources, coastal development, tourism and recreation, those that cause pollution, etc., in parallel to the global policy dialogue on addressing climate change. This is consistent for example with recommendations from the Conference of the Parties (CoP) to the Convention on Biological Diversity, urging states to address those drivers of change that are tractable at non-global levels, in order to help strengthen the resilience of coral reef ecosystems to climate change.^{lxxxi}

Causal links. This analysis aims to answer the question of whether or not the international community has sufficient public policy tools to address the anthropogenic drivers of change in coral reef ecosystems. Assuming a standard public policy cycle that includes: (i) a phase of policy design, and (ii) a phase of policy delivery (i.e. implementation), which (iii) leads to outcomes,^{lxxxii} this analysis focuses on the first phase of the cycle only: design. This is because a full analysis of policy delivery would require assessment of delivery at the national level on a country-by-country basis, which was not feasible. Perhaps more importantly, an assessment of the *effectiveness* of policy delivery, i.e. the degree to which the policies goals were realized due to the instrument, was simply not possible.^{lxxxiii} This is because determining whether or not the introduction of any particular instrument has led to targeted outcomes in coral reef ecosystems, requires establishing a causal link between observed outcomes and the instrument introduced, by investing heavily to measure changes in ecological outcome indicators compared to a counterfactual without the instrument.^{lxxxiv} For these reasons, the analysis focuses on the design of international coral reef policy instruments to address the known drivers of change in coral reef ecosystems, rather than the effectiveness of the governance mechanisms for instrument delivery, or their impact (i.e. outcomes realized due to the instruments). This assumes characteristics of instrument delivery, given consistency between design and ecological outcomes (e.g. if policy instruments are designed to deliver a range of outcomes, and those outcomes are subsequently observed, the instruments can be assumed to have been effectively delivered). Of course a range of factors external to instruments can also affect ecological outcomes, e.g. demographics, markets and technology, etc.).

2.3 Brief Overview of Methods Used

Based on the conceptual framework described previously, where instruments and the governance mechanisms they create or use are considered as independent variables that affect anthropogenic drivers of change in coral reef ecosystems, the first step was to identify the relevant global and regional instruments that would constitute the data set for analysis (see Annex 1 for more detail on methods). Once the inventory of international coral reef instruments was constructed, their content was analyzed to identify the commitments made in each document, and assess any gaps between these commitments and the various drivers of change, as well as the strength of these commitments, and the governance mechanisms established to deliver them. This analysis was conducted in order to assess the extent to which the various drivers of change are addressed by international instruments. Numerous assumptions were made in bounding discrete commitments within instruments, and assigning numerical values to represent various characteristics. The results should be interpreted as indicative, for purposes of illustrating gaps and for illustrating ratios of certain types of content to others in the instruments, but not as a quantitative analysis with margins of error for estimates. For example, in matching commitments to specific drivers of change (e.g. to activities), there are some cases where the language was not identical so did not match, but the drivers may be addressed through other commitments articulated in broader language. Such cases are noted as they occur, to ensure that the results are not misleading. Finally, somewhat analogous to efforts to

identify ‘bright spots’ of coral reefs that have proved resilient to key drivers such as impacts from climate change,^{lxxxv} examples of interventions characterized as ‘successful’ are highlighted in boxes, in order to illustrate effective delivery mechanisms.

This research strategy can be summarized along the following steps (see Annex 1 for details):

1. *Step One*: Create an inventory of the current global and regional instruments relevant to the key anthropogenic drivers of change in coral reef ecosystems, to consider if they have been designed to address the known drivers or if there are gaps;
2. *Step Two*: Analyze the content of these instruments to consider if they have collectively been designed to address the known drivers or if there any potential gaps that can be identified;
3. *Step Three*: Summarize the key findings; and
4. *Step Four*: Propose policy-relevant recommendations, based on the analysis and drawing upon expert elicitation from the coral reef policy advisory committee.

III. Results

3.1 The International Coral Reef-Related Policy Inventory

As the units of analysis, 232 international instruments and associated protocols were included in the inventory as aiming directly or indirectly to support conservation and sustainable management of coral reef ecosystems, and/or address anthropogenic drivers of change in these systems – i.e. ‘coral reef-related policy’ (see Annex 2 for the inventory). Of these, 150 are instruments agreed by states at the global level, and the remaining 82 at the regional level. The global instruments can be further sub-divided into 32 binding international agreements between states to assume commitments for which they can be held accountable (legal instruments often referred to as ‘hard law’ – see Box 3 below), as well as 118 voluntary agreements, guidelines and initiatives that are non-binding (and often referred to as ‘soft law’), of which 102 are ‘nested’ under one of the binding agreements (i.e. linked to a previous binding agreement, for example a resolution of the conference of parties to a legal instrument,

Box 3. Global Legal Instruments and Associated Protocols Related to Coral Reefs [Number of Parties that Ratified]

1969: International Convention on Civil Liability for Oil Pollution Damage [34]
 1969: International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties [89]
 1971: Ramsar Convention on Wetlands [170]
 1972: The United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention [193]
 1973: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [183]
 1973: International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) [157]
 1979: Convention on Long-Range Transboundary Air Pollution (CLRTAP) [51]
 1982: United Nations Convention on the Law of the Sea (UNCLOS) [168]
 - 1995: United Nations Fish Stocks Agreement [89]
 1983: Convention on Migratory Species (Bonn Convention) [126]
 1989: Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal [186]
 1990: International Convention on Oil Pollution Preparedness, Response and Cooperation [112]
 1991: Espoo Convention on Environmental Impact Assessments in a Transboundary Context [45]
 1992: Convention on Biological Diversity (CBD) [196]
 - 1995: The Jakarta Mandate [196]
 - 2010: The Nagoya Declaration; The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity [112]
 1992: Protocol to International Convention on Civil Liability for Oil Pollution Damage [137]
 1992: The Water Convention - Convention on the Protection and Use of Transboundary Watercourses and International Lakes [43]
 1996: Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention – London Protocol) [50]
 1997: Convention on the Law of the Non-Navigational Uses of International Watercourses [36]
 1998: Aarhus Convention - Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters [47]
 1998: United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol [192]
 2000: Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances [39]
 2001: International Convention on Civil Liability for Bunker Oil Pollution Damage [90]
 2001: International Convention on Control of Harmful Anti-Fouling Systems on Ships [81]
 2001: Stockholm Convention on Persistent Organic Pollutants (POPs) [182]
 2004: International Convention for the Control and Management of Ships' Ballast Water and Sediments [78]
 2005: Mauritius strategy for the further implementation of the Programme of Action for the Sustainable Development of Small Island Developing States (BPOA) [NA]
 2007: The Nairobi International Convention on the Removal of Wrecks [41]
 2009: Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships [6]
 2009: The Port State Measures Agreement [55]
 2013: Minamata Convention on Mercury [101]

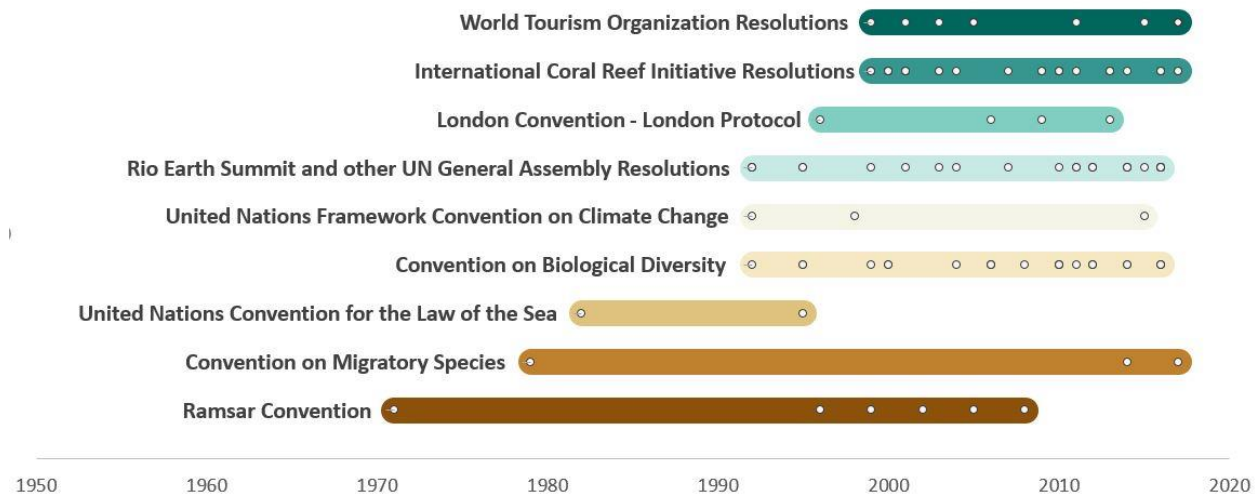
often referred to as a ‘convention’).⁴ Of note, a subset of the global legal instruments are often categorized as multilateral environmental agreements (MEA). The regional instruments can be sub-divided into 44 legal (binding) instruments and 38 voluntary (non-binding) instruments, and from this total 32 of the regional instruments are Regional Seas instruments developed under the Regional Seas Programme initiated in 1974.

In addition to the global legal instruments listed in Box 3, the inventory includes a number of voluntary global instruments that are often cited in the literature on coral reef policy, such as the Global Program of Action (GPA) for the Protection of the Marine Environment from Land-based Activities and the International Coral Reef Initiative (ICRI), among others. At the regional level, almost forty percent of the instruments in the inventory were created under the Regional Seas programmes. In general, some of the international instruments relevant to coral reef ecosystems that are most often cited in the scientific literature include (not in order):

- The Convention on Biological Diversity (CBD),
- The Convention on the International Trade in Endangered Species (CITES),
- The Ramsar Convention,
- The Regional Seas conventions (Antigua Convention and the Cartagena Convention),
- The United Nations Convention on the Law of the Sea (UNCLOS), and
- The UNESCO World Heritage Convention, among others.

This body of international coral reef-related instruments has developed incrementally since the 1960s, with global legal instruments agreed in clusters around the early 1970s and the United Nations Conference on the Human Environment, and the early 1990s and the United Nations Conference on Environment and Development (i.e. the ‘Earth Summit’) among others (e.g. the CBD as a global biodiversity conservation treaty, the UNFCCC, subsequently the GPA as a source of conceptual and practical guidance to states on reducing marine pollution and conserving the ocean environment, the United Nations Fish Stocks Agreement, the Code of Conduct for Responsible Fisheries, etc.). Subsequent voluntary instruments were increasingly introduced through initiatives like ICRI starting in the 1990s (see Figure 4).^{lxxxvi}

Figure 4. Timeline of Selected Global Coral Reef-Related Instruments

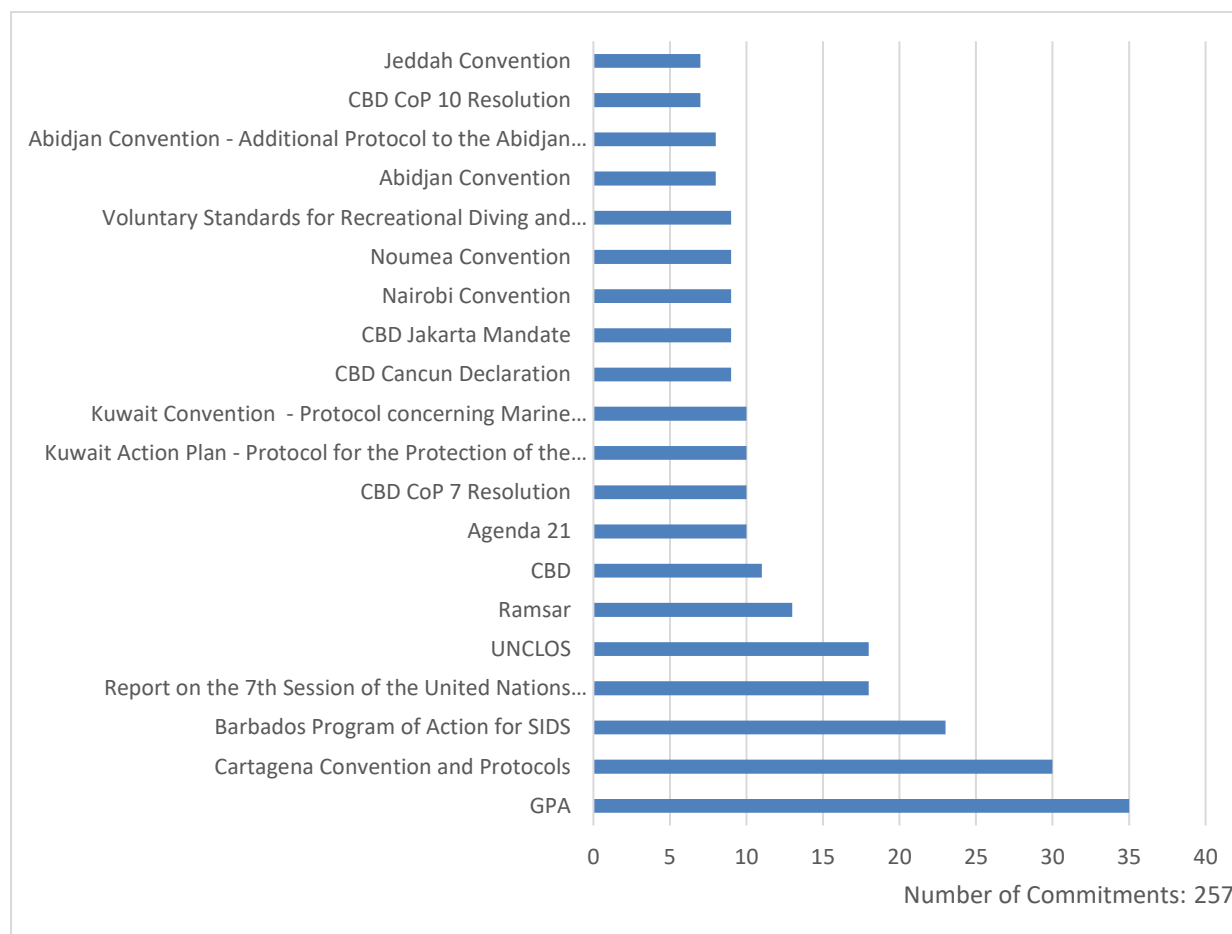


The individual reef-relevant commitments made by states in each instrument were identified, according to the specific human activities addressed, and any additional commitments to address specific anthropogenic pressures (or all collectively). Figure 5 below illustrates the twenty international instruments with the largest number reef-

⁴ Legal agreements may also be nested under other legal agreements, e.g. the ‘UN Fish Stocks Agreement’ is a legal agreement nested under the United Nations Convention on the Law of the Sea (as an implementing agreement to that treaty).

relevant commitments identified, with the GPA for the Protection of the Marine Environment from Land-based Activities having the largest amount (roughly 6 percent of the total).

Figure 5. Instruments with the Most Reef-Related Policy Commitments



Note that Figure 5 indicates only the potential relevance of these instruments for coral reef conservation and sustainable management outcomes (e.g. the instruments most frequently referenced in the analysis). It does not however indicate the relative importance of individual commitments to coral reef outcomes, e.g. UNCLOS may have a small number of direct reef-related commitments, but all of these would be essential for the body of policy to follow. Indeed among this body of instruments (e.g. Figures 5 and 6), the most important milestone for international policy related to conservation and sustainable management of coral reef ecosystems was the adoption in 1982 of UNCLOS, which created the legal framework for all activities in the oceans and seas and established the rights and obligations of states within the different maritime zones.^{lxxxvii} In the territorial sea, coastal States exercise sovereignty over their natural resources. UNCLOS established a new maritime zone beyond the territorial sea, i.e. the exclusive economic zone (EEZ), which can extend up to a limit of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured. In the EEZ, coastal States have “sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds.”^{lxxxviii, lxxxix} At the same time, in the EEZ, coastal States have jurisdiction with regard to the protection and preservation of the marine environment.^{xc} On the continental shelf, which comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance, coastal States exercise sovereign rights for the

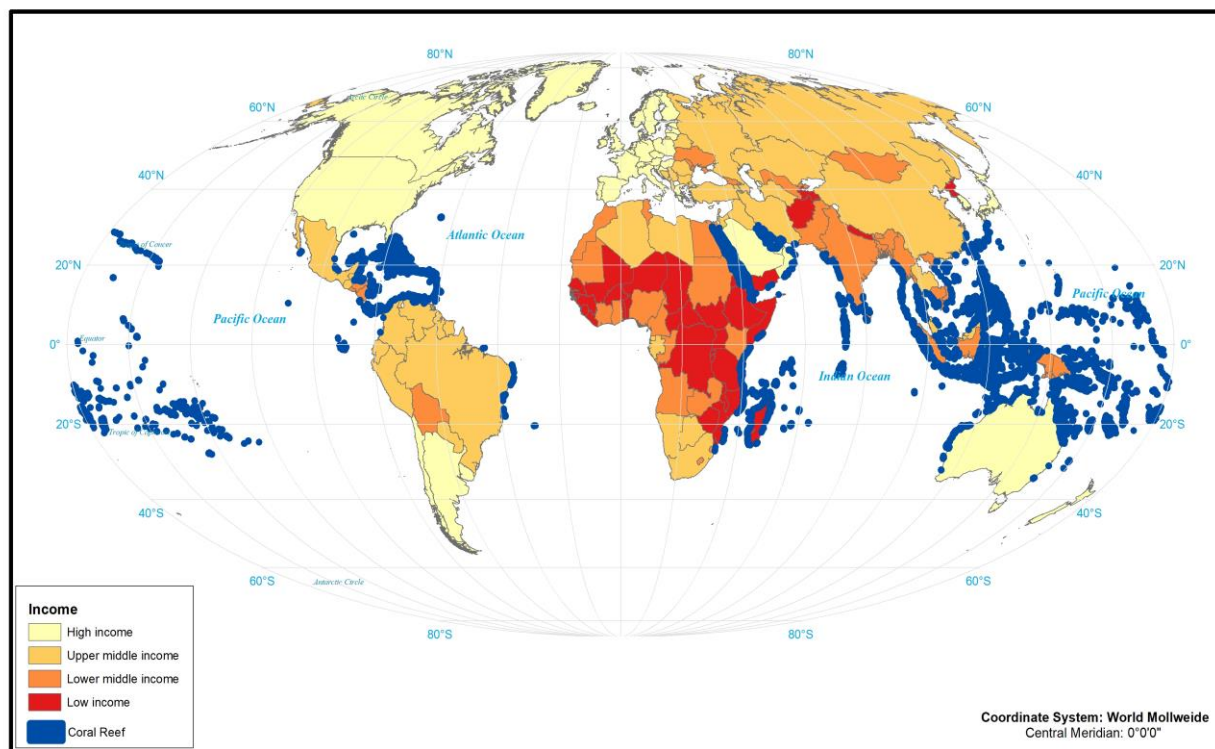
purpose of exploring it and exploiting its natural resources, which consist of the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil. In the EEZ and on the continental shelf, coastal States have jurisdiction with regard to marine scientific research.

By virtue of the maritime zones established under UNCLOS, the world's warm-water coral reefs fall under national jurisdiction. More specifically, some 85 percent of the world's warm-water coral reefs are estimated to be under the jurisdiction of 25 countries (and more specifically, over 40 percent of the world's warm-water coral reefs are under the jurisdiction of 3 countries – Australia, Indonesia and the Philippines)^{xci}:

- Australia
- Bahamas
- China
- Cuba
- Egypt
- Eritrea
- Federated States of Micronesia
- Fiji
- France
- India
- Indonesia
- Kiribati
- Madagascar
- Malaysia
- Maldives
- Marshall Islands
- Mozambique
- Papua New Guinea
- Philippines
- Saudi Arabia
- Seychelles
- Solomon Islands
- Tanzania
- United Kingdom
- United States

Approximately half of these 'coral reef states' are considered as low-income and lower-middle-income economies, potentially with relatively fewer resources to devote to conservation (see Figure 6).

Figure 6. Global Distribution of Warm-Water Coral Reefs



Sources: UNEP-WCMC, WorldFish Centre, WRI, TNC (2018). Global distribution of warm-water coral reefs, compiled from multiple sources including the Millennium Coral Reef Mapping Project. Version 4.0. Includes contributions from IMaRS-USF and IRD (2005), IMaRS-USF (2005) and Spalding et al. (2001). Cambridge (UK): UN Environment World Conservation Monitoring Centre. URL: <http://data.unep-wcmc.org/datasets/1>, World Bank Countries by income group, available at <http://databank.worldbank.org/data/download/site-content/CLASS.xls>

In summary, by jurisdiction twenty-five states are essentially quasi-trustees over most of the world's warm-water coral reefs, with sovereign rights for their conservation and sustainable management, and as a result subsequent international reef-related instruments (the majority, as shown in Figure 4) tend to focus on action that should be taken by states at the national level.^{xcii}

3.2 Analysis of the Design of International Reef-Related Instruments to Address Key Anthropogenic Drivers of Change

The results of the analysis of the design of international reef-related instruments to address the key anthropogenic drivers of change are summarized as follows: (i) a general overview of the design of the instruments and the governance mechanisms created to support their delivery, and (ii) a summary of the design of the instruments to address the different drivers of change (climate change, production from living resources, generation of land-based sources of pollution, extraction of non-living resources, production of energy, physical restructuring of the coastline, rivers and seabed, tourism and recreation, and transport).

3.2.1 General overview of the design of the instruments and the mechanisms created to support their delivery

The breadth of international reef-related instruments. Looking first at the breadth of coverage by the international instruments (both legal and voluntary), Table 2 summarizes the number of individual commitments contained within the instruments in order to address each anthropogenic driver of change in coral reef ecosystems. Again, these values should be seen as indicative of gaps and ratios, rather than exact measures, given the assumptions used in the qualitative analysis, for example to bound where one commitment ends and another begins, etc. As such, the focus is on gaps or cells shaded, rather than on ascribing importance to a higher count of commitments for one activity as opposed to the other (e.g. having 20 commitments for an activity as compared to 10 for another). Even in the case of the gaps or shaded cells, this often reflects that commitments were not specified in the same terms or language as the particularly activity within a driver, though such activities may be covered within broader commitments (e.g. no commitments were specified in terms of harvesting of living resources by large-scale/industrial operators, however the commitments articulated in terms of all activities related to production from living resources apply to harvesting by large-scale/industrial operators).

Table 2. Total Number of Reef-Relevant Commitments contained within the Instruments, per Human Activity Driving Changes in Coral Reef Ecosystems

Anthropogenic Drivers of Change		Number of Policy Commitments	
Theme	Activity	Per Activity	Per Theme
Climate change	Activities resulting in emissions of greenhouse gases in the atmosphere	33	33
Production from living resources	Harvesting of living resources by large-scale/industrial operators	0	64
	Harvesting of living resources by small-scale and/or subsistence operators	8	
	Harvesting of living resources by recreational operators	0	
	Hunting and collecting of living resources for other purposes (including 'bioprospecting')	7	
	Coastal aquaculture (including 'ranching', seaweed cultivation)	10	
	All activities related to production from living resources	39	
Generation of land-based	Production and disposal of plastics	18	160
	Waste treatment and disposal	48	
	Urban or industrial activities	3	

sources of pollution	Agriculture	9	
	All activities generating marine pollution	82	
Extraction of non-living resources	Extraction of minerals (e.g. sand, coral mining)	3	48
	Extraction of oil and gas (including infrastructure)	45	
	Extraction of water (i.e. desalination)	0	
Production of energy	Transmission of electricity and communications (cables)	3	4
	Renewable energy generation (wind, wave and tidal power), including infrastructure*	1	
Physical restructuring of the coastline, rivers or seabed	Coastal land claim (e.g. mangrove loss)	13	19
	Canalization and other watercourse modifications	1	
	Coastal defense and flood protection	0	
	Restructuring of seabed morphology, including dredging and depositing of materials	5	
Tourism and recreation	Tourism and recreation activities (e.g. resulting in anchor use on reefs, vessel groundings, diving and snorkeling)	32	65
	Tourism and recreation infrastructure	3	
	Marine biota souvenirs to sell to tourists, exporters	30	
Transport	Transport – shipping	54	54
	Transport - infrastructure	0	
TOTAL		447	447

Note: red shading indicates a category where no commitments were identified

In addition to the policy commitments referenced in Table 2 above, a number of commitments are contained within the instruments that aim to address drivers at the level of specific pressures, or aim to address all pressures simultaneously (e.g. the resiliency of the ecosystems to these multiple pressures combined). These additional commitments are summarized in Table 3 below. Note that shaded cells are not necessarily a gap, as commitments were matched to activities in Table 2 first, and then only those that could not be matched to these activities were assessed in terms of pressures in Table 3. Essentially, the instruments include commitments that broadly cover almost all of the anthropogenic drivers of change in coral reef ecosystems.

Table 3. Total Number of Reef-Relevant Commitments contained within the Instruments, per Anthropogenic Pressure Driving Changes in Coral Reef Ecosystems

Anthropogenic Pressure	Number of Policy Commitments
Elevated sea surface temperature causing thermal stress	0
Ocean acidification	6
Tropical cyclone damage	1
Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	0
Input of litter (solid waste matter, including micro-sized litter)	0
Input of nutrients	0
Input of organic matter	0
Input of microbial pathogens	1
Input or spread of non-indigenous species	12
Input of other substances	2
Physical loss	2
Physical disturbance (temporary or reversible)	1
Sedimentation rate changes	4
Changes to hydrological conditions	0
Reduction in light penetration (i.e. 'shading')	0
Sea level rise	2
Underwater noise changes	1
Disturbance of species due to human presence	0
Commitments aiming to address all pressures simultaneously – (e.g. ecosystem-based)*	112
TOTAL	144

**This category is not the sum of the commitments aiming to address the other specific pressures, but rather an additional category to capture those commitments that aim to address all pressures simultaneously, e.g. that focus on the ecosystems rather than specific drivers.*

Note: shading indicates a category where no commitments were identified

Tables 2 and 3 indicate the large volume of commitments (591) that states have included in the instruments contained in the inventory, distributed widely across all of the various anthropogenic drivers of change in coral

reef ecosystems. The vast majority (over 76 percent) were defined in terms of the human activities driving changes in the reef ecosystems, rather than the specific pressures on the ecosystems caused by these activities. Essentially, 76 percent of the reef-relevant commitments made by states correspond to human activities, and another 15 percent could only be broadly defined to simultaneously address all anthropogenic pressures on reef ecosystems.

In terms of the geographic coverage of the commitments made, just as the majority of the reef-related international instruments are global, so too are the specific commitments they contain – with almost two thirds (64 percent) at the global level, and just over a third (36 percent) at the regional level. The latter are largely from instruments linked to the Regional Seas Programme or the Large Marine Ecosystem (LME) projects funded by the Global Environment Facility (GEF). The Regional Seas Programme was launched by UN Environment in the 1970s to bring states together around action plans for protection of the marine environment, often beginning with a conference of the governments.^{xciii} This program and practice led to the 32 Regional Seas instruments included in the inventory (see section 3.1), and a significant number of policy commitments relevant for coral reef ecosystems throughout these regions.^{xciv}

The geographic coverage of these regional instruments is not uniform: there are a number of gaps in drivers addressed at the regional level, at least from the instruments included in this inventory (see Annex 2). Within these instruments, a focus of many of the commitments is on addressing activities generating land-based sources of pollution across the regions, as well as pollution from extraction of oil and gas and activities resulting in coastal land claims. Essentially where drivers are addressed, e.g. addressing sources of land-based ocean pollution or production from the ocean's living resources, the distribution of commitments covers most regions, while those that are not addressed such as production of energy from the ocean, much of the activities leading to physical restructuring of the coastline, are uniformly missing across the regions. No one region stands out as a glaring gap, but of course many of these commitments may only apply to a portion of a region, e.g. to one of many LMEs within a given region.

In addition to the drivers and regions covered by specific commitments in the international reef-related instruments, this body of policy has set a large number of targets to achieve specified outcomes relevant to coral reef ecosystems or the anthropogenic drivers of change affecting them. From the inventory, 79 discrete global targets were identified, as well as 58 regional targets (see Annex 13 for the full list of global targets). The majority of these targets are found in just nine instruments (global: GPA, Aichi Targets, Paris Agreement, 2030 Agenda; regional: CTI Regional Action Plan, SPREP Action Plan 2011-2015, Bay of Bengal SAP, Arafura and Timor Seas SAP, Western Indian Ocean SAP). Of the 79 targets, 14 percent have expired (i.e. the deadline has passed). Box 4 below highlights a sample of the current global targets relevant to coral reef ecosystems, organized by drivers of change, to illustrate the breadth.

Box 4. Selected Global Targets to Address Anthropogenic Drivers of Change in Coral Reef Ecosystems, found within International Reef-Related Instruments

Climate change

- Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change [Paris Agreement]
- Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production [Paris Agreement]

Production from living resources

- By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics [2030 Agenda]
- By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained [Aichi Targets]
- By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism [2030 Agenda]
- Provide access for small-scale artisanal fishers to marine resources and markets. Indicator is Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries [2030 Agenda]

Generation of land-based sources of pollution

- By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity [Aichi Targets]
- By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution [2030 Agenda]
- By the year 2025, dispose of all sewage, waste waters and solid wastes in conformity with national or international environmental quality guidelines [GPA]

Extraction of non-living resources

- By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits [Aichi Targets]

Tourism and recreation

- By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism [2030 Agenda]

Targets aiming to address all anthropogenic drivers simultaneously (i.e. driver not specified)

- By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning* [Aichi Targets]
- By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans [2030 Agenda]
- By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information [2030 Agenda]

* Target has expired (i.e. deadline has passed).

Sources: Paris Agreement, UNGA 2030 Agenda, CBD Aichi Targets, GPA

Taken together, the global targets to address specific anthropogenic drivers of change (which features gaps for activities related to the production of energy; physical restructuring of the coastline, rivers or seabed; and transport) and the broad commitments to simultaneously address all drivers, form a comprehensive if broad set of measurable targets for achieving coral reef conservation and sustainable management outcomes. They address most of the anthropogenic drivers of change in coral reef ecosystems, including for example targets to hold the increase in the global average temperature to well below 2 degrees above pre-industrial levels; to end overfishing

and effectively regulate harvesting; to prevent and reduce marine pollution of all kinds; to conserve at least 10 percent of coastal and marine areas; and the now overdue target to minimize the multiple anthropogenic pressures on coral reefs by 2015, so as to maintain their integrity and functioning (see Box 4).

In sum, the breadth of the anthropogenic drivers covered by the current body of international instruments is wide, with a large number of commitments made by states over the recent decades, corresponding to almost every driver, and most regions. However, many of these commitments are relatively broadly defined, to various economic sectors of human activity or coastal and marine ecosystems in general. While the breadth of international reef-related instruments may be wide, this does not indicate the ‘depth’ of the instruments, e.g. characteristics of the individual commitments made.

The depth of international reef-related instruments. The ‘depth’ of international reef-related instruments refers here to measures of a range of characteristics of the commitments that states have made (see Tables 3 and 4): what is prescribed in the commitment (an act, a prohibition, or a plan), the type of commitment made (substantive or procedural), and the ‘strength’ of the commitment (required, required with discretion, or not required). The vast majority (at least 85 percent) of the commitments prescribe some form of planning to address specific or multiple anthropogenic drivers of change in coral reef ecosystems. This distinction is given in order to better characterize the design of the instruments, but does not assign a particular greater importance or weight to ‘actions’ compared to ‘plans’. Similarly, at least 79 percent of the commitments could be characterized as procedural, e.g. to carry out planning processes. For example, many of the commitments require states to carry out integrated coastal zone management processes to develop plans that can address and for example regulate, various anthropogenic drivers of change. Similarly, many others require processes for states to prepare fisheries management plans to regulate activities for harvesting living resources. Essentially, this characterization illustrates that the majority of commitments require states to conduct various forms of planning to develop rules and responses to locally-generated anthropogenic pressures on coral reef ecosystems. This is also consistent with a body of policy that is heavily state-centric, as mentioned in section 3.1, as national governments have the primary responsibility for delivering a minimum of 75 percent of the 591 commitments contained in the policy instruments (with the remainder largely the responsibility of CoP secretariats, as well as in some cases the scientific community and/or civil society (e.g. for voluntary guidelines).

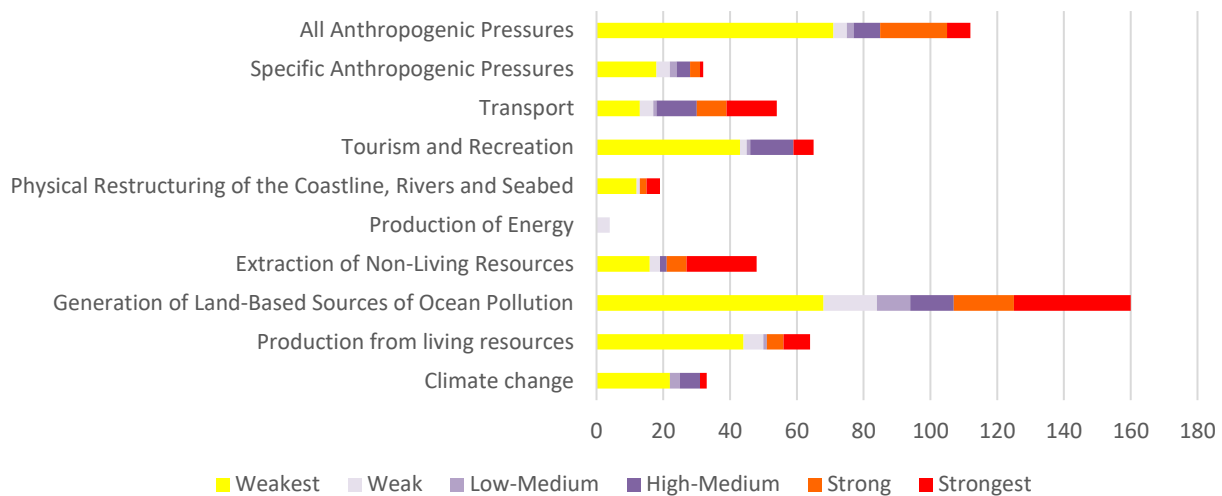
For all of these commitments, the ‘strength’ or robustness can be roughly measured, by considering both if the commitment itself is required of states who are parties to the agreement, and also if the entire instrument is binding (i.e. ‘hard law’). Each reef-relevant commitment included in the international instruments was assigned at least one of three measures of strength: required, required with discretion or not required. Combined with two possible measures of the strength of the underlying instrument, either binding or non-binding, this provides for six possible combinations of strength measures for each commitment, assigned a number from one to six with one the ‘weakest’ and six the ‘strongest’, as follows:

1. Weakest: non-binding instrument, commitment not required
2. Weak: binding instrument, commitment not required
3. Low-medium: non-binding instrument, commitment required with discretion
4. High-medium: non-binding instrument, commitment required
5. Strong: binding instrument, commitment required with discretion
6. Strongest: binding instrument, commitment required.

Note that some commitments may have multiple measures of strength, and in such instances they were ranked according to the single highest measure. This index of the strength of reef-related commitments contained in the international instruments is a crude approximation for indicative purposes only – most useful for noting the difference between strongest and weakest commitments, rather than the small gradations in the middle. These should not be seen as exact measures or the product of quantitative analysis, but rather values assigned for the purpose of indicating significant differences between various commitments and overall ratios of commitments with certain characteristics compared to others. Of course simply because the strength of a commitment is

characterized as the weakest possible in the above measures, does not mean that it would not be met by states or deliver impact, but simply that the requirement upon states to do so is relatively weak.

Figure 7. ‘Strength’ of Reef-Related Policy Commitments to Address Anthropogenic Drivers of Change



The majority (52 percent) of the 591 commitments were considered in the weakest category, while 17 percent were considered as strongest (Figure 7). A small number of drivers had a much higher proportion of commitments considered as strongest, compared to the average across all 591 commitments, include:

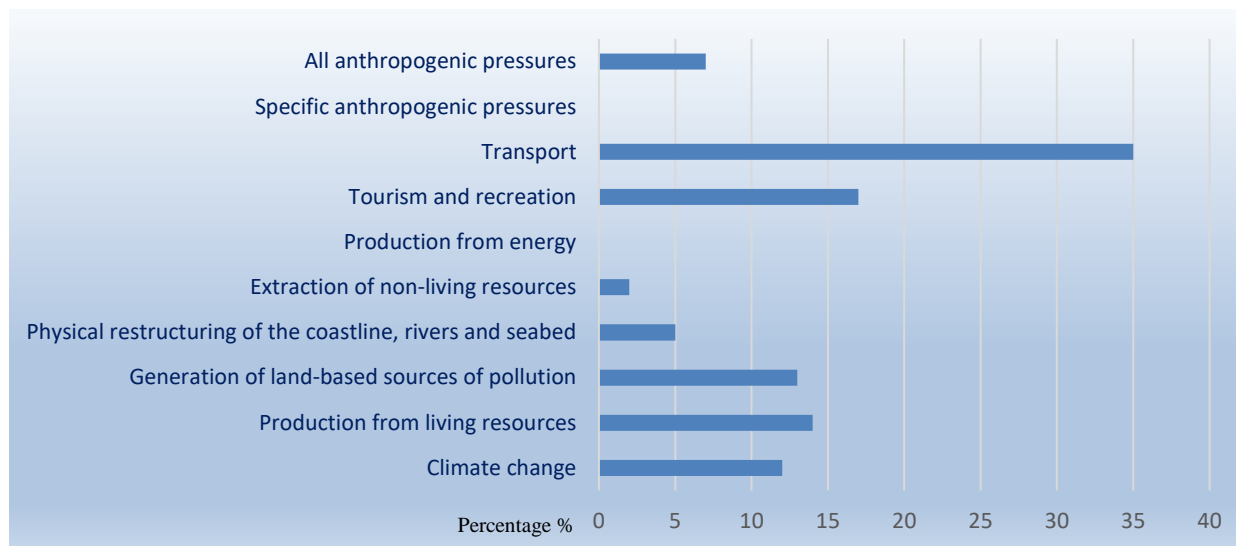
- Extraction of non-living resources: 44 percent of commitments considered as strongest,
- Transport: 28 percent of commitments considered as strongest,
- Generation of land-based sources of pollution: 22 percent of commitments considered as strongest, and
- Physical restructuring of the coastline, rivers and seabed: 21 percent of commitments considered as strongest.

The commitments linked to the other drivers all had a proportion considered as strongest that was below the mean for the entire population. In summary, with a few exceptions such as above, the majority of the reef-related commitments identified in the inventory of international instruments, were considered to be the weakest—i.e. were commitments that are not required, contained in non-binding instruments.

The governance mechanisms for delivery of international reef-related instruments. The efficiency of instruments depends on the governance mechanisms through which they function.^{xcv} The large number of commitments that states have made to address various anthropogenic drivers of change in coral reef ecosystems, can be matched to governance mechanisms described in the same instruments to support their delivery, for example provisions to enhance compliance with commitments (i.e. enforcement, including monitoring and the penalty assessment process), including systems for monitoring progress in implementation and reporting to other states and stakeholders. Additionally, given the prevalence of warm-water coral reefs in areas under the jurisdiction of low and lower-middle income states, mechanisms for helping to finance the costs associated with these commitments are also identified, including to support technical capacity.

Of the 591 commitments identified in the 232 instruments, 13 percent were linked to enforcement mechanisms described in the instruments, depending upon the type of anthropogenic drivers addressed, as shown below in Figure 8.

Figure 8. Percentage of Commitments linked to Enforcement Mechanisms



Given the state-centric nature of these international instruments, this overall trend is perhaps not surprising, as typical references to enforcement call upon states who are parties to an agreement to adopt and enforce measures necessary for instrument delivery (in many cases as part of the integrated planning processes prescribed). First and foremost, some 16 percent of the commitments linked to references for enforcement are found in UNCLOS, which requires States to adopt and enforce rules relating to the conservation and utilization of the living resources in the EEZ and to the prevention, reduction and control of pollution of the marine environment from various sources of pollution, including from land-based sources, seabed activities within and beyond national jurisdiction, dumping and from vessels. UNCLOS also requires other States to comply with the laws and regulations adopted by coastal States in accordance with UNCLOS.

A number of legal and voluntary instruments further elaborate on the provisions of UNCLOS. For example, the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks aims to give effect to the provisions of UNCLOS requiring cooperation between coastal States and high seas fishing States, and provides the legal regime for the conservation and management of straddling fish stocks and highly migratory fish stocks. The Code of Conduct for Responsible Fisheries provide guidance to states on setting science-based fishing limits and monitoring fishing activities among others, while the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA_IUU) includes minimum requirements for a state to authorize any vessel to harvest living resources within its EEZ, to maintain records of these authorized vessels, and to monitor their activities through satellite-based vessel monitoring systems (VMS) and human observers. The Voluntary Guidelines for Small-Scale Fisheries call on states to take these measures in order to secure access to living resources within their EEZs for small-scale fishers. Lastly, the recent enforcement mechanism established by the Port States Measures Agreement to prevent, deter and eliminate illegal, unreported and unregulated fishing commits states to manage access to their ports in such a way as to ensure compliance of foreign vessels with the regulations in other states' EEZs.

Several other global instruments call upon states to adopt and enforce measures to ensure compliance with the commitments they contain, and in many cases to periodically report to the conference of parties (CoP), e.g. the CITES, the Convention on Migratory Species and the UNFCCC, as well as the non-binding GPA. These

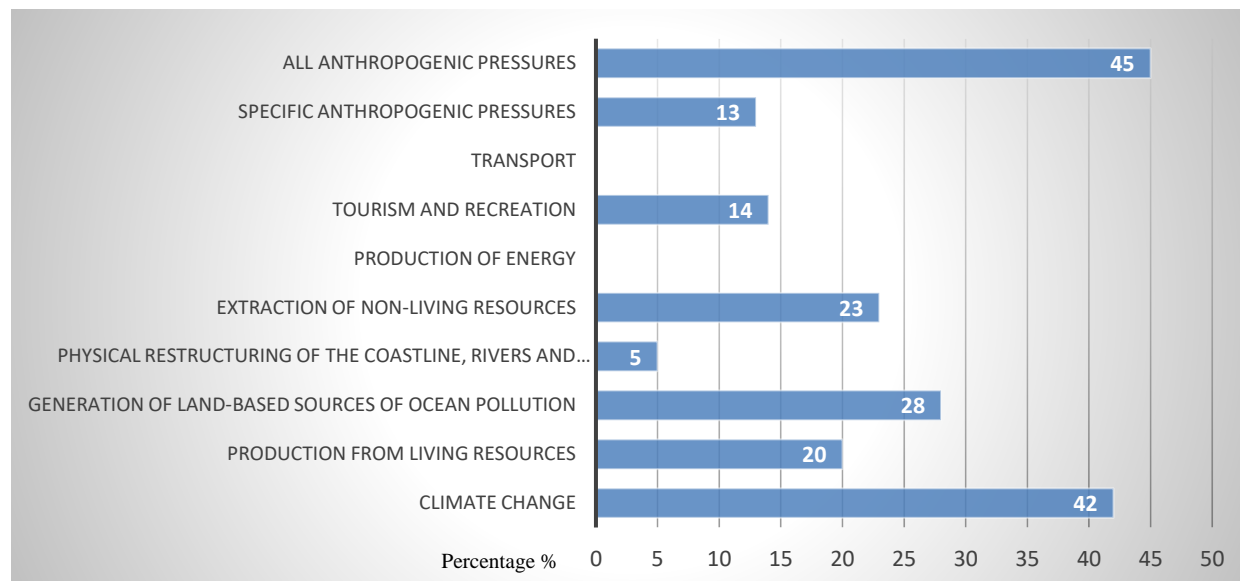
instruments typically specify monitoring and reporting requirements on compliance and progress towards achieving targeted outcomes, for states to report periodically to the conferences of the parties (e.g. CBD, CITES, Stockholm Convention, UNFCCC and World Heritage Convention among others). Uniquely, the Paris Agreement is a non-binding instrument where states have significant reporting requirements, to verify compliance with their voluntary commitments to reduce emissions of greenhouse gases. Additionally, the GPA includes commitments for states to establish consistent national monitoring programs, which would support verification of compliance.

However, the vast majority of commitments linked to references to enforcement mechanisms are found in the various regional instruments linked to Regional Seas programmes – some one third of the total (i.e. 25 out of 74 commitments matched to references of enforcement). These regional agreements are one level closer to the states who have the primary responsibility under UNCLOS for adopting and enforcing measures to ensure compliance with the reef-related commitments in the international instruments reviewed. They typically create monitoring mechanisms between the states, specifying detailed reporting programs where states designate national authorities with the responsibility (e.g. the Coordinating Body on the Seas of East Asia).

In summary, only 13 percent of the reef-related commitments were matched to references of enforcement mechanisms. Of these, one sixth were commitments in UNCLOS. These typically require states to ‘adopt and enforce’ the measures needed to deliver the commitments in the instrument, and in some cases the global, binding instruments require states to report to the conferences of the parties to monitor progress. In addition to UNCLOS, another third of the reef-related commitments matched to references of enforcement were contained in Regional Seas instruments – one level closer to states. From an economic perspective, social actors will violate rules when the expected benefits of the violations exceed the expected costs.^{xcvi, xcvi} With relatively few enforcement mechanisms or penalties specified in the body of international reef-related instruments, many states may not have incentive to comply with their commitments, particularly in lower income countries with competing demands for scarce public resources. Hence, more of the instruments emphasize ‘the carrot’ rather than ‘the stick’, i.e. economic incentives rather than penalties and enforcement.

In terms of financial mechanisms, references to financing support for developing states to meet their commitments in the international reef-related instruments are more prevalent than those concerning enforcement, though still limited in number. Of the 591 reef-related commitments, roughly 25 percent are linked to references of financing provisions or mechanisms, with a much higher proportion for those aiming to address climate change (see Figure 9).

Figure 9. Percentage of Commitments linked to Financing Mechanisms



However, few of these references actually describe the establishment or enhancement of financial mechanisms to support developing states to meet the commitments (including to support technical capacity), but rather most can be characterized as general calls for developed states and development finance institutions (DFIs) to provide additional financing as needed to support delivery by developing states (this is the case for example with UNCLOS, Agenda 21, the GPA, the Code of Conduct for Responsible Fisheries, the WSSD, the Barbados Program of Action, the Voluntary Guidelines for SSF, and a number of resolutions of UNEA, among others). Similarly, the majority of regional instruments do not specify a financing mechanism, but rather direct states who are parties to cooperate in order to mobilize external financing as needed (e.g. the Abidjan Convention, COBSEA, CTI Action Plan, the Jeddah Convention, the Noumea Convention, among others). Where regional instruments specified a financing mechanism, these were relatively small and covered only operating costs for the secretariat, based on contributions from states who are party to the agreement, as well as donors.

The few financial mechanisms created by the reef-related international instruments to support developing states to meet the commitments made, were established by global, binding conventions such as the CBD, UNFCCC and the Stockholm Convention, building upon the example in the international instruments to protect the ozone layer (the 1985 convention and subsequent protocols).^{xviii} These mechanisms include the GEF (operating the financing mechanism of the CBD and the Stockholm Convention), the Green Climate Fund (GCF) and the World Heritage Fund. While the World Heritage Fund has unique characteristics, the mechanisms established under the three instruments share common features, for example that they:

- Aimed to provide new and additional resources to developing states to finance the costs of meeting commitments;
- Provided financing to developing states on a grant or concessional basis;
- Were governed by the Conference of the Parties (COP), i.e. defined policies, programs, procedures and eligibility criteria for the mechanism; and
- Were operated by a DFI, for example through the GEF in these three cases.

For example, the CBD financing mechanism⁵ is operated by the GEF, under the guidance of the CoP which periodically reviews effectiveness (and has signed a memorandum of understanding with the GEF).^{xcix, c} The mechanism aims to support initiatives of developing states to achieve the Aichi targets and the CBD Strategic Plan for Biodiversity 2011 – 2020, and is funded by developed country parties to the convention as part of their obligation under Article 20, through periodic contributions (i.e. ‘replenishments’) to the GEF. More specifically, according to Article 20 developed states should provide new and additional financing to developing states in order to meet the ‘full and incremental costs ... of implementing measures which fulfil their commitments under the CBD.’^{ci} The inclusion of this commitment to create a financial mechanism reflected the reality that many developing states felt they could only meet the commitments in the CBD with additional resources, including for technical capacity.^{cii} Most states indicated in their fourth national reports to the CoP that limited capacity, both financial and human, was a major obstacle to meeting the commitments in the CBD.^{ciii} Operationally, the CoP typically provides guidance to the financial mechanisms operated by the GEF in a single decision that identifies a consolidated list of priorities for financing and an outcome-oriented framework, and the GEF reports on disbursements and outcomes.^{civ} In some cases, CoP decisions aimed to mobilize additional funding for the mechanism, e.g. for specific priorities such as establishing and maintaining protected areas, through convenings of donors, ongoing dialogues of parties, etc.^{cv}

From this financing mechanism and the GEF more broadly, an estimated US\$1.4 billion was committed between 2010 and 2016 to support conservation and sustainable management of coral reefs and associated mangroves and ecosystems, together with US\$0.5 billion from other sources (in a total of 314 projects, 75 percent of which were small project).^{cvi} The trend in financing flows increased over this time period, from US\$44 million committed in 2010 to US\$865 million in 2016, notably increasing after the sixth replenishment of the GEF included a focus on expanding the area of coral reefs within MPAs. However, these estimates include projects with multiple objectives beyond just coral reef conservation, so may be an overestimate.^{cvii} Additionally, the global distribution of the funds did not necessarily match the distribution of coral reefs (with very different rates of expenditure per hectare of reef across different geographies).

In summary, the international instruments include a number of commitments for developed states to increase financing to support developing states to meet the reef-related commitments in the international instruments, but far fewer commitments to establish financial mechanisms and/or identify resources for them (Table 4). While the absolute volume of financial flows to support developing states to conserve and sustainably manage coral reef ecosystems is difficult to estimate (given projects with multiple objectives, and incomplete reporting on funding), the trend seems clearly to be increasing since 2010. At the same time, a significant gap could be assumed between the supply of funding available through current financial mechanisms, and the likely costs to developing states of meeting the commitments in the international reef-related instruments – based on estimates of US\$4 to 8 billion in annual management costs required to meet the commitments of the entire CBD.^{cviii, cix}

Box 5. Examples of Calls for Increased Financing of Coral Reef Conservation

Commitment to “support international cooperation with a view to conserving coral reef and mangrove ecosystems” – UNGA the Future We Want (2012)

Resolution “invites governments and donors to provide technical and financial support for the conservation and management of coral reefs, including in developing countries” – UNEA 2/12 (2016)

⁵ See CBD, Articles 20 and 21; <https://www.cbd.int/financial/>

Table 4. Summary of the Analysis of the Design of International Reef-Related Instruments to Address Key Anthropogenic Drivers of Change

Anthropogenic Drivers of Change		Number of Commitments	Characteristics of Commitments		Governance Mechanisms	
Theme [# of Commitments]	Activity	Per Activity	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
Climate change [33]	Activities resulting in emissions of greenhouse gases in the atmosphere	33	6.1	66.7	12.1	42.4
Production from living resources [64]	Harvesting of living resources by large-scale/industrial operators	0	0	0	0	0
	Harvesting of living resources by small-scale and/or subsistence operators	8	12.5	87.5	12.5	25.0
	Harvesting of living resources by recreational operators	0	0	0	0	0
	Hunting and collecting of living resources for other purposes (including 'bioprospecting')	7	57.1	42.9	0	0
	Coastal aquaculture (including 'ranching', seaweed cultivation)	10	40.0	60.0	0	0
	All activities related to production from living resources	39	25.6	71.8	20.5	28.2
Generation of land-based sources of	Production and disposal of plastics	18	5.6	94.4	5.6	11.1
	Waste treatment and disposal	48	33.3	43.8	6.25	29.2
	Urban or industrial activities	3	0	100.0	0	66.7

Anthropogenic Drivers of Change		Number of Commitments	Characteristics of Commitments		Governance Mechanisms	
Theme [# of Commitments]	Activity	Per Activity	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
pollution [160]	Agriculture	9	33.3	44.4	0	0
	All activities generating marine pollution	82	59.8	25.6	20.7	31.7
Extraction of non-living resources [48]	Extraction of minerals (e.g. sand, coral mining)	3	100.0	0	0	0
	Extraction of oil and gas (including infrastructure)	45	60.00	35.6	2.2	24.4
	Extraction of water (i.e. desalination)	0	0	0	0	0
Production of energy [4]	Transmission of electricity and communications (cables)	3	100.0	0	0	0
	Renewable energy generation (wind, wave and tidal power), including infrastructure*	1	100.0	0	0	0
Physical restructuring of the coastline, rivers or seabed [19]	Coastal land claim (e.g. mangrove loss)	13	53.8	46.2	7.7	7.7
	Canalization and other watercourse modifications	1	0	100.0	0	0
	Coastal defense and flood protection	0	0	0	0	0
	Restructuring of seabed morphology, including dredging and depositing of materials	5	0	100.0	0	0
Tourism and recreation [65]	Tourism and recreation activities (e.g. resulting in anchor use on reefs, vessel groundings, diving and snorkeling)	32	6.3	50.0	3.1	6.3

Anthropogenic Drivers of Change		Number of Commitments	Characteristics of Commitments		Governance Mechanisms	
Theme [# of Commitments]	Activity	Per Activity	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
	Tourism and recreation infrastructure	3	0	100.0	0	0
	Marine biota souvenirs to sell to tourists, exporters	30	20.0	80.0	33.3	23.3
Transport [54]	Transport – shipping	54	51.9	24.1	35.2	0
	Transport - infrastructure	0	0	0	0	0
Pressure						
All pressures		112	27.7	63.4	7.1	44.6
Inputs of Microbial Pathogens		1	0	100.0	0	0
Inputs of Other Substances		2	50.0	50.0	0	0
Inputs or Spread of Non-Indigenous Species		12	41.7	33.3	0	0
Ocean Acidification		6	0	83.3	0	0
Physical Disturbance		1	100.0	0.0	0	0
Physical Loss		2	50.0	50.0	0	0
Sea Level Rise		2	0	0.0	0	50.0
Sedimentation Rate Changes		4	0	100.0	0	75.0
Tropical Cyclones		1	0	100.0	0	0
Underwater Noise		1	0	100.0	0	0

Anthropogenic Drivers of Change		Number of Commitments	Characteristics of Commitments		Governance Mechanisms	
Theme [# of Commitments]	Activity	Per Activity	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
TOTAL		591	34.9	51.6	12.5	24.7

Note: values are highlighted to show concentrations of commitments and/or percentages of commitments linked to mechanisms. Values are highlighted as follows:

- 'Number of Commitments': all positive values
- '% located in binding instruments': all values of 25% or greater
- '% considered weakest ': all values of 25% or less
- '% linked to text referencing enforcement': all values of 25% or greater
- '% linked to text referencing financial mechanisms': all values of 25% or greater

3.2.2 Design of instruments to address climate change

Commitments to address the climate change generally aimed to: (i) support action to mitigate emission of greenhouse gases and enhance sinks to reduce climate change, or (ii) enhance the capability of ecosystems, for example coral reefs, and communities to adapt to the impacts of climate change. For the first, commitments broadly aimed to stabilize concentrations of greenhouse gases in the atmosphere and reduce emissions or enhance sinks based on common but differentiated responsibilities and respective capabilities among states.^{cx, cxi, cxiii} In terms of adaptation, commitments often aimed to support developing states to identify and introduce actions to adapt to impacts of climate change, particularly in SIDS and notably to enhance resilience of coral reef ecosystems. For example, a commitment that aims “to identify coral reef areas that exhibit resistance to raised sea temperatures, testing and refinement of management regimes to enhance reef resilience to and recovery from raised sea temperatures and/or coral bleaching.”^{cxiii}

In terms of the number of commitments (not effectiveness), eleven commitments aimed to mitigate climate change, while 22 aimed to support adaptation to the impacts of climate change on coral reefs (see Table 5). These were typically in voluntary instruments and the majority (over 60 percent) considered ‘weakest’ strength – though for example voluntary commitments in the Paris Agreement may still be fulfilled and effective. More than almost any other driver of change in coral reef ecosystems, over 40 percent of the commitments to address climate change were linked to text referencing financing mechanisms – reflecting the establishment of mechanisms such as the Green Climate Fund, as well as calls for financing adaptation in developing economies and particularly SIDS. In summary, this qualitative data suggests a body of commitments largely voluntary and not linked to enforcement mechanisms, but heavily linked to financing mechanisms and calls for financing adaptation in developing economies.

Box 6. Examples of Interventions to Deliver Commitments to Address Climate Change

Mexico, Quintana Roo State: Good Practices for Climate Change Adaptation project. This project aimed from 2013 to 2015 to develop a catalog of good practices to prevent or reduce the impact of climate change on coastal areas in the state, with a focus on land use, construction and ecosystems management. To achieve this objective, the project established a multi-stakeholder agreement and engaged a range of interest groups, documenting experiences and best practices. As a result of the efforts, some 50 best practices were identified from hotels, dwellers, architects and engineers living and working along the coast, all of which have proven successful in reducing the damages from the effects of climate change. These included practices such as building on poles or behind the dunes, maintaining healthy coral reefs as a natural barrier, leaving natural flows undisturbed. The Nature Conservancy has since used the process undertaken to identify best practices, in order to develop adaptation plans and conservation plans in a number of other areas around the world.

Source: <https://panorama.solutions/en/solutions/good-practices-for-climate-change-adaptation>

Table 5. Summary of Commitments to Address Climate Change

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement
Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
Mitigate climate change	11	9.1	9.1	45.5	36.4	54.5
Support adaptation to the impacts of climate change on coral reefs	22	27.3	4.5	72.7	0.0	36.4
TOTAL	33	21.2	6.1	63.6	12.1	42.4

3.2.3 Design of instruments to address production from living resources

A large body of commitments exists across instruments for states to regulate production from marine living resources, beginning with those that establish jurisdiction over this production within defined areas of the oceans.^{cxiv} A number of commitments aim to conserve and manage stocks of living resources¹, for example commitments in the Code of Conduct for Responsible Fisheries for states to set science-based limits on harvests that maintain or rebuild fish stocks to targeted levels and protect associated ecosystems. Beyond commitments focused on fish stocks, many aim to promote an 'ecosystem approach to fisheries' that includes actions to manage fish by-catch, discards and other adverse ecosystem impacts from fisheries, including eliminating destructive fishing practices.^{cxv} Lastly, a number of commitments aim to support small-scale fisheries and ensure that management measures consider human rights and the broader development context for these activities.^{cxvi}

In terms of the number of commitments (not effectiveness), over half aimed to either conserve and manage stocks of living resources in EEZs (20 percent), conserve and protect the habitats and ecosystems supporting living resources and apply the ecosystem approach to fisheries (19 percent) or regulate coastal aquaculture (14 percent) (Table 6). While a portion were located in legal instruments such as UNCLOS, a large number were found in voluntary instruments such as the Code of Conduct for Responsible Fisheries and the Voluntary Guidelines for Securing Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. In general, over two thirds of the commitments to address production from marine living resources are considered ‘weakest’, and only 20 percent are linked to text referencing financing mechanisms. In summary, UNCLOS includes clear and binding commitments to address production from marine living resources and particularly to conserve and manage the stocks of these resources, while the CBD’s Jakarta Mandate includes commitments also focused on conserving the habitats and ecosystems that support these resources, followed in both cases by a number of voluntary commitments. The key gaps suggested by this data are found in the governance mechanisms, where relatively small percentages of the commitments are linked to text referencing enforcement or financing mechanisms.

Box 7. Examples of Interventions to Deliver Commitments to Address Production from Marine Living Resources

Fiji, Kubulau District, Bue Province: Community-based integrated land-sea management in Kubulau District – Fiji’s first district-level ridge-to-reef management plan.

Beginning in 2005, this project has aimed to preserve the functional integrity of Kubulau’s ecosystems, from ridge to the reef, through community-based management measures. To achieve this objective, the project introduced a network of three locally-managed marine areas, 21 periodically-harvested fisheries closures, one community-managed forest area, and various restrictions of activities within and adjacent to freshwater habitats, all of which were included in a comprehensive ridge-to-reef management plan endorsed by all village chiefs in 2012. As a result, the communities have seen increases in catch size, fish size, fish diversity and the status of reefs, with total fish biomass increasing both inside and outside of protected areas.

Source:

https://www.icriforum.org/sites/default/files/ICRI_casestudies_2015_0.pdf

Table 6. Summary of Commitments to Address Production from Marine Living Resources

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement
Objective	Per Activity					
Establish jurisdiction over production from living resources within defined areas of the oceans	1	0.0	100.0	0.0	100.0	0.0
Conserve and manage stocks of living resources (e.g. fish stocks) in exclusive economic zones (EEZs)	13	30.8	30.8	69.2	46.2	38.5
Conserve and manage stocks of living resources in the high seas and/or straddling stocks and/or migratory stocks	3	0.0	33.3	66.7	33.3	33.3
Conserve and protect the habitats and ecosystems supporting living resources, and apply the ecosystem approach to fisheries	12	33.3	16.7	83.3	0.0	8.3
Regulate harvests of living resources in coral reef ecosystems	4	0.0	0.0	100.0	0.0	25.0
Protect species from activities related to production from living resources	2	0.0	50.0	50.0	0.0	50.0
Support small island developing states (SIDS)	2	0.0	50.0	0.0	0.0	100.0
Eliminate subsidies contributing to overfishing	2	0.0	0.0	100.0	0.0	0.0
Support small-scale producers	8	12.5	12.5	87.5	12.5	25.0
Regulate hunting and collecting of living resources for other purposes	7	57.1	57.1	42.9	0.0	0.0
Regulate coastal aquaculture	9	33.3	33.3	66.7	0.0	0.0
Sea ranching	1	0.0	100.0	0.0	0.0	0.0
TOTAL	64	25.0	29.7	68.8	14.1	20.3

3.2.4 Design of instruments to address generation of land-based sources of pollution

The largest body of commitments aims to address land-based sources of ocean pollution, particularly to support states to meet their duties under UNCLOS to prevent, reduce and control marine pollution (Table 7). These commitments have a range of objectives, the most frequent being to: regulate land-based sources of ocean pollution (25 percent), to reduce ocean pollution from wastewater (18 percent), to more generally reduce ocean pollution from all sources, including land-based sources (14 percent), to prevent or reduce ocean pollution from hazardous waste (12 percent), or to address ocean pollution from plastics and other marine litter (11 percent). Additionally, many commitments aim to support integrated planning (e.g. integrated coastal zone management, marine spatial planning, etc.) to reduce pollution into the ocean.^{cxvii} Additionally, a number of specific commitments aim to reduce persistent organic pollutants from land-based sources, activities such as agriculture providing anthropogenic nutrient inputs into coastal waters, urban and industrial sources of ocean pollution, a growing number of commitments (mostly regional) to address sources of plastic pollution, and particularly those to support waste treatment (e.g. GPA commitments to develop national programs of action for the installation of appropriate and environmentally sound sewage facilities).

In many cases, the majority of these commitments are found in legal, regional instruments established through the Regional Seas Programs. These commitments are relatively ‘stronger’, and for those aiming generally to address ocean pollution from all sources or from all land-based sources, a much smaller proportion is considered ‘weakest’ than is the case in many other drivers – again reflecting the relative ‘strength’ of commitments in regional instruments. Similar to the commitments to address other drivers, key gaps appear to be in the governance mechanisms for delivery, where some 13 percent of the commitments were linked to text referencing enforcement mechanisms and almost 28 percent were linked to text referencing financing mechanisms.

Box 8. Examples of Interventions to Deliver Commitments to Address Generation of Land-Based Sources of Pollution

Grenada, Beausejour watershed, Grenada Island: Reef Guardian Stewardship Program. With aid funding from the Australian government (via the Great Barrier Reef Marine Park Authority to the Grenada Fund for Conservation), since 2013 the government’s Fisheries Division aimed to educate farmers on safeguarding coral reefs and associated ecosystems through the introduction of marine protected areas and the promotion of good practices in agriculture (e.g. in fertilizer application and use, water quality management, and soil management). The program has developed awareness tools to support farmers, conducted informational and training workshops, constructed a bio-digester plant to use hog waste for local energy production, and generally with these stakeholders following the Australian approach in the Reef Guardian Stewardship Program.

Source: ICRI. 2015. Case Studies: From Ridge to Reef. Implementing coral reef conservation and management through a community-based approach emphasizing land-sea connectivity.
https://www.icriforum.org/sites/default/files/ICRI_casestudies_2015_0.pdf

Table 7. Summary of Commitments to Address Generation of Land-Based Sources of Pollution

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement
Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
Reduce ocean pollution from all sources	22	68.2	68.2	31.8	9.1	27.3
Regulate and reduce all sources of pollution in the coastal waters of small island developing states (SIDS)	9	0.0	11.1	0.0	0.0	88.9
Regulate all land-based point sources of ocean pollution	40	80.0	80.0	17.5	27.5	10.0
Regulate persistent organic pollutants from all land-based sources	5	0.0	20.0	80.0	80.0	100.0
Reduce anthropogenic nutrient inputs to the ocean from all land-based sources	2	0.0	0.0	100.0	0.0	100.0
Regulate land-based sources of heavy metal pollution to the ocean	1	0.0	0.0	100.0	0.0	100.0
Regulate land-based sources of pollution to coastal waters of SIDS	3	0.0	0.0	0.0	0.0	0.0
Address ocean pollution from agriculture	9	44.4	33.3	44.4	0.0	0.0
Address ocean pollution from plastics and other marine litter	18	72.2	5.6	94.4	5.6	11.1
Address ocean pollution from urban and industrial sources	3	0.0	0.0	100.0	0.0	66.7

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments
Reduce ocean pollution from waste water	29	72.0	20.7	41.4	0.0	6.9
Prevent or reduce ocean pollution from hazardous waste	19	42.1	52.6	47.4	15.8	63.2
TOTAL	160	58.8	43.1	41.3	13.1	27.5

3.2.5 Design of instruments to address extraction of non-living resources

Commitments aiming to address pressures from activities extracting non-living resources focus largely on establishing jurisdiction over offshore extraction activities, and regulating these activities in order to prevent pollution (Table 8). In particular, half of the commitments focus on regulating the extraction of oil and gas and its effects on the marine environment. Regional commitments tend to be far more specific, for example setting standards for pollution control technologies and measures, particularly in offshore oil and gas activities.

A large percentage of these commitments are located in binding instruments (over 62 percent), and partially as a result are generally 'stronger' than those aiming to address other drivers (only one third of the commitments are considered 'weakest' strength, compared to over 68 percent of the commitments to address production from marine living resources for example).

Again, as is the trend throughout the commitments and drivers, the key gap is in the governance mechanisms to ensure delivery: only 2 percent of the commitments are linked to text referencing enforcement, and just under 23 percent are linked to text referencing financing mechanisms.

Box 9. Examples of Interventions to Deliver Commitments to Address Extraction of Non-Living Resources

Belize: Economic Valuation of Belize's Reefs and Mangroves.

This project aimed to support the government to account for and recover damages to environmental resources such as coral reef ecosystems. To achieve this objective, the project supported an economic valuation of the services provided by the country's coral reef and mangrove ecosystems. The results provided stakeholders and the government information needed to advocate and enact a ban on offshore drilling. Since this time, a similar study was conducted in St. Maarten leading to enactment of a MPA in 2010, and in 2011 the government of Jamaica was awarded damages for a ship grounding, citing the Belize case as a precedent.

Table 8. Summary of Commitments to address Extraction of Non-Living Resources

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments
Establish jurisdiction over all offshore extraction activities	3	0.0	100.0	0.0	0.0	0.0
Regulate all activities for offshore extraction	17	0.0	88.2	5.9	5.9	0.0
Regulate extraction of oil and gas (from both offshore and onshore)	24	37.5	45.8	50.0	0.0	45.8
Regulate extraction of minerals from the ocean	4	0.0	25.0	75.0	0.0	0.0
TOTAL	48	18.8	62.5	33.3	2.1	22.9

3.2.6 Design of instruments to address production of energy

Relatively few commitments focused solely on addressing production of energy apart from extraction of non-living resources (Table 9). These included three commitments in UNCLOS aiming to establish jurisdiction over the laying of submarine cables and pipelines, and one to address the production of energy from the water, currents and winds. For the former, UNCLOS states that the laying of submarine cables and pipelines is part of the freedom of the high seas, which is also enjoyed in the EEZ, subject to the relevant provisions of the Convention, and all States are entitled to lay submarine cables and pipelines on the continental shelf, in accordance with its provisions. The delineation of the course for the laying of such pipelines on the continental shelf is subject to the consent of the coastal State. In addition, coastal states have the right to establish conditions for cables or pipelines entering their territory or territorial sea. For the latter, UNCLOS establishes that coastal states have sovereign rights with regard to the production of energy from the water, currents and winds in the EEZ. On the continental shelf, coastal States exercise sovereign rights for the purpose of exploring it and exploiting its natural resources, which include the mineral and other non-living resources of the seabed and subsoil. Beyond these commitments stating the jurisdiction to regulate production of energy, there is little more found in the body of instruments specific to this driver – which could be considered as one of the few gaps in coverage.

Table 9. Summary of Commitments to address Production of Energy

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments
Establish jurisdiction over underwater cables	3	0.0	100.0	0.0	0.0	0.0
Address reef-related impacts of renewable energy generation (wind, wave and tidal power), including infrastructure	1	0.0	100.0	0.0	0.0	0.0
TOTAL	4	0.0	100.0	0.0	0.0	0.0

3.2.7 Design of instruments to address physical restructuring of the coastline, rivers and seabed

Commitments to address physical restructuring of the coastline, rivers and seabed typically aimed to address impacts of coastal development (over 60 percent), while several others aimed to address dredging and depositing of materials, as well as impacts of coastal defenses, canalization and other watercourse modifications (Table 10). Many of these commitments are included in the GPA or CBD resolutions, as well as several UN General Assembly resolutions on oceans and the law of the sea, urging states to stop the degradation and loss of ecologically important ecosystems and habitats such as coral reefs, due to coastal development. Roughly one third of these commitments are found in binding regional instruments, and almost two-thirds of these commitments are considered 'weakest' strength. Only five percent of these commitments are linked to text referencing enforcement mechanisms, and the same proportion is linked to text referencing financing mechanisms.

Box 10. Examples of Interventions to Deliver Commitments to Address Physical Restructuring of the Coastline, Rivers and Seabed

St. Lucia: Coastal Protection at Point Sables Environmental Protected Area. With support from IUCN, this project aimed to safeguard ecosystem services provided by coastal agro-forests, beaches and coral reefs. To achieve this objective, the project supported the St. Lucia National Trust to provide interventions such as integrated management and re-vegetation of coastline, sand dunes and mangroves; exclusion of vehicles from the beach; clearance and rehabilitation of storm drains; improved waste management; and public awareness and education campaigns, among others. The results included more effective drainage and re-vegetation of sand dunes to prevent further erosion and counteract the impact of illegal sand-mining, as well as a reduction in this illegal activity.

Source: <https://panorama.solutions/en/solution/coastal-protection-point-sables-environmental-protected-area-psepa-saint-lucia>

Specifically, a significant number of commitments aim to address pressures from physical restructuring of the coastline, particularly those aiming to support integrated coastal zone management and marine spatial planning, as well environmental impact assessments for coastal development. For example, the CBD Conference of the Parties resolved to focus on “actions to manage coastal development to ensure that the health and resilience of coral reef ecosystems are not adversely impacted, including prioritizing the protection of coral reef ecosystems in coastal development in land-use and sea-use management in coastal areas, through the application of area-based management measures, such as marine and coastal protected areas and/or marine spatial planning.”^{cxviii} A number of commitments aim to address impacts from coastal defenses and flood protection, for example that “states should adopt measures to minimize changes to natural erosion, sediment transport and sedimentation resulting from the construction of barrier and barrages.”

Table 10. Summary of Commitments to Address Physical Restructuring of the Coastline, Rivers and Seabed

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			% located in Regional Instruments	% located in Binding Instruments	% considered ‘weakest’ strength	% linked to text referencing enforcement
Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments	% considered ‘weakest’ strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
Address the reef-related impacts of coastal development	12	58.3	58.3	41.7	8.3	8.3
Address the reef-related impacts of coastal defenses and flood protection	1	0.0	0.0	100.0	0.0	0.0
Address the reef-related impacts of canalization and other watercourse modifications	1	0.0	0.0	100.0	0.0	0.0
Address the reef-related impacts of restructuring seabed morphology, including dredging and depositing of materials	5	0.0	0.0	100.0	0.0	0.0
TOTAL	19	36.8	36.8	63.2	5.3	5.3

3.2.8 Design of instruments to address tourism and recreation

Commitments aiming to address pressures from tourism and recreation activities often focused on developing national plans, policies and programs for sustainable tourism, e.g. ecotourism, as well as prohibiting trade in coral reef species using CITES. Those related to transport activities typically aimed to reduce oil pollution from shipping, as well as the spread of invasive species (Table 11). Over half of the commitments aiming to address the reef-related impacts of all tourism and recreation activities are found in regional instruments. Similar to many other drivers, the majority (two thirds) of these commitments were considered ‘weakest’, and only 17 percent were linked to text referencing enforcement mechanisms, and less than 14 percent linked to text referencing financing mechanisms.

In the case of tourism and recreation, similar to commitments aiming to address other drivers, the breadth of objectives and aspects of the driver covered is significant, but the depth or ‘strength’ of the commitments was small as mentioned previously. Similarly, little reference was provided to governance mechanisms for delivery, both in terms of enforcement and in terms of financing.

Box 11. Examples of Interventions to Deliver Commitments to Address Tourism and Recreation

Global: Green Fins. With support from the Reef World Foundation, this project aims to develop a recognized set of environmental standards to guide and support scuba diving and tourism business owners and national authorities. To achieve this objective, the project supported a code of conduct, an assessment system, outreach and capacity building and development of regulations where needed. The results have included completion of a study providing evidence that effective implementation of the practices described in the standards, such as programs designed to change scuba diving activities on coral reefs, may translate into reduced impacts; as well as completion of a study in the Philippines indicating that implementation of these standards and approach may significantly reduce the impact of the scuba diving industry on the marine environment. The approach and standards have been taken up in across six sites in Malaysia, leading to measurable reductions in anchoring, dive contacts with reefs, chemical discharge and garbage management. In the Philippines the Green Fins standards have been incorporated into the government’s Biodiversity Strategy and Action Plan, and Departmental Administrative Order 2016-16 Coastal and Marine Ecosystems Management Program.

Source: www.greenfins.net; Green Fins. 2018a. Overview of the Green Fins Assessment Scores in Malaysia; Roche et al. 2016. Recreational Diving Impacts on Coral Reefs and the Adoption of Environmentally Responsible Practices within the SCUBA Diving Industry. Environmental Management, DOI 10.1007/s00267-016-0696-0; Hunt et al. 2013. The Green Fins approach for monitoring and promoting environmentally sustainable scuba diving operations in South East Asia. *Ocean and Coastal Management* 78: 35-44.

Table 11. Summary of Commitments to Address Tourism and Recreation

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement
Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
Address the reef-related impacts of all tourism and recreation activities	30	56.7	6.7	53.3	3.3	0.0
Address the reef-related impacts of all tourism and recreation activities in SIDS	2	0.0	0.0	0.0	0.0	100.0
Address the reef-related impacts of all tourism and recreation infrastructure	3	0.0	0.0	100.0	0.0	0.0
Regulate marine biota souvenirs for sale to tourists, exporters	30	10.0	20.0	80.0	33.3	23.3
TOTAL	65	30.8	12.3	66.2	16.9	13.8

3.2.9 Design of instruments to address transport

Commitments to address transport aimed largely to address all reef-related impacts of shipping (over 53 percent), as well as to regulate discharges from ships (20 percent), invasive species transported by shipping (20 percent) and the remainder to regulate impacts from shipping on SIDS (Table 12). Many of these commitments are included in UNCLOS, as well as those in MARPOL 73/78 and resolutions of the CBD. Over one third of these commitments are found in binding regional instruments, and overall the 'strength' of these commitments is high relative to other drivers (over half are found in binding instruments for example). Over one third are linked to text referencing enforcement mechanisms, but none are linked to text referencing financing mechanisms.

Table 12. Summary of Commitments to Address Transport

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments
Address all reef-related impacts of shipping	29	58.6	62.1	17.2	34.5	0.0
Regulate discharges from ships	11	9.1	36.4	18.2	81.8	0.0
Address invasive species transported by shipping	11	9.1	54.5	45.5	0.0	0.0
Regulate impacts from shipping on SIDS	3	0.0	0.0	0.0	0.0	0.0
TOTAL	54	35.2	51.9	22.2	35.2	0.0

3.2.10 Design of instruments to address all anthropogenic pressures on coral reef ecosystems simultaneously

In addition to those commitments aiming to address specific types or themes of activities (e.g. production from marine living resources, tourism and recreation, etc.), a number of commitments did not refer to specific activities, but instead to addressing the pressures on coral reef ecosystems from these activities (Table 13). A relatively small number of commitments aimed to address specific pressures (e.g. input of organic matter, input of nutrients, etc.), while a large number (112) of commitments aimed to address all or multiple pressures simultaneously. These commitments typically aimed to address all pressures on coral reef ecosystems, or in some cases more broadly in coastal and marine ecosystems. They include a large number of commitments for general conservation and sustainable management of coastal and marine ecosystems, which were considered as applicable to coral reefs, such as commitments in the World Heritage Convention for protected areas (which includes 29 marine sites that protect coral reef ecosystems and a marine program that advises the World Heritage Committee on their monitoring).^{cxix. cxx} Also, under the Ramsar Convention, 104 Ramsar Sites have been designated with coral reefs and 973 with marine and coastal wetlands.^{cxxi} There is also a large body of commitments made through the CBD and instruments nested under it, for example to develop national biodiversity strategies and action plans and focus these efforts on coastal and marine ecosystems, as well as area-based regulations such as marine protected areas (MPAs) and marine spatial planning. In addition, the Ramsar Convention and the Convention on Migratory Species included commitments aiming to ensure habitat conservation and protection of migratory species, as well as application of environmental impact assessments to coastal development.

Box 12. Examples of Interventions to Deliver Commitments to Simultaneously Address All Pressures on Coral Reef Ecosystems

Maldives, North Ari Atoll: Project Regenerate – Reefs Generate Environmental and Economic Resiliency for Atoll Systems. With support from the United States Agency for International Development and IUCN, this project aims to enhance the use of GIS in national environmental decision-making; enhance understanding of resilience to climate change in North Ari Atoll; build the capacity of civil society to monitor and improve management of marine resources; and support environmental education and public awareness, among others. To achieve this objective, since 2013 the project has supported the development of a resilience-based management framework to improve the ability of policy-makers and stakeholders to understand and address the risks from pressures on the marine environment, and particularly to improve the ecological status of coral reef ecosystems. The results have included increased government capacity for use of GIS to plan ecosystem management measures; completion of social surveys with North Ari fishers on bait and reef fisheries; collection and analysis of high-resolution ecological data in 36 sites in North Ari atoll; assessment of ecosystem services; and adoption of Green Fins standards in local scuba diving centers.

Source: ICRI. 2015. Case Studies: From Ridge to Reef. Implementing coral reef conservation and management through a community-based approach emphasizing land-sea connectivity. Available at https://www.icriforum.org/sites/default/files/ICRI_casestudies_2015_0.pdf

Almost two-thirds of these commitments are considered as ‘weakest’ strength, and only 7 percent are linked to text referencing enforcement. The majority are not linked to text referencing financing mechanisms, with the exception of the commitments for conservation and sustainable use of marine and coastal biological diversity under the CBD – an instrument that includes a financing mechanism. Again, as with many of the drivers, the key gaps here are in the governance mechanisms for delivery, with the exception of the CBD.

Box 13. Examples of Interventions to Deliver Commitments to Simultaneously Address All Pressures on Coral Reef Ecosystems

Indonesia, Birds Head Seascape, West Papua: Community-based conservation at scale. A collaboration between coastal communities; local, regency, provincial and national government agencies; international and local non-governmental organizations; and universities, this initiative aims to address habitat destruction in the waters of West Papua as a result of overfishing and resource exploitation, through the creation and management of a large-scale marine protected area network. To achieve this objective, the initiative has included efforts to: complete scientific assessments and characterization of the seascape (i.e. region); support awareness and social and political support for conservation; develop a marine protected area network jointly established by local communities and the government; supporting institutions for co-management of this protected area network; and developing a sustainable financing strategy for the initiative. The results have included a marine protected area network established and managed effectively according to rapid assessment scores; a reduction in the intensity of key, locally-generated drivers of change in the coral reef ecosystem (e.g. destructive fishing practices reduced to 1 percent of fishers in the area, illegal fishing from outside poachers reduced by over 90 percent, government ban on mining and shark and ray fishing, average annual growth in tourism of 30 percent, average increase in live coral cover within the protected areas of 12 percent since their establishment, and average increase in fish biomass within the protected areas of 114 percent since establishment – including increased fishing productivity for local fishers.

Table 13. Summary of Commitments to simultaneously address all Anthropogenic Pressures on Coral Reef Ecosystems

Anthropogenic Drivers of Change	Number of Commitments	Regional	Characteristics of Commitments		Governance Mechanisms	
			% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement
Objective	Per Activity	% located in Regional Instruments	% located in Binding Instruments	% considered 'weakest' strength	% linked to text referencing enforcement	% linked to text referencing financing mechanisms
General conservation and sustainable management of coastal and marine ecosystems, considered applicable to coral reefs	38	60.5	42.1	42.1	8.7	26.1
Conservation and sustainable use of marine and coastal biological diversity under the CBD	34	0.0	35.3	64.7	0.0	79.4
Commitments under the Ramsar Convention	10	0.0	40.0	60.0	0.0	0.0

Commitments under the CMS	6	0.0	33.3	66.7	0.0	0.0
Commitments under the GPA	1	0.0	0.0	100.0	100.0	100.0
Commitments specifically for coral reef ecosystems	23	26.1	4.3	95.7	8.7	26.1
TOTAL	112	25.9	31.3	63.4	7.1	44.6

3.2.11 Additional issues in the design of the instruments

In addition to identifying and characterizing the reef-related commitments that states have made in international instruments as well as key delivery mechanisms, the treatment of several broad issues in the design of these instruments is highlighted here.

Stakeholder participation. Given that most of the reef-related commitments prescribe some form of planning process for states to develop and implement measures for coral reef ecosystem conservation and sustainable management, the role of stakeholders in these processes becomes significant. Many of the instruments include guidance to ensure stakeholder participation in these planning processes. For example, the CBD includes provisions that each state shall respect, preserve and maintain traditional lifestyles of indigenous and local communities in biodiversity conservation. A number of instruments prescribe stakeholder participation in the regulation of specific activities driving changes in reef ecosystems, such as

formulating fisheries management rules together with communities,^{cxxii, cxxiii cxxiv}

In particular, the SSF Guidelines commit states to involve small-scale fishing communities in decision-making over production from living resources, with special attention to equitable participation of women, vulnerable and marginalized groups in the design and planning of instruments (see Box 14).^{cxxv} Similarly, the CBD commits states to “take action to strengthen the capacities of indigenous peoples and local communities to implement the Convention by respecting their rights, the customary sustainable use of biodiversity, and the

fair and equitable sharing of benefits arising from the use of their traditional knowledge and practices.^{cxxvi} Additionally, the Barbados Program of Action is an instrument dedicated to the unique circumstances and needs of SIDS, and calls upon states to support the efforts of island states to meet commitments for conservation and sustainable management of coastal and marine ecosystems.

Box 14. Small-Scale Fisheries and Gender

States and small-scale fisheries actors should encourage and support the role and involvement of both men and women, whether engaged in pre-harvest, harvest or post-harvest operations, in the context of co-management and in the promotion of responsible fisheries, contributing their particular knowledge, perspectives and needs. All parties should pay specific attention to the need to ensure equitable participation of women, designing special measures to achieve this objective. The specific knowledge of women fishers and fish workers must be recognized and supported. States should investigate and document traditional fisheries knowledge and technologies in order to assess their application to sustainable fisheries conservation, management and development.

Coherence and coordination. Policy coherence is a concept that refers to objectives of avoiding or minimizing negative spill-over effects of various policies across a body of policy, and the institutional mechanisms to promote coherence between them.^{cxxvii} Given that high number of relevant international instruments (232) introduced over a period of several decades (see Figure 4), coherence is certainly an issue. However, within this body of instruments the common objectives of the 591 commitments do not

register apparent contradictions based on an initial assessment, and in many cases the instruments aim to make explicit linkages. For example, the CBD calls on states to use existing instruments (e.g. the Regional Seas Programmes) to deliver reef-related policies, and in particular to implement the Code of Conduct for Responsible Fisheries,^{cxxviii} the International Plan of Action for IUU fishing, the Port State Measures Agreement, and the GPA.^{cxxix}

Alternatively, few mechanisms are established or designated by the instruments to explicitly promote coherence and coordination, though in practice financial mechanisms can serve this purpose, (e.g. the CBD uses its financial mechanism to promote coherence, developing strategic priorities for funding together with other global, binding instruments generally related to biodiversity such as CITES, CMS, etc.). In the absence of such mechanisms focused on reef-related commitments and outcomes, coordination across the 232 instruments and 591 commitments could be a significant issue and challenge for the international community. Given the large volume of instruments and commitments, it seems hard to imagine that some level of duplication would not exist, in the absence of coordination.

Climate change and other future changes. A key challenge for any instrument is to include processes for adjustment and adaptation based on monitoring and periodic evaluations of lessons learned.^{cxxx} Is this body of international reef-related policy ‘future-proofed’ to ecological and potentially latitudinal shifts expected due to climate change? To what extent can this body of policy address emerging issues such as artificial reefs, genetic manipulation of corals and assisted evolution, among others? In this sense, the nature of the commitments prescribed in the body of instruments may be well-suited to respond and adapt to such changes, with its heavy focus on integrated national and in some cases regional-level planning processes (e.g. marine spatial planning). In essence, the majority of the commitments are for achieving targeted outcomes through prescribed planning processes, such that even though issues such as genetic manipulation of corals may not be explicitly addressed in the instruments, the processes should be flexible enough to accommodate them. A typical example is the 2013 ICRI Call to Action, which “encourages governments to develop and implement legislation and integrated management programs, including through marine spatial planning approaches (including targets and incorporating zoning and enforcement, managed access and participatory governance), to ensure that threats to coral reefs are systematically addressed.” Such planning processes and approaches by design, allow for monitoring and evaluation, and adjustment to new drivers of change or changes in the intensity of drivers.^{cxxxi} Hence, in this state-centric body of instruments, a focus on commitments for state-level planning processes rather than prescribed actions, may be a feature rather than flaw.

3.2.12 Discussion on the effectiveness of delivery of the instruments

The previous sections summarized the results of the analysis of the design of international reef-related instruments, examining how the commitments contained in these instruments collectively responded to known anthropogenic drivers of change in coral reef ecosystems. However, as noted in chapter two, this is essentially one half of the equation in public policy analysis: assessing the design of instruments, but not how effectively they were delivered by states (or their impact). As mentioned previously, to systematically evaluate the delivery of international reef-related instruments would require state-by-state data and control sites that are likely unavailable, in order to provide the evidence for causality linkages between given instruments and observed ecological outcomes. This information is not currently available, but for indicative purposes a number of examples of interventions at the state level or lower to deliver some or all of the commitments have been reviewed and summarized in Annex 14, somewhat analogous to efforts to identify ‘bright spots’ of coral reefs that have proved resilient to key drivers such as impacts from climate change.^{cxxxii} These examples are ad-hoc and non-exhaustive, provided by members of the ICRI network to highlight cases considered by observers as ‘successful’ in achieving either outputs or outcomes related to delivery of various international reef-related instruments. Such examples highlight the importance of, and

differences in, state-level capabilities to delivery international reef-related instruments, irrespective of the design.

A total of 94 examples were identified by members of the ICRI network, roughly half of which occurred in Africa (25 percent) and the Caribbean (26 percent), followed by the Western and Central Pacific Ocean (18 percent), Southeast Asia (16 percent) and Latin America (11 percent). Most of these examples occurred at the local level (70 percent), with the remainder occurring at the national level (16 percent), or in a handful of cases at the sub-national level (4 percent) or multi-national level (10 percent). These examples often highlighted efforts to deliver instruments aiming to simultaneously address multiple anthropogenic drivers of change in coral reef ecosystems, through relatively broad interventions. The interventions typically focused on empowering stakeholders for resource and ecosystem management, supporting area-based ecosystem management measures, establishing national or local financial mechanisms for protected areas, science-based coastal and land-use planning, and ecological restoration. More specifically, the interventions could be non-exhaustively summarized as follows, to illustrate the types of national and local actions undertaken that help deliver on global policy commitments:

- ***Stakeholder-led management of small-scale fisheries***, developed through social marketing campaigns, supported by information and communications technology (ICT) innovations to monitor fish catches and/or report illegal fishing activities, training and support to small-scale fishing organizations, etc.;
- ***Innovative techniques and processes for participatory planning to establish and/or strengthen areas-based management measures*** that account for vulnerabilities to climate change at different scales, such as temporal closures to fishing, multi-use MPAs based on zoning, MPAs as ‘no-take reserves’ or ‘fish refuges’, MPA networks, locally-managed marine areas, etc., where states and stakeholders co-govern (e.g. stakeholders manage and states support, such as community measures formalized as state by-laws, or national instruments that allow communities to establish MPAs according to standards and criteria, with financial assistance from the state);
- ***Inter-sectoral and agency planning processes for area-based management by the state***, e.g. using multi-layered management tools (spatial and temporal), economic valuations of coral reef ecosystem services, scientific investigations of larval dispersal among reef populations in order to identify MPA networks, etc., translating into a combination of measures such as zoning of permitted or prohibited activities, no-take reserves, ‘whole-of-reef’ management plans to address multiple stressors, etc.;
- ***Integrated coastal zone and land use planning by the state***, e.g. at the level of coastal districts and cities as required by national instruments (e.g. Indonesia’s Spatial Planning Law No. 26/2007, Coastal Area Law 27/2007);
- ***New techniques, technology and processes to help build capacity for management of MPAs***, such as the establishment of MPA learning sites; introduction of new conservation leadership models (e.g. cohorts of fellowships); national training programs for MPA management with state agency staff; design of visualization tools that help stakeholders plan management measures; certification programs for MPA management, etc.;
- ***Small and large-scale restoration efforts***, including installation of reef structures to enhance coastal defenses; large-scale reef restoration projects that use ‘coral gardening’, where small pieces of healthy coral are collected after a bleaching event, raised in underwater nurseries and transplanted to degraded reefs;

- *Establishment of MPA financial mechanisms such as conservation trust funds*, e.g. national conservation trust funds (NCTFs) created throughout the Caribbean with a combination of endowment and sinking funds, or the Meso-American Barrier Reef Fund, etc.; and
- *Private sector initiatives* such as certification for eco-tourism, promotion of sponge aquaculture as a more profitable alternative to seaweed farming, public-private partnerships for eco-tourism and MPA management, etc.

IV. Key Findings and Policy-Relevant Recommendations

4.1 Summary of Key Findings

The results presented in the previous chapter illustrate the type of international instruments that have been introduced at both the global and regional level to address the anthropogenic drivers of change in coral reef ecosystems – considering the interaction between these drivers and reef ecosystems as part of socio-ecological systems (SES) where humans interact with nature, and this interaction in turn affects the services that nature provides to people (see Chapter 2 for a description of the SES framework underpinning this analysis). The results of this qualitative analysis can be synthesized in the following key findings:

A large and very broad body of international reef-related policy has developed incrementally over several decades, designed to address almost every anthropogenic driver of change in coral reef ecosystems. As a positive result for coral reef ecosystem conservation, this analysis suggests that the current body of international policy instruments related to coral reefs is already quite broad, with relatively few gaps in design in terms of the drivers addressed or geographic regions covered. The inventory of this large body of international policy includes:

- *232 international reef-related instruments*, which include *at least 591 commitments* to address anthropogenic drivers of change in coral reef ecosystems; and
- *79 discrete global targets to address the drivers of change that are time-bound and measurable (14 percent of which have expired)*, as well as 58 regional targets, most of which are found in just nine instruments (global: GPA, Aichi Targets, Paris Agreement, 2030 Agenda; regional: CTI Regional Action Plan, SPREP Action Plan 2011-2015, Bay of Bengal SAP, Arafura and Timor Seas SAP, Indian Ocean SAP). An example of a target specific to coral reef ecosystems, and which has expired, is the Aichi target that “by 2015 the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.” Examples of broader global targets to address various drivers include commitments: to hold the increase in the global average temperature to well below 2 degrees above pre-industrial levels; to end overfishing and effectively regulate harvesting; to prevent and reduce marine pollution of all kinds; and to conserve at least 10 percent of coastal and marine areas.

This broad body of international policy is focused on action by states at the national level, with states having the primary responsibility for some 75 percent of the commitments. By virtue of the maritime zones established under UNCLOS, the world’s warm-water coral reef ecosystems fall under national jurisdiction. In that context, in the territorial sea, coastal States exercise sovereignty over their natural resources. In the EEZ, coastal States have sovereign rights for the purposes of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, and jurisdiction for the protection and preservation of the marine environment. On the continental shelf, coastal States exercise sovereign rights for the purpose of exploring it and exploiting its natural resources, which consist of the

mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species. In the EEZ and on the continental shelf, coastal States also have jurisdiction with regard to marine scientific research. These rights and responsibilities are reflected in the body of international reef-related policy: of the 591 commitments identified in this body of policy, a minimum of 75 percent are primarily the responsibility of states to deliver.

Given the focus on action by states, most of the commitments are planning and process-oriented. The majority of commitments focus on various forms of planning that states should or are required to conduct in order to develop rules and responses to locally-generated anthropogenic pressures on coral reef ecosystems – consistent with a body of policy that is heavily state-centric. Some of the most common objectives of the commitments included: (i) stabilizing atmospheric concentrations of greenhouse gases and reducing emissions, while supporting adaptation in developing states and particularly SIDS; (ii) regulating harvesting of fish resources to maintain stocks at targeted levels through science-based limits and measure to protect associated ecosystems, with a priority on support to small-scale fisheries; (iii) conducting integrated planning processes to prevent and reduce land-based sources of ocean pollution, together with environmental impact assessments and particularly an emphasis on waste treatment capabilities; (iv) regulating pollution from non-living resources, as well as shipping; and (v) addressing physical restructuring of the coastline together with multiple anthropogenic pressures on coral reef ecosystems or coastal and marine ecosystems more broadly, typically through area-based planning and regulation, such as integrated coastal zone management and marine spatial planning, and networks of marine protected areas.

While the body of international reef-related policy may be broad in its coverage of the drivers of change, it is not necessarily ‘deep’ in its response – i.e. the nature of the commitments for states are quite general, and are largely voluntary. Many of the commitments are focused on “marine and coastal ecosystems” in general or on the various economic sectors of human activity that may driver changes in coral reef ecosystems, rather than on coral reef ecosystems themselves. These commitments are nonetheless applicable to coral reefs even if not focused on them. Additionally, over half of all commitments were considered as having the weakest level of commitment (i.e. commitments that are not required, contained in non-binding instruments), though commitments linked to extraction of non-living resources, transport, generation of land-based sources of pollution and physical restructuring of the coastline all had an above-average proportion of strong commitments.

Although states (many of whom are low or lower-middle-income economies) have the primary responsibility to deliver the vast majority of the international policy commitments, relatively few governance mechanisms have been designed by the instruments to support them to do so. More specifically, large areas of the world’s warm-water reefs are under the jurisdiction of states with developing economies, and many of the international commitments are the responsibility of these states, yet most of the instruments are not linked to financing mechanisms or new and additional financial resources to support delivery. Additionally, given national jurisdiction over most reefs, the international instruments define relatively few enforcement mechanisms for the reef-related commitments.

4.2 Policy-Relevant Recommendations

As described in Chapter 1, this analysis aims to answer the question: does the international community currently have sufficient policy instruments to address the anthropogenic drivers of change in coral reef ecosystems, given recent observations and the current state of knowledge? If not, what role could international policy play in helping to address these drivers and conserve and protect coral reef ecosystems, and what policy changes would be needed?

Based upon the results of the analysis (see Chapter 3), this last question can be refined based on a distinction between those drivers that are globally widespread, and those that are locally-generated. The driver of climate change (exerting pressures in the form of elevated sea surface temperatures and ocean acidification) poses an existential threat to warm-water coral reef ecosystems and is globally widespread, beyond the reach of any one state. The international instrument agreed to respond to climate change is the Paris Agreement, which aims to hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. Achieving this target depends on voluntary, non-binding actions by states. Hence the question can be refined slightly, to ask: beyond assisting states to make the greenhouse gas emissions reductions needed to meet the target in the Paris Agreement, what role can international policy play in supporting conservation and sustainable management of coral reef ecosystems?

This slightly refined question remains essential for coral reef conservation objectives, because while climate change may be driving the largest changes in coral reef ecosystems, these systems are affected simultaneously by multiple anthropogenic drivers of change, that are not necessarily isolated and often result in a positive feedback loop. Additionally, different types of drivers may interact in a given coral reef ecosystem, and where such interactions occur, combined with ecological complexity, negative impacts on coral reef ecosystems may happen sooner and be more severe than previously thought. For these reasons, states and stakeholders have often emphasized efforts to address the cumulative impacts of multiple anthropogenic drivers in order to enhance the integrity and resilience of coral reef ecosystems in the face of climate change, as essentially global warming is a widespread anthropogenic driver of change, exacerbated by locally-generated drivers. In summary, given the cumulative effect of multiple, locally-generated anthropogenic drivers of change on coral reef ecosystems, this analysis raises a revised version of the question as follows: *what role can international policy play in helping states to address the locally-generated anthropogenic drivers of change in coral reef ecosystems, in order to enhance their resilience and potential for survival in the face of globally-widespread climate change?*

To answer this question, an analysis was conducted of the design of international reef-related instruments. The results of the analysis suggest that instruments have been broadly designed to address the known drivers of change. However, given the ecological outcomes measured (e.g. continued decline in reefs and a projected acceleration in this decline under climate change), the key gap is assumed to be in the effectiveness of delivery at the national level (given that an estimated 85 percent of warm-water coral reefs are under the jurisdiction of 25 states). For this reason, the recommendations focus on the political will and capability of coral reef states to deliver the large number of existing international reef-related policy commitments (i.e. implementation). International policy commitments currently exist for almost all of the known locally-generated human drivers of change in coral reef ecosystems, even as these changes are still occurring and often increasing. However, while there are few gaps in the drivers covered in the design of the current body of international policy, these policies lack enforcement mechanisms for most commitments, and also financing mechanisms to provide new or additional financial resources to the large number of low-income states responsible for the commitments. Additionally, given the breadth of reef-related commitments across so many instruments (agreed incrementally over a long period of time), there is a need for more consolidated and coordinated monitoring and reporting of the status of delivery for these commitments. For these reasons, the following policy pathways (i.e. policy-dependent scenarios) were recommended by the coral reef policy advisory committee for consideration by UNEA, to focus on accelerating implementation of existing commitments:⁶

⁶ Three policy pathways are proposed for consideration here in order to spur discussion, though an infinite number of options may exist from any given starting point. Note that they are articulated in terms of the expected time to completion: short-term (1 – 2 years), medium-term (3 – 5 years) or long-term (5 – 10 years).

Option One: status quo for international reef-related policy, with accelerated implementation. Given that the current body of policy covers almost all known human drivers of change in coral reef ecosystems, and that implementation by states is the key challenge or gap, one scenario could envisage a status quo in the body of policy, with accelerated and coordinated action by states. This acceleration would be based on a renewed commitment from states to address the locally-generated drivers of change in coral reef ecosystems, and could include the following actions:

- a) States conduct a similar analysis or review of reef-related policies at the state level, following the analytical framework and methods used for this analysis of international policy, to assess the extent to which current international commitments have been translated into national policy and identify gaps [short-term], including
 - A self-audit by states of national policies to deliver the current commitments in international instruments,
 - Regular (e.g. every 3 to 5 years) reporting on progress toward national delivery of current international commitments s; and
- b) States develop implementation plans for delivering the international commitments, with an emphasis on supporting local implementation of national policies, analyzing and articulating the social and economic benefits from implementation, utilizing existing management tools and identifying any technical and financial support needed [short-term].

Next steps for UN Environment, in consultation and cooperation with competent international organizations, to support this scenario would be to:

- identify states interested to move forward and conduct the self-audit and develop implementation plans (including any technical and financial support needed);
- establish a community of practice for conducting these policy reviews and developing implementation plans; and
- identify focal points in each state for tracking national delivery of international policy commitments and coordinating across relevant national agencies.

Option Two: strengthening the existing international policy framework, including governance mechanisms, to increase implementation by states. While option one assumes a status quo for international reef-related policy (with accelerated implementation by states), another option may be to revise existing international instruments to strengthen mechanisms and incentives for states to implement existing commitments. This could include a combination of changes to existing international instruments, and support from international organizations to assist states to accelerate implementation, such as the following actions:

- a) States may create a new overarching international monitoring group (e.g. a ‘coral reef policy observatory’), or task ICRI with the role (in consultation and cooperation with competent international organizations), to be responsible for monitoring progress in implementing international commitments at the national level, including a focused effort to collect more information to establish causal links between given instruments and ecological outcomes, and helping states to coordinate among the many reef-related commitments in multiple instruments [short-term];
- b) Development finance institutions, such as the World Bank, the Asian Infrastructure Investment Bank, etc., may expand upon the existing environmental safeguards that apply to all projects they finance, in order to provide reef-specific guidance to ensure that all funding takes into consideration potential impacts on coral reef ecosystems, e.g. ‘coral reef safeguards’ [short-term];
- c) States may conduct self-audits to assess the status of implementation of current international commitments, and report the results to the UN General Assembly and UNEA [short-term];

- d) States could agree on a new global coral reef target, that would be quantifiable and ambitious in order to address the various drivers, as part of the post-2020 global biodiversity framework following the Aichi targets [medium-term];
- e) UNEA could invite states to ratify those global, legal instruments where further support is needed (e.g. the Port State Measures Agreement) [medium-term];
- f) International instruments may be amended to expand the mandate of existing governance mechanisms, likely on a regional basis through the Regional Seas Conventions, to support states to meet the existing commitments (e.g. with coordination from the ICRI Secretariat) [medium-term].

Next steps for UN Environment, in consultation and cooperation with competent international organizations, to support this scenario would include:

- identifying global legal instruments where additional ratification is essential to implementing international policy commitments for coral reef conservation and management;
- assessing opportunities for amendment of Regional Seas Conventions to strengthen governance mechanisms to support implementation by states; and
- preparing terms of reference for a new international monitoring role for existing reef-related policy commitments.

Option Three: introduction of new international policy instruments and/or governance mechanisms to support national implementation. Options one and two focus on the existing international body of policy, but another option would be to add to it, in order to accelerate implementation. As mentioned previously, existing commitments are largely considered to be ‘weak’ in terms of the requirements placed on states, and mechanisms to support delivery are often missing. This suggests an option for either: (i) a new global instrument focused solely on coral reefs, and/or (ii) a new international mechanism to support implementation of existing reef-related commitments, including the following actions:

- a) States agree on a new global instrument specific to coral reefs, for example a negotiated binding treaty or convention on coral reefs, with specific targets for different drivers of change and linked to governance mechanisms to support delivery (including monitoring and reporting), or agree on a new policy instrument nested under an existing instrument (e.g. an ambitious new coral reef target as part of the post-2020 global biodiversity framework following the Aichi targets under the CBD) [long-term], and/or
- b) States agree to create a new mechanism(s) to support delivery on existing reef-related policy commitments, for example:
 - A new financing mechanism specifically for coral reef ecosystems, such as a global fund for coral reefs (e.g. a ‘Coral Environment Fund’ or a ‘REDD for Reefs’ fund) to provide grant or concessional financing through an existing institution such as the GEF (with governance linked to an existing instrument such as the CBD or UNFCCC where the CoP sets priorities, procedures and criteria for funding, or even under the GEF Council),⁷ with funding targeted to cross-sectoral collaboration where possible and linked to reporting by states on progress towards existing targets and international policy commitments (the mechanism could also include a facility for non-grant financing of private sector models and operations that support delivery of existing policy commitments) [short to medium-term]; and/or
 - A new global monitoring and reporting mechanism to support national implementation, e.g. a new international commission on coral reefs comprised of representatives of UN member states, in order to monitor and report progress on state delivery of international

⁷ For example, the CBD CoP could direct the secretariat to work with the GEF under the existing MOU to establish a window of funds solely for coral reefs, additional to country-based GEF allocations.

reef-related policy commitments, as well as to help coordinate delivery of reef-related commitments scattered across a large number of international instruments [short-term].

Next steps for UN Environment to support this scenario would include:

- Supporting an ad-hoc committee of UN member states to develop proposals for a new policy instrument specific to coral reefs; and/or
- Developing the concept for a new global financing mechanism to support coral reefs.

Importantly, the three options identified by the committee and described above are not mutually exclusive, and could be combined into various packages. As one example, a fourth option is presented below, consolidating from the three pathways identified by the coral reef policy advisory committee, to focus on policy delivery in the world's warm-water coral reef states:

Option Four (consolidated from the three previous): rapid support to states for policy implementation, i.e. “the coral reef-state solution”. Focusing only on short and medium-term actions and on providing international support to the relatively small group of states with jurisdiction over the world's warm-water coral reefs (e.g. twenty-five states have jurisdiction over 85 percent of the world's warm-water coral reefs), the following actions could be consolidated from the three pathways identified by the committee, into a fourth option:

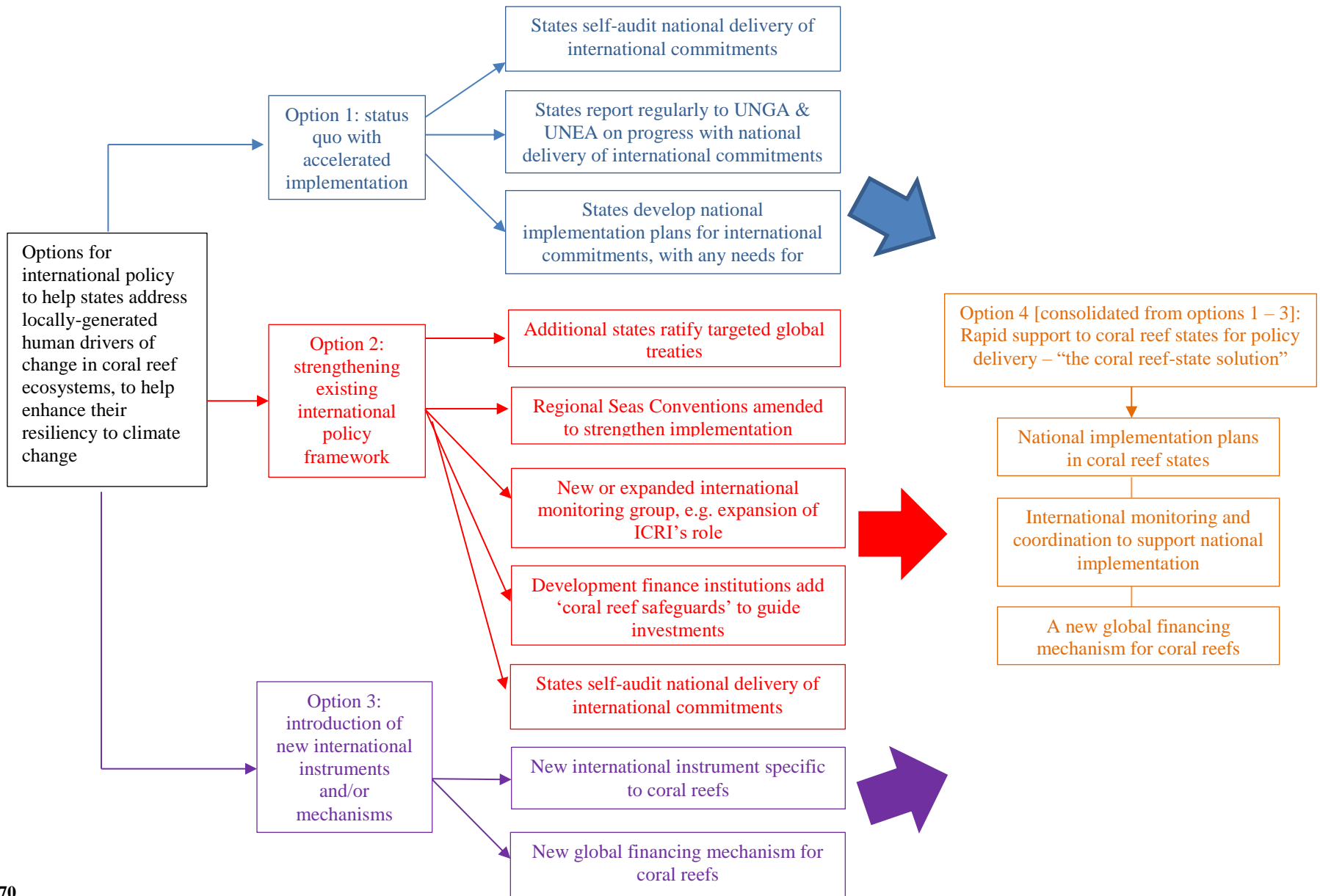
- a) *National implementation plans:* Coral reef states conduct a self-audit of national policies to deliver the current commitments in international instruments and develop implementation plans for policy delivery, identifying any technical and financial support needed [short-term];
- b) *International monitoring and coordination to support national implementation:* States may create a new overarching international monitoring group (e.g. a ‘coral reef policy observatory’), or task ICRI with the role (in consultation and cooperation with competent international organizations), to be responsible for monitoring progress in implementing international commitments at the national level in coral reef states [short-term]; and
- c) *A new global financing mechanism for coral reefs:* States agree to create a new financing mechanism specifically for coral reef ecosystems, such as a global fund for coral reefs (e.g. a ‘Coral Environment Fund’ or a ‘REDD for Reefs’ fund) to provide grant or concessional financing to low-income and lower-middle-income coral reef states through an existing institution such as the GEF [short to medium-term].

In summary, given:

- The existential threat to warm-water coral reef ecosystems from climate change, based on the projections in the IPCC 2018 special report that the world's coral reefs will decline by a further 70 to 90 percent with a 1.5 degree Celsius increase in the global mean temperature from pre-industrial levels (with losses greater than 99 percent with a 2 degree Celsius increase);^{cxxxiii}
- The cumulative effect of multiple anthropogenic drivers of change on coral reef ecosystems, such that efforts to address locally-generated anthropogenic drivers of change (e.g. extraction of reef fish, input of pollutants, physical loss, etc.) can enhance the integrity and resilience of coral reef ecosystems in the face of pressures from the globally-widespread driver of climate change (e.g. bleaching is a cumulative-stress response where global warming is the most widespread stressor, but which known localized stresses exacerbate);^{cxxxiv, cxxxv, cxxxvi, cxxxvii, cxxxviii, cxxxix, cxl}
- The large body of international policy that currently exists includes commitments for states to address almost all of the major known locally-generated anthropogenic drivers of change in coral reef ecosystems that may increase their vulnerability to climate change; and
- The voluntary nature of a number of international reef-related instruments, with relatively few global mechanisms to support states with low-income economies to deliver the instruments locally; then

- Figure 10 below aims to represent the three policy-relevant options for utilizing international policy to help states address the locally-generated anthropogenic drivers of change in coral reef ecosystems, in order to enhance their resilience and potential for survival in the face of globally-widespread climate change, as well as an indicative example (labelled ‘option four’) of how these non-mutually exclusive options could be combined or consolidated.

Figure 10. Simple Decision Tree for Considering Options to Leverage International Policy for Increased Conservation and Management of Coral Reef Ecosystems



The above simple decision tree proposes only one set of decisions and possible policy pathways (options 1 – 3, as well as an example of how these options could be combined or consolidated – option 4), though again there could be infinite combinations (including the ‘do-nothing’ or ‘business-as-usual’ option, which is implicit). The option or combination of options that best supports enhanced delivery of existing reef-related commitments would likely depend on whether the current constraint for states is: (i) willingness (i.e. political will to prioritize coral reef commitments on a limited agenda, and/or (ii) capability (i.e. capacity to implement actions needed to meet the commitments, including both technical and financial capacity). If a lack of political will is the main factor contributing to coral reef degradation from locally-generated anthropogenic drivers,^{cxli, cxlii} then perhaps a new international instrument may be introduced to help strengthen states’ commitment and prioritize reefs on national agendas, and/or existing instruments strengthened or delivery accelerated (options 1 and 2, and option 3.a for a new instrument). For example, reefs may not be prioritized in national agendas because they are lost among all of the other commitments and objectives in the current body of international reef-related policy instruments, so a new, reef-specific instrument could help address this challenge, or reef-specific commitments featured prominently in a new treaty. However, even with a new binding instrument, the options for establishing international enforcement mechanisms may be limited. At the same time, a new treaty could provide a reporting mechanism, which could enhance political will by providing greater visibility to states’ commitments.^{cxliii} Of note, a review in 2011 concluded that a single coral reef treaty may be unnecessary given the breadth of existing instruments and the commitments they contain.^{cxliv}

If the key constraint is the capacity of low-income and lower-middle income coral reef states to meet international reef-related commitments, then creating a new financial mechanism to provide additional resources could help states fill the capacity gap (option 3.b), or some targeted combination of the three option such as the example presented in option four. Perhaps the biggest advantage of international policy instruments is to mobilize additional resources and provide an exchange of information.^{cxlv} Coral reefs may be under the national jurisdiction of coastal states and difficult to characterize as global public goods as a basis for collective action and aid, however they exhibit characteristics of common pool resources (or quasi-public goods).^{cxlvi} While interdependence on a shared resource, including global public goods, is typically the rationale for collective action for new investment, there is also a rationale for collective action for a ‘common concern of humanity’. Such a shared concern, even if not a shared resource, can be a basis for collective action and was part of the rationale for the CBD.^{cxlvii} More specifically, a common concern of humankind can be a rationale for international cooperation and aid to low-income and lower-middle-income coral reef states, who have jurisdiction to protect and sustainably manage coral reef ecosystems. Such aid can also be linked to information exchange, one of the central advantages to international policy. New and additional resources could also be linked to increased and coordinating monitoring and reporting, both enhancing information exchange and reducing the costs for developing states to meet existing commitments. Essentially, the provision of a new financial mechanism could help foster agreement by states to meet existing commitments, which may not have been the preference for independent decision-making. Such a mechanism could also foster increased accountability between states for meeting the targets already set in current international instruments.

The financial mechanism could be supported by ICRI, acting as a clearinghouse for information exchange on interventions, progress towards existing commitments, indicators of targets, etc. Developing states could prioritize needs for support based on the 79 targets identified here from existing international policy, as well as the 591 commitments throughout international policy, organized by the common anthropogenic drivers of change. While avoiding a ‘check-list approach’, a starting point could be to conduct of the self-audit of the relevant national instruments recommended in option 1, to assess coherence with existing commitments in international law, and any gaps. Such gaps could form the basis for any needed support through the financial mechanism, and monitoring progress toward the existing targets (e.g. in the 2030 Agenda and the Aichi targets). Using a standardized diagnostic of national reef policy instruments and delivery mechanisms for commitments made under current international policy, states could prioritize directed and targeted funding from this new mechanism, to make measurable progress toward meeting existing targets. Table 14 below summarizes potential advantages and disadvantages between the proposed options.

Table 14. Potential Advantages and Disadvantages of Proposed International Policy Options

Option	Potential Advantages	Potential Disadvantages
<p>Option 1: Status quo with accelerated implementation:</p> <ul style="list-style-type: none"> • States self-audit national delivery of international commitments • States report regularly on progress • States develop national implementation plans 	Does not require a change to the existing international policy framework, but rather renewed prioritization by coral reef states, facilitated by self-audits, national planning and international reporting	Focus is solely on assessment and planning, rather than on concrete actions
<p>Option 2: Strengthen the existing international policy framework</p> <ul style="list-style-type: none"> • Create an international monitoring group (or task ICRI) for national policy implementation • DFIs expand guidance for coral reef safeguards, leverage portfolios • States self-audit national delivery of international commitments • New global coral reef target • Invite states to ratify those global, legal instruments where further support needed • Amend instruments to expand the mandate of existing governance mechanisms, e.g. Regional Seas Conventions 	Leverages existing international policy framework to try increase prioritization of coral reef commitments by coastal states; also helps to address coordination and monitoring challenges/gaps in current framework	Does not include any new mechanisms to support national implementation of coral reef commitments
<p>Option 3: Introduction of new international instruments and/or mechanisms</p> <ul style="list-style-type: none"> • New international instrument specific to coral reefs • New global financing mechanism for coral reefs 	Creates new priorities for coral reef conservation, and new resources to support national implementation of commitments	New international instrument is a long-term undertaking, significant additional funds likely required for new financing mechanism
<p>Option 4: Consolidated from previous three options: “coral reef-state solution”</p> <ul style="list-style-type: none"> • States develop national implementation plans • Create an international monitoring group (or task ICRI) for national policy implementation • New global financing mechanism for coral reefs 	Targeted and action-oriented package of support to coral reef states, for national implementation of existing international commitments, including new monitoring and coordination, new financing for low-income and lower-middle-income economies	Significant additional funds likely required for new financing mechanism

In closing, regardless of the option(s) taken, international policy can play a role in helping to address the drivers of change in coral reef ecosystems, and particularly in this case the locally-generated drivers, to enhance resilience of the ecosystems to globally-widespread climate change to the extent possible. As mentioned previously and illustrated in option 4, the actions proposed in these options are not mutually exclusive, and could be seen as part of a package to meet both the reef-related Aichi targets^{§§} and reef-related

^{§§} Reef-related Aichi targets include:

- By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning;
- By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained;
- By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits; and

targets for SDG 14.^{***} As the post-2020 global biodiversity framework is developed, and the 2020 ocean conference approaches to assess the status of implementation of SDG 14, these options or some combination of them would likely be a central piece of any coordinated action by states.

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- By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

^{***} Reef-related targets for SDG 14 include:

- By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics;
- By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism;
- Provide access for small-scale artisanal fishers to marine resources and markets;
- By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution;
- By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism;
- By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans; and
- By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.

Glossary

Anthropogenic drivers of change in coral reef ecosystems: defined here as the types of impact that social systems have upon coral reef ecosystems, and deconstructed into: (i) the human activities driving the changes, and (ii) the actual pressures on the coral reef ecosystems caused by these activities, organized according to ‘themes’ that are analogous to a ‘sector’.^{cxlviii}

Coral reefs: defined as a physical structure which has been built up, and continues to grow, over decadal time scales, as a result of the accumulation of calcium carbonate laid down by hermatypic corals and other organisms.^{cxlix}

Enforcement mechanisms: organizations, processes and/or systems to enhance compliance with policy commitments (i.e. for enforcement, including monitoring and the penalty assessment process)

Financial mechanisms: organizations, processes and/or systems established to provide financing support for developing states to meet their commitments in the international reef-related policy instruments, typically in the form of grant or concessional funds

Governance: the process of discussing, agreeing on, designing, and implementing informal and formal rules (i.e., procedures, laws) to allow for members in society to have orderly and productive interactions with one another for a specific goal.^{cl} Governance is a complex concept broken down here into the components of (i) instruments and (ii) mechanisms, operating at various levels, for further analysis.

Governance mechanisms: defined here as organizations or processes to help administer and deliver (i.e. to implement) policy instruments. This may include associated funding mechanisms and investments. Essentially, governance mechanisms are defined as the means by which governments deliver the instruments that they have specified, e.g. organizations or funds created for implementation.

Institutions: the rules, norms, shared strategies that members of a society construct in order to guide behavior toward specific goals.^{cli}

International legal instruments: defined here as treaties or agreements concluded between states in written form and governed by international law.^{clii}

International voluntary instruments: defined here as non-binding, voluntary policy instruments agreed in written form between two or more states, for example guidelines and initiatives

Organizations: created by rules in order to administer them (and typically create subsequent rules for this purpose).^{cliii}

Policy instruments: defined here as tools by which governments use power in attempting to ensure support and effect social change, in this case to protect and sustainably manage coral reef ecosystems.^{cliv}

Policy commitments: within instruments, legal instruments contain ‘obligations’ and voluntary instruments contain ‘provisions’, both of which are collectively defined here as ‘commitments’ made by the states, which can be considered as discrete, multi-dimensional variables for analysis

Policy instrument effectiveness: the degree of goal-realization due to the use of certain policy instruments.^{clv}

Public policy: a particular course of action or inaction pursued by governments, individually or collectively.^{clvi}

Socio-ecological systems: human-nature interactions described as coupled human and natural systems, in which societies and environments shape each other, where the changing human condition serves to both directly and indirectly change ecosystems, and in turn changes in ecosystems cause changes in human well-being.^{clvii, clviii}

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