World Heritage papers 45

The Future of the World Heritage Convention for Marine Conservation

Celebrating 10 years of the World Heritage Marine Programme

United Nations
Educational, Scientific and
Cultural Organization

World
Heritage
Convention

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Foreword

Dr Mechtild Rössler,
Director of the World Heritage Centre
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When I began working for the World Heritage Centre 25 years ago, the pace of ocean protection was lagging far behind conservation on land. While the ocean is absolutely vital to life on Earth—it supplies half of the world's oxygen and one fifth of our protein—problems in the marine environment are invisible from the surface and therefore do not always receive the same attention as terrestrial challenges like deforestation and overdevelopment.

Fortunately, the global community has come together in the past 15 years to steward the seas that sustain us. At the 2002 World Summit on Sustainable Development, 189 countries committed to establishing networks of marine protected areas by 2012. The 2003 World Parks Congress in Durban again emphasized the need for more marine conservation, including a stronger network of World Heritage marine sites.

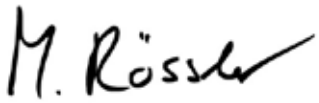
The 1972 World Heritage Convention is uniquely suited to facilitate conservation of the world's oceans, since the actions of individual nations have ripple effects well beyond their boundaries in a dynamic world connected by currents and migratory species. Moreover, international cooperation is the very foundation of the Convention. Recognizing that we had a key role to play in marine conservation, UNESCO established the World Heritage Marine Programme in 2005. The programme's mandate is to promote effective conservation of existing and potential marine areas of Outstanding Universal Value, helping them thrive for generations to come.

Over the past decade, the World Heritage Marine Programme has been a catalyst, helping to accelerate the pace of ocean protection around the world. Over that time, we have seen the percentage of the global ocean covered by marine protected areas grow from 1,3 percent in 2005 to 5,1 percent today.[1] The total surface of unique marine areas that benefits from international protection through the World Heritage Convention has more than doubled over the past decade. Today, the World Heritage Marine Programme encompasses 49 sites in 37 countries amounting to 10 percent by surface area of all the world's marine protected areas. It includes renowned sites like the Galápagos Islands (Ecuador) and the Great Barrier Reef (Australia), as well as lesser-known treasures like Socotra Archipelago (Yemen) and Ogasawara Islands (Japan). World Heritage designation raises the profile of these sites and brings resources and expertise to support their protection.

1 IUCN and UNEP-WCMC (2016), The World Database on Protected Areas (WDPA) [On-line], December 2016, Cambridge, UK: UNEP-WCMC. Available at: www.protectedplanet.net

The global network of World Heritage marine sites allows us to track challenges like climate change and overfishing from the equator to the poles. It facilitates the exchange of ideas and information, so we can replicate successes and avoid costly mistakes. The World Heritage system also provides an unparalleled level of accountability. In the race to save the seas, we must not rely on paper parks. True conservation requires an ongoing commitment, especially in this era of climate change, growing development pressure, and increased demand for fresh seafood.

In the past decade, the sites within the World Heritage marine network have pioneered solutions to some of the planet's most pressing problems, leading the way on sustainable tourism, low carbon operations, and market-based sustainable fishery management. The World Heritage Marine Programme is positioned to continue leading on 21st-century marine conservation, but we need the support of nonprofit, corporate and government partners. We are proud to report on our accomplishments to date, and invite you to join us to scale up our efforts so that, together, we can meet the opportunities and challenges for the next 10 years.



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Director of the World Heritage Centre

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The editors wish to thank all the authors and co-authors that have contributed to this publication. Several articles build on the outcomes of the third World Heritage marine site managers conference (27 to 31 August 2016, Gálapagos Islands, Ecuador), and it is thanks to these global gatherings that new ideas and synergies emerge. We would therefore like to acknowledge the Gálapagos National Park and the Gálapagos Government Council, and express our sincere gratitude to Lindblad Expeditions-National Geographic for their leadership support. We also wish to thank the following contributors to the conference: The Leona M. and Harry B. Helmsley Charitable Trust, the French Marine Protected Areas Agency, the Swiss manufacture Jaeger-LeCoultre, the governments of Flanders, the Netherlands and Australia, the Great Barrier Reef Foundation, World Wildlife Fund, Conservation International and Gálapagos Conservancy.

Finally, we would like to thank everyone who has supported Marine World Heritage in one way or another during the last 10 years. Together we can safeguard these priceless assets of humanity for future generations.

Abbreviations

ABNJ	Areas Beyond National Jurisdiction
ACBC	Arctic Circumpolar Boundary Current
AECO	Association of Arctic Expedition Cruise Operators
AIS	Automatic Identification System
AMTP	Arctic Marine Tourism Project
AP	Associated Press
ARMS	Arctic Register of Marine Species
AWTS	Advanced Wastewater Treatment Systems
BBNJ	Biodiversity Beyond National Jurisdiction
CITES	Convention for International Trade of Endangered Species
CMAR	Eastern Tropical Pacific Marine Corridor (Corredor Marino del Pacífico Este Tropical)
CMS	Convention on Migratory Species
ECA	Emission Control Area
EEZ	Exclusive Economic Zone
EMODnet	European Marine Observation and Data Network
FAA	Federal Aviation Administration
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GOOS	Global Ocean Observing System
HFO	Heavy Fuel Oil
IATTC	Inter-American Tropical Tuna Commission
IFO	Intermediate Fuel Oil

ILBI	International Legally Binding Instrument
IOC	Intergovernmental Oceanographic Commission
ISA	International Seabed Authority
IMF	International Monetary Fund
IMO	International Maritime Organization
IUCN	International Union for Conservation of Nature
IUU	Illegal, unreported and unregulated fishing
MARPOL	International Convention for the Prevention of Pollution from Ships
MoU	Memorandum of Understanding
MPA	Marine Protected Area
NCA	Norwegian Coastal Administration
NGO	Non-Governmental Organization
NHTC	Northern Hemisphere Thermohaline Circulation
NMA	Norwegian Maritime Authority
NOx	Nitrogen Oxides
NPS	United States National Park Service
NRDC	Natural Resources Defense Council
OUV	Outstanding Universal Value
PAME	Protection of the Arctic Marine Environment Working Group
PM	Particulate Matter
PIPA	Phoenix Islands Protected Area
RFMO	Regional Fisheries Management Organization
SIF	Seychelles Island Foundation
SOx	Sulfur Oxides
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly
UNICPOLOS	United Nations Informal Consultative Process on the Oceans and the Law of the Sea
WCPFC	Western and Central Pacific Fisheries Commission
WNF	West Norwegian Fjords - Geirangerfjord and Nærøyfjord

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The 1972 World Heritage Convention for ocean conservation: Past, present and future

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Fanny Douvere,
Coordinator,
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Children playing in the Rock Islands Southern Lagoon World Heritage site, Palau.

1. Introduction

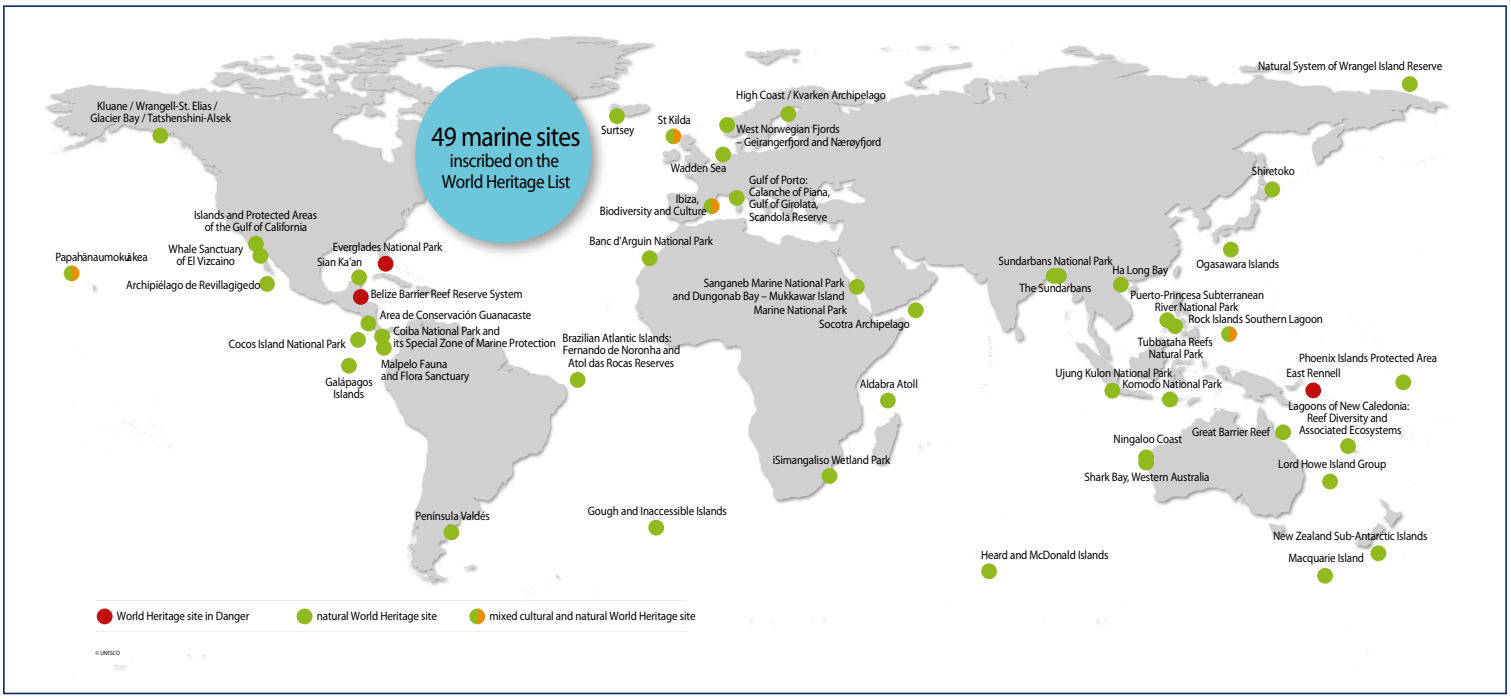
The World Heritage marine network includes the crown jewels of our ocean. It protects the breeding grounds of the world's largest healthy population of grey whales, the highest density of ancestral polar bear dens, the home of one of the world's most ancient fish, the coelacanth, and that of the inimitable marine iguanas. Like the rest of the world's ocean, these flagship Marine Protected Areas (MPAs) are facing grave challenges. But, with the backing of one of the most successful international conservation instruments in human history, marine sites on UNESCO's World Heritage List are also beacons of hope in a time of unprecedented change. This article looks at what has been achieved in the 10 years since the establishment of the World Heritage Marine Programme, and what the future holds for the next decade.

1.1. Marine World Heritage: Protection of sites already listed

The 1972 World Heritage Convention unites nations behind a shared commitment to preserve the world's outstanding heritage for the benefit of present and future generations[1]. The Convention was created to safeguard sites of natural or cultural significance that *"need to be preserved as part of the world heritage of humankind as a whole."* It recognizes that the protection of these exceptional places is the duty of the international community, and ensures that the preservation of these special sites becomes a shared responsibility while fully respecting the sovereignty of States. Over its 44-year history, the World Heritage Convention has recognized

1 UNESCO. 1972. Convention Concerning the Protection of the World Cultural and Natural Heritage adopted by the General Conference at its 17th session, Paris, 16 November 1972: http://whc.unesco.org/en/conventiontext/

The 49 marine sites inscribed on UNESCO's World Heritage List (as of 1 August 2016)



over 1,000 cultural and natural treasures in more than 160 countries that are considered of Outstanding Universal Value (OUV)[2]. Their disappearance would be an irreversible loss to humanity.

While the ocean covers two-thirds of our planet, marine conservation has historically received less attention and resources than the protection of terrestrial sites. In the past twenty years, there has been a concerted international effort to change that, caused in part by a recognition that our ocean is facing mounting pressures, and that international cooperation can help scale-up solutions to problems like pollution, overfishing, and invasive species. The World Heritage Convention is a natural fit for the job of advancing ocean protection at a global scale, but experts noted the World Heritage List included various major gaps—globally unique marine ecosystems that did not yet benefit from international protection—and that sites on the list should benefit from more dedicated attention in state of conservation reviews as well as support to share learning and replicate successes. This was first recognized at the 2003 IUCN World Parks Congress in Durban, South Africa, which led to the establishment of the World Heritage Marine Programme that was officially inaugurated at the 29th session of the World Heritage Committee in 2005[3]. The Programme's overall mission is to secure effective conservation of existing and potential marine areas of OUV to make sure they will be maintained and thrive for generations to come.

Since the Programme's founding in 2005, 16 new marine sites have been added to the World Heritage List, more than doubling the surface area protected in a little over 10 years. Today, the World Heritage List includes 49 unique ocean places – distributed across 37 countries – recognized for their unique marine biodiversity, singular ecosystem, unique geological processes or incomparable beauty. Together these sites cover about 10 percent by surface area of all existing MPAs, many of them household names, known and treasured the world over.

World Heritage designation raises the visibility and profile of key ocean conservation concerns, and equips managers to advocate more effectively for their protection. This has resulted in many high profile successes since the first marine site—the Great Barrier Reef—was inscribed on the World Heritage List in 1981 (Douvere, 2015). For example:

- In Mexico, skilled use of the Convention helped local stakeholders in the Whale Sanctuary of El Vizcaino prevent commercial salt factories from disrupting the last pristine breeding lagoon for the Pacific Grey Whale;
- In South Africa, the listing of iSimangaliso Wetland Park helped transform one of the country's poorest regions into a prosperous, job-generating community engaged in managing the wildlife-rich wetlands;
- In Seychelles, Aldabra Atoll has seen its green turtle population go from near extinction to one of the largest on earth.

More recently, the World Heritage Centre and IUCN were able to work with the Australian Government to secure a major new Long Term Plan to protect the Great Barrier Reef. Despite the reef's iconic status, the site suffers from decades of incremental decisions that threatened death by a thousand cuts.[4] In 2012, the World Heritage Committee issued its first warning that it would list the site as World Heritage in Danger unless it saw proof of substantial progress by the following year. In 2015, the Australian Government banned the dumping of dredged material throughout the World Heritage site, restructured its port development along the reef and set an ambitious target to reduce polluted runoff by 80 percent by 2025. Sustained action is now crucial to tackle the challenges ahead.

"The work of World Heritage does not end when a site is inscribed. On the contrary—it is UNESCO's commitment to ongoing oversight that makes World Heritage designation so powerful. Since the inception of the World Heritage Marine Programme, understanding the conservation status as well as the strengths and weaknesses of each site's management has been a core priority."

2 http://whc.unesco.org/en/list/

3 WHC-05/29.COM/5B. Paris, 9 September 2005. http://whc.unesco.org/archive/2005/whc05-29com-22e.pdf

4 Russell Reichelt, Chairperson, Great Barrier Reef Marine Park Authority

Box 1.
UNESCO World Heritage marine sites. How do they differ from other marine protected areas?

World Heritage sites are recognized for their Outstanding Universal Value (OUV) – places that are so unique and exceptional that their protection should be a shared and common responsibility of us all. A central difference between marine protected areas (MPAs) and marine World Heritage sites is the international oversight that comes with monitoring, evaluation and reporting obligations for the latter. To ensure the characteristics that make up a site's World Heritage status will endure all sites inscribed on the UNESCO World Heritage List are subject to systematic monitoring and evaluation cycles embedded in the official procedures of the 1972 World Heritage Convention. Along with the recognition and inscription of an area on the List, the State of Conservation process is a key value added to the protection of MPAs that are globally unique. This monitoring and evaluation of all natural sites – and by definition all marine ones -- on UNESCO's World Heritage List is done in cooperation with IUCN, which has an official advisory role formally recognized under the World Heritage Convention.

Similarly, at the Belize Barrier Reef Reserve System (Belize), the World Heritage Centre and IUCN worked closely with the government and stakeholders on a plan to get the site off the Danger List, where it had been placed in 2009 because of the destruction of mangrove forests for coastal development and ongoing threats of offshore oil exploration. In December 2015, the Belizean Government announced a permanent ban on oil exploration in the site. In February 2016, it approved an ambitious coastal-management plan.

These are just a few examples of how strategic use of the World Heritage Convention, wise government action, the skilled work of site managers, and support from experts, advocates and donors can yield rich dividends for conservation. In each example, the World Heritage Convention has played a crucial role in ensuring that local conservation problems receive international attention when their exceptional values are in jeopardy.

This work of international oversight affords the World Heritage Marine Programme and IUCN a unique bird's eye view of ongoing and emerging threats to our ocean treasures. It allows, for example, observing the many faces of climate change at sites around the world, and the extent to which water quality, unsustainable fisheries and invasive species are impacting these precious places. We also collect and share valuable insights about what works and what does not in MPA management. Few other organizations have such in-depth firsthand knowledge of both local and geopolitical challenges and opportunities in marine conservation.

Tracking changes in these sentinel sites helps to bring the global ocean health picture into focus. Over the past decade, we have made a substantial investment of time and resources to understand the current status of the world's flagship MPAs, and to document best practices that can be replicated to achieve durable results in other places. Now is the time to leverage this hard won knowledge and redouble our conservation efforts to meet the unprecedented challenges ahead.

"This work of international oversight affords the World Heritage Marine Programme and IUCN a unique bird's eye view of ongoing and emerging threats to our ocean treasures."

Blue-footed booby, Galápagos Islands (Ecuador).
© Daniel Correia

UNESCO and IUCN have laid the groundwork for the international community to come together to forge sustainable solutions to 21st century marine conservation challenges. A core strength of the World Heritage system is its convening power—to harness the public and political support for the protection of beloved ocean places to bring the right experts and decision makers to the table. Our work from the past decade has been a catalyst for improved management in several of these flagship MPAs and has – perhaps most importantly – allowed identifying key needs and opportunities, so we can target more effectively our efforts.

There are two core issues that will be the focus of collective action in the coming decade: climate change and illegal, unreported and unsustainable fisheries (See Part 2).

1.2. Climate Change

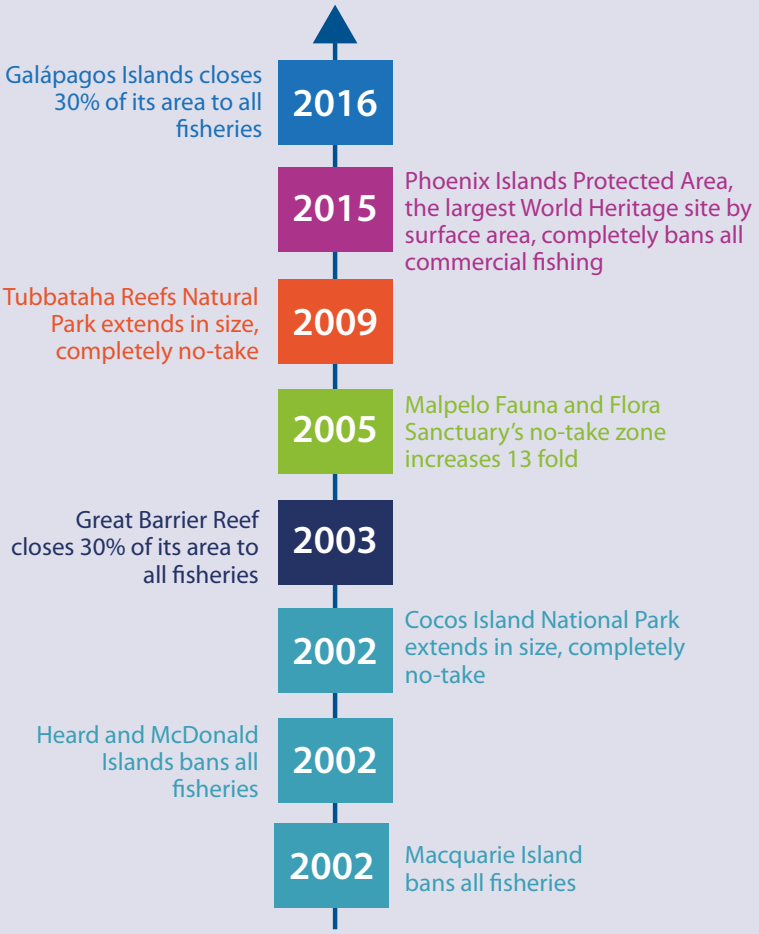
Climate change is an issue that cuts across national boundaries. This is not a problem for tomorrow. The loss of corals at the Great Barrier Reef (Australia) has been widely reported, but it is far from isolated. Unique World Heritage places like Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems (France) and Aldabra Atoll (Seychelles) are also seeing serious bleaching. Rising ocean temperatures have pushed corals beyond their tolerance levels, and scientists warn some of these reefs may never recover. Reefs are not the only systems under strain. We are seeing unprecedented ice loss in Glacier Bay and Natural System of Wrangel Island Reserve (Russian Federation), saltwater intrusion in the mangrove forests of the Sundarbans (Bangladesh), flooding in the West Norwegian Fjords - Geirangerfjord and Naroyfjord (Norway) and typhoons off Ningaloo Coast (Australia).

This is a global problem that requires global solutions. The Paris Climate Agreement was an important step, and now nations are starting the hard work of implementing this vital plan to manage carbon emissions. Scientists suggest it is essential that we keep the global temperature increase to 1.5 degrees to minimize damage to our ocean treasures. But it is equally critical to build and manage for resilience at a local level, minimizing other stresses and helping individual sites develop adaptation plans. This will be a key priority for the World Heritage Marine Programme and IUCN in the coming years (See Part 2).

Bleached coral reef.
© Paul Marshall

Box 2.
No-take zones in World Heritage marine sites

Most World Heritage marine sites have designated parts of their site as no-take zones, using a variety of names such as replenishment zones, zero-use zones or sanctuary zones. A handful of sites are completely no-take for all (commercial) fishing activities. The number of no-take zones in World Heritage marine sites, and their size, are gradually increasing. More and more research suggests that no-take zones are crucial components to restore fish stocks. At the recent Third World Heritage Marine Managers Conference, Enric Sala stated that "There is no future for artisanal fisheries without large no-take areas".



Enric Sala at the third World Heritage Marine Managers conference, Galápagos Islands, 27 to 31 August 2016.
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1.3. Fisheries

A second core focus will be fisheries. While important strides have been made to address illegal and unsustainable fisheries, this problem still plagues a third of World Heritage marine sites. Unsustainable fisheries do not make sense anywhere in our oceans but it certainly does not in the world's most iconic ocean places. Fishing illegally and unsustainably in marine World Heritage sites is unacceptable in the 21st century. And like climate change, unsustainable fisheries cut across national boundaries, requiring global cooperation to achieve successful results.

As you will read in the pages of this publication, we now have better technology to track the fish that are being taken from the ocean (See Part 3). From satellite tracking systems to apps that artisanal fishers can use to record their catches, we have access to data that helps to inform management strategies and focus enforcement efforts. In 2015, Global Fishing Watch helped the island nation of Kiribati recover millions of dollars from a vessel caught poaching in Phoenix Islands Protected Area, and we look forward to helping other sites take advantage of this "eye in the sky." We are also seeing an increase in the size and number of no-take zones, which allow fisheries to recover and thrive (See Box 2). Amplifying such successes will be central to our efforts in moving forward.

But at the very heart of the problem is the fact that we do not know how much fish we are taking out of marine World Heritage sites. Recent science suggests that the world's actual catch might be twice as much as what the official Food and Agriculture Organization of the United Nations (FAO) data suggests (Pauly and Zeller, 2016). Often only industrial fishing is accounted for in official statistics, while many marine World Heritage sites also include small scale fisheries such as subsistence fishing, artisanal fishing, and sports fishing[5].

5 Stephen Box. Replacing Barbies' Notebook. Presentation at the third World Heritage Marine Managers Conference. Galápagos Islands, Ecuador. 27-31 August 2016.

Daniel Pauly at the third World Heritage Marine Managers conference, Galápagos Islands, 27 to 31 August 2016.
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"Our research suggests that actual catch might be twice as much as what official data suggests. We simply do not know what we are taking out of marine World Heritage sites."

Daniel Pauly. Third World Heritage Marine Managers conference, Galápagos Islands, 27-31 August 2016.

2. Marine World Heritage sites as beacons of hope

The foundation of the World Heritage Marine Programme is the global community of managers entrusted with the care of our planet's 49 most exceptional ocean places. These guardians are on the frontlines, observing changes in real-time and balancing economic and ecological imperatives. They are often working in remote areas with limited resources, but each has the backing of the World Heritage Convention. Realizing the potential of this network, and helping them harness the power of World Heritage has been a top priority since the Programme was founded in 2005. With our ocean facing existential threats, the stakes are higher than ever. International cooperation can help individual sites build on successes and avoid costly mistakes.

This sense of connectedness—and interdependence—is a fact of life in the ocean. Birds, sharks, whales and fish are heedless of national boundaries (See Part 5). So are plastic pollution, climate change, and invasive species. That is why UNESCO brings together the network of marine site managers every three years to discuss our common challenges and collaborate on solutions. In addition to these global gatherings, substantial investments were also made to facilitate collaboration between sites that have specific challenges or species in common. Here are a few examples:

- Europe's Wadden Sea (Denmark, Germany, Netherlands) and West Africa's Banc d'Arguin National Park (Mauritania)—two of the world's largest stopovers for migratory birds—signed an agreement in 2014 to protect the millions of birds that travel between their sites each year. One of their goals is to secure Banc d'Arguin National Park against shipping accidents through the International Maritime Organization (IMO). Wadden Sea secured similar protections in 2002.

- Glacier Bay National Park (United States of America) and West Norwegian Fjords – Geirangerfjord and Nærøyfjord (Norway) are both visited primarily by cruise ships, and both have made big strides to reduce impacts like air and water pollution. Glacier Bay National Park created a competitive bidding program that allows ship companies to propose sustainable operations in exchange for the opportunity to tour the Bay. In Norway, the Green Fjord Initiative extends to land-based transport as well. As explained in more depth elsewhere in this publication (See Part 6), the two sites are currently exploring the potential for common standards for ship visits that target both World Heritage sites.

- The Great Barrier Reef (Australia) and Galápagos Islands (Ecuador) have long been working together to share management practices, particularly around fishery management. In 2004, the Great Barrier Reef closed about a third of the park to fishing. Recent studies have shown that sharks are thriving in these no-take zones, which are also helping to replenish the reef with trout and snapper that spill out into open areas where they can be legally caught. Earlier this year, Galápagos National Park followed in the Great Barrier Reef's footsteps, rezoning the marine site to fully protect about a third of its waters.

- Tubbataha Reefs Natural Park (Philippines) revised its entire management plan to focus more efficiently on the preservation of its World Heritage values while the Natural System of Wrangel Island Reserve (Russian Federation) finalized its first ever integrated management plan with the help of the global managers community.

"With our ocean facing existential threats, the stakes are higher than ever. International cooperation can help individual sites build on successes and avoid costly mistakes."

This is just a small sample of what committed experts can achieve when they work together to steward our shared heritage. The World Heritage marine managers network has tens of thousands of hours of practical experience, and has confronted every imaginable challenge in ocean protection. Collectively, they steward about ten percent of the planet's protected ocean areas, and their successes reverberate well beyond their boundaries.

Impressions from the third World Heritage marine site managers conference (27 to 31 August 2016, Galápagos Islands, Ecuador).
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3. Marine World Heritage in the High Seas: The last frontier

Today, the 49 marine sites on the World Heritage List stretch from the tropics to the Arctic. They span 37 countries and include coral reefs, mangrove forests, tidal flats, and ice floes. But, despite the network's reach and diversity, it does not yet encompass all the world's most significant marine areas. Addressing gaps in the World Heritage List is a key part of our work, to ensure that the World Heritage Convention is being applied to areas of OUV, wherever they are found.

In the past six years, the World Heritage Marine Programme and IUCN have been exploring opportunities to apply the World Heritage Convention to the High Seas—the open ocean beyond national boundaries. The High Seas cover half our planet and contain natural wonders that rival the Grand Canyon National Park (United States of America) and Serengeti National Park (Republic of Tanzania). This global commons is shared by all people, and it will take international cooperation to ensure a sustainable future as advances in technology and the retreat of sea ice are opening more of the High Seas to shipping, fishing, and other industries.

In 2016, we published a report that identified five exceptional sites in the High Seas that could warrant World Heritage designation (See Part 9). They include an underwater oasis where endangered species feed and breed, the only known gathering point for white sharks in the north Pacific, a floating sea of algae that supports a thriving ecosystem, a deep area dominated by soaring carbonate monoliths found nowhere else, or a sunken fossil island.

The World Heritage Convention is unique among international conservation tools in that it looks beyond biodiversity, and considers criteria like outstanding beauty and unusual geological and natural processes. The Convention is well suited to safeguard exceptional places in the High Seas. It has been ratified by nearly every country on earth, and has a 44 year history of protecting sites in 165 nations. In the coming years, IUCN and the World Heritage Centre will work together toward possible ways through which sites in the High Seas could benefit from the protection under the World Heritage Convention and how the management of such areas could be secured.

Crossota, a deep red medusa found just off the bottom of the deep sea. Alaska, Beaufort Sea, North of Point Barrow.

The pelagic bolitaenid octopus *Japatella diaphana*.

4. Conclusion

The World Heritage Marine Programme has overseen important advances in ocean conservation over the past ten years but it has also allowed us a unique birds-eye view of what works and what does not in MPA management across 37 countries. The oceans are facing unprecedented challenges and using resources where they will be most effective is more critical than ever. For sites already inscribed on the List, we will focus on building climate resilience, and leveraging the network's worldwide reach to enhance our understanding of local impacts. We will also emphasize fisheries research, so we can measure what is being taken out of these sentinel sites. Unsustainable fishing compromises their health, jeopardizing long-term benefits for the many in exchange for short-term gain for the few. In the coming years, the World Heritage Centre and IUCN will be exploring a minimum standard for sustainable fisheries. As always, we will continue to document lessons learned and share ideas and resources with the broader community. Finally, we will work to fill in current gaps on the World Heritage List, so the unparalleled protection of the World Heritage Convention can be extended to sites of OUV in the High Seas, and other regions not yet represented. Above all we will support the listed marine World Heritage sites to achieve excellence as leaders in global ocean conservation.

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Part 2
Marine World Heritage and climate change: Challenges and opportunities

2

Antarctic Melting Glacier in a Global Warming Environment.
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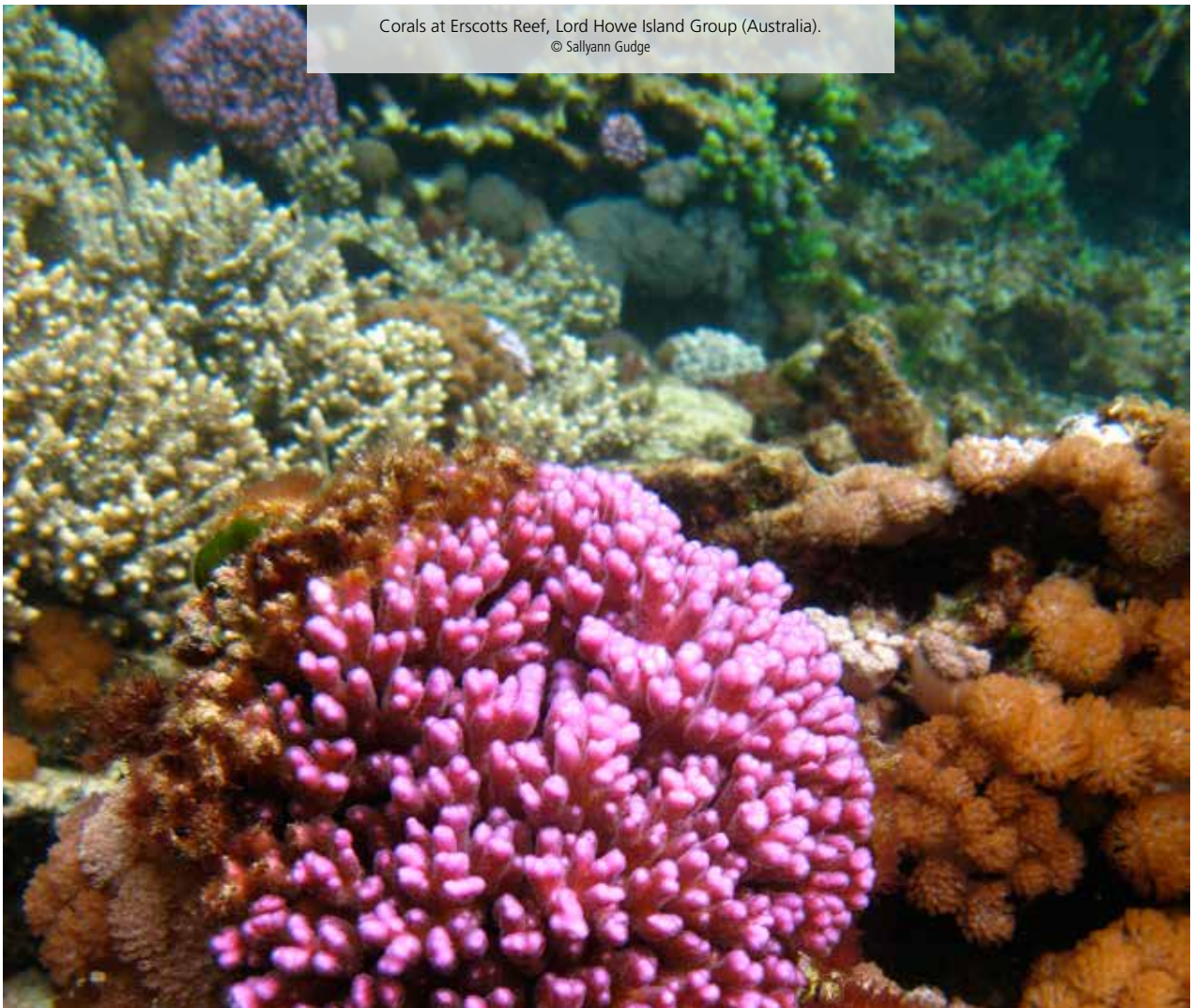
Marine Programme

1. Introduction

It is no secret that climate change is affecting our ocean treasures at an unprecedented scale. Despite their iconic status, marine sites on UNESCO's World Heritage List do not escape this reality. While the effects of the recent El Niño related bleaching events in Australia's Great Barrier Reef were scientifically well documented and reported in international press, several other marine World Heritage sites have suffered equally important changes to their marine environments but stayed largely outside the public eye. Earlier this year, scientists observed alarmingly high ocean temperatures in Phoenix Islands Protected Area (Kiribati) (Obura et al., 2016), the world's largest World Heritage site by surface area while Socotra Archipelago (Yemen) experienced two extremely rare and very powerful cyclones within eight days[1]. Experts predict increases in both severity and frequency of El Niño events to come. These sweeping changes of weather patterns and ocean currents can have devastating effects, as we have seen with the recent widespread coral bleaching, and could potentially seriously damage whole swaths of exceptional ocean features that are part of the legacy of humanity and as such protected under the 1972 World Heritage Convention. This article will share some of the initial examples that illustrate how climate change is already affecting marine World Heritage sites globally, explain what can be expected in coming years, and describe the opportunities for marine World Heritage sites to help secure a better future for the ocean in the face of a changing climate.

1 https://www.iucn.org/content/photo-gallery-cyclones-hit-yemen%E2%80%99s-remote-socotra-archipelago



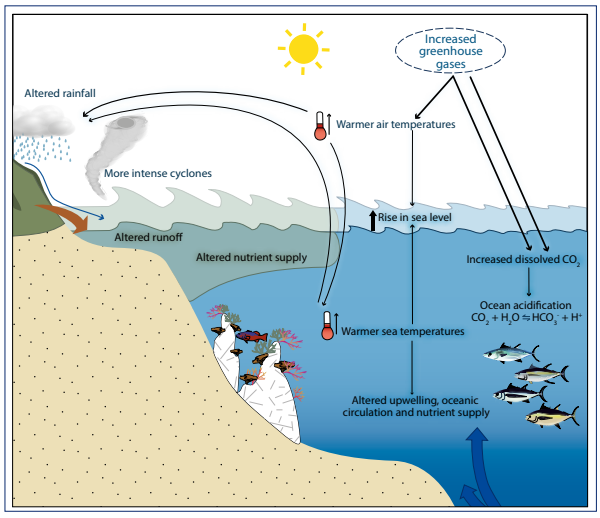
Corals at Erscotts Reef, Lord Howe Island Group (Australia).
© Sallyann Gudge

2. Current impacts of climate change and what to expect in the coming decade

Climate change is a global problem, but it wears many faces, causing increased occurrences of flooding in some areas and drought in others. At the same time weather patterns and natural climate variability are embedded in slow changes in the globes climate pattern yielding record high temperatures in one year, and cooling the next. But slow and steady warming is clearly detectable especially in the ocean. Ocean warming has been recognized as a significant driving force causing changes in the abundance and distribution of marine species (Portner and Peck, 2010). This is potentially detrimental to the Marine World Heritage network, which consists of a broad continuum of biodiversity. The 49 marine sites on UNESCO's World Heritage List are spread around the globe, from the tropics to the poles and include many iconic but fragile ecosystems. While some sites, like Australia's Lord Howe Island Group, serve as a refuge for species due to oceanographic and climate conditions that have so far spared them from devastating impacts, most others are already experiencing noticeable degradation. We are already seeing more frequent coral bleaching events, increased acidity, regionally varying rates of rising seas, and changes to the food web in several World Heritage sites. Warming waters, sea level rise and changes in freshwater dynamics all directly impact marine World Heritage sites, some of them at a frightening pace.

Global sustained monitoring shows that ocean temperatures have been warming substantially since the 1950s. Despite some year-to-year variations, sea temperatures have been consistently higher in the last three decades than at any other time since reliable observations began in the late 1800s[2]. This year, the effects of warming tropical waters have been among the most severe in history as they were multiplied by a strong El Niño that brought record-breaking temperatures to much of the Pacific Ocean.

Figure 1: How climate change affects the ocean

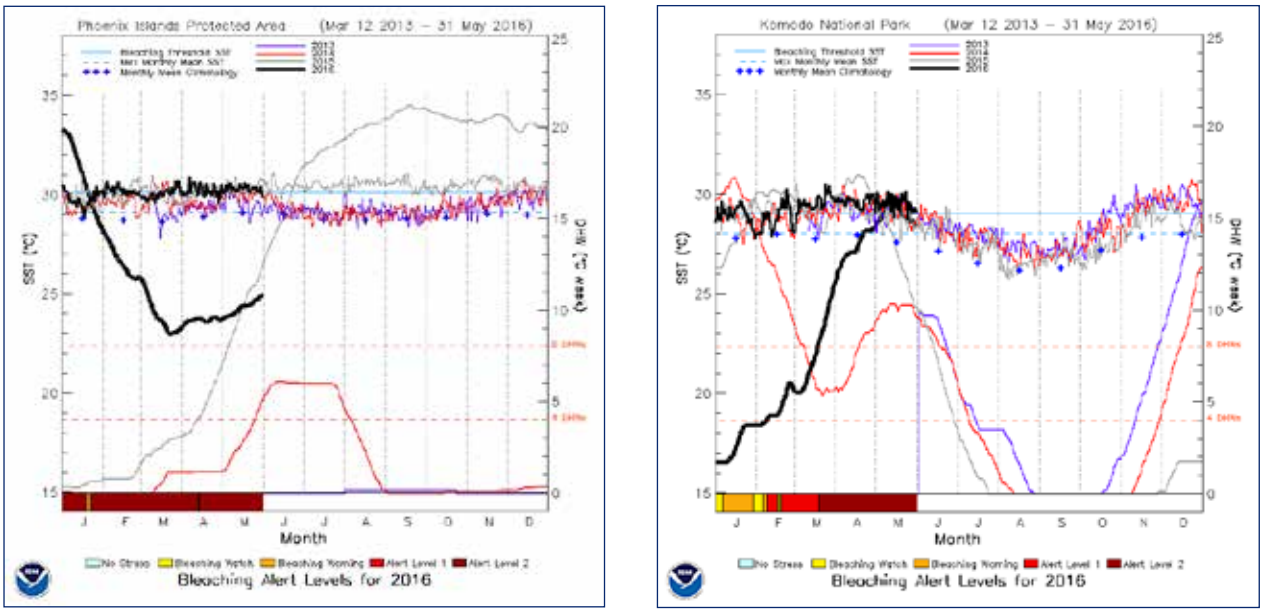


© Pacific Community 2011
Source: http://www.spc.int/climate-change/fisheries/assessment/e-book/#/36/

Among the most visible effects of this temperature spike has been the mass bleaching of coral reefs. An unprecedented number of World Heritage sites, from the well-known Great Barrier Reef (Australia) to Phoenix Islands Protected Area (Kiribati) and Papahānaumokuākea (United States of America), have been harmed by high temperatures brought on by global warming. Earlier this year, the Great Barrier Reef saw the worst mass bleaching event on record. Extensive scientific surveys have documented a range in impacts, with minimal damage in the southern areas of the Great Barrier Reef, but a loss of 67 percent of coral cover in the northern third (Hughes et al., 2016). While the major tourism areas of Cairns and the Whitsunday Islands were largely spared by this most recent coral bleaching event, the most serious coral mortality occurred in the 600 kilometer stretch between the tip of Cape York and just north of Lizard Island, where virtually no other activity takes place (GBRMPA, 2016). The latest scientific data suggests that up to 15 of the universally

2 Environmental Protection Agency. Unites States of America: https://www.epa.gov/climate-indicators/oceans

Figure 2. Bleaching alert levels for 2016 in Phoenix Islands Protected Area (Kiribati) and Komodo National Park (Indonesia).



Source: Coral Reef Watch, NOAA. http://coralreefwatch.noaa.gov/coralreefwatch.noaa.gov.

outstanding coral reef systems on UNESCO's World Heritage List might be affected by the time the current bleaching event is over[3].

According to preliminary internal research from Mark Eakin, Coordinator of NOAA's Coral Reef Watch, an unprecedented number of World Heritage sites, from the well-known Great Barrier Reef (Australia) to the more remote Aldabra Atoll (Seychelles), Phoenix Islands Protected Area (Kiribati), and Papahānaumokuākea (United States of America) have been harmed by high temperatures brought on by global warming and El Niño (Fig. 2).

Warming waters also affect the migration of fish and marine mammals. Growing scientific evidence shows that fish that find the waters too hot or too cold will migrate to other locations rather than adapt to new local conditions. Generally, marine life seeks cooler conditions at higher latitudes and deeper waters and thus might relocate outside the current boundaries of World Heritage sites. Marine World Heritage sites include migratory species throughout the network, many of them travelling great distances from one World Heritage site to another. The Whale Sanctuary of El Vizcaino in Mexico, for example, is the birthplace of the Eastern subpopulation of the North Pacific Grey Whale. Located in the central part of the peninsula of Baja California, the sanctuary contains exceptional conditions for these species that, after giving birth in the lagoon, travel up north along the coast of the United States of America and Canada. Information suggests they might reach as far as the Natural System of Wrangel Island Reserve in the Russian part of the Arctic to feed[4]. El Vizcaino and Wrangel Island are often referred to as the northern and southern "ends" of grey whale migration.

As warming waters increasingly influence the migration of species and the location of their breeding and feeding grounds, the question arises whether World Heritage boundaries meant to protect vital habitat for whales, sharks, turtles, fish and other iconic wildlife need to be reconsidered to adapt to changing condition and remain relevant in years to come.

Global warming is also threatening the very existence of some World Heritage sites, as rising temperatures contribute to sea-level rise through melting of glaciers and ice sheets and the expansion of ocean water as it warms. Over the course of the 20th century, global average sea level rose 1.8 millimeters per year. The rate has increased in recent decades and is now the highest annual average since satellite recordings with a steady annual increase of about 3.2 mm per year since 1993.[5] However, the regional sea level changes can be significantly different from the global picture. Over the last 20 years the Western Pacific has seen up to three times the global rise while sea level was dropping in the Eastern Pacific both associated with stronger trade winds. The Intergovernmental Panel on Climate Change (IPCC) assessment reports that sea level will rise by at least 0.4 metre above the current value by the end of the century under very strict mitigation measures. 0.8 – 1 metre higher global averaged sea level is expected for business as usual scenarios (IPCC, 2013).

3 Mark Eakin. Coral Reef Watch. National Oceanic and Atmospheric Administration. Preliminary Internal Research.

4 WHC-04/28COM.14B, Suzhou, 29 June 2004. http://whc.unesco.org/archive/2004/whc04-28com-14Badde.pdf

5 National Ocean and Atmospheric Administration: climate-change-global-sea-level

Sea level rise is likely to affect both the communities living in and around World Heritage marine sites as well as the composition of ecosystems protected under the Convention. For example, Kiribati hosts the largest and deepest UNESCO World Heritage site—Phoenix Islands Protected Area--but sea level rise threatens to render Kiribati uninhabitable due to flooding well before it is completely submerged[6] thereby threatening the country's very existence as well as its globally outstanding heritage.

In the Wadden Sea (Denmark/Germany/Netherlands), where the world's largest unbroken system of sand and mud flats support millions of birds, sea level rise of 50 centimeters would reduce the size of the intertidal area by 15 percent (CPSL, 2001). As the waters rise at the Wadden Sea, experts predict that the tidal basins that provide critical foraging grounds for millions of birds, would take the form of tidal lagoons. An increase in storms would further erode the tidal flats (CPSL, 2001). Another change in the Wadden Sea has been the birds from the Arctic getting smaller (van Gils et al., 2016). These birds from the Arctic have to start their migration to the Wadden Sea and Banc d'Arguin National Park – both iconic places protected through the 1972 World Heritage Convention for their outstanding value – with an empty stomach and have thus smaller chances of survival. Because the Wadden Sea is so closely connected with Banc d'Arguin National Park in Mauritania and other World Heritage sites along the East Atlantic Flyway, such effects would be felt well beyond the boundaries of the Wadden Sea. The management of the Wadden Sea is shared between Germany, the Netherlands and Denmark. All three nations have made it a priority to address these important challenges.

Rising seas also affect the composition of fresh water systems in marine World Heritage sites, as salt water intrudes into rivers and wetlands. In the Bangladesh part of the Sundarbans—which is part of the largest unbroken mangrove system in the world and home to the Royal Bengal Tiger—salt tolerant mangrove species are expanding and gradually displacing other species while higher salinity is stimulating an increase in barren areas. Estimates suggest that several mangrove species are likely to disappear in the next few decades. Research conducted in 2011 shows that the central longitudinal belt of the forest is now rapidly turning into a high salinity zone. Biodiversity is higher in low salinity areas of the Sundarbans and increased salinity is expected to result in changes to the composition, dominance and number of species in those previously less saline areas (Doak et al., 2017). Combined with decreased water influxes and other threats such as extreme weather events, these fragile ecosystems are particularly vulnerable for these effects.

Finally, these direct effects are further exacerbated by ocean acidification. The ocean has become more acidic over the past few decades because the increased levels of atmospheric carbon dioxide are leading to changes in ocean chemistry. As some of the excess carbon dioxide (CO_2) is absorbed by seawater, chemical reactions occur that reduce seawater pH, carbonate ion concentration, and saturation states of biologically important calcium carbonate minerals. These chemical reactions are termed ocean acidification. This process makes it more difficult for certain marine animals to build their protective skeletons or shells. Scientists estimate that the ocean has become approximately 30 percent more acidic since the beginning of Industrial Revolution. This is expected to impact ocean species to varying degrees over the next decades. Studies show that an increasingly acidic ocean has a dramatic effect on some calcifying species, including oysters, clams, sea urchins, corals (both in shallow waters and the deep sea), and calcareous plankton[7]. When these shelled organisms are at risk, the entire food web may also be at risk. Nearly all marine World Heritage sites include these organisms and millions of people in local communities are dependent on the resources these sites provide for their livelihood.

The Sundarbans, Bangladesh
© UNESCO/Amanullah Bin Mahmood

6 Union for concerned scientists. 2011. http://www.climatehotmap.org/global-warming-locations/republic-of-kiribati.html#end17

7 National Oceanic and Atmospheric Administration. Available at: http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F

3. Marine World Heritage: Uniquely positioned to spearhead change?

Climate change is a global problem demanding a global solution. Obviously, reducing CO_2 emissions is central to the future preservation of marine World Heritage sites and the ocean in general. The Paris Agreement has created a framework for climate action around the world and its coming into force last November is an important step in the right direction. If global average temperature increases are not kept below the 1.5 - 2°C target set by the Paris Agreement, we can expect even greater changes and severe losses in biodiversity and significant risk to marine World Heritage sites. If we are not successful in meeting this target, it is unlikely that future generations will still enjoy the precious marine systems that are part of the common legacy of humankind.

While the overall implementation of the Paris Agreement depends on many partners and is beyond the scope of the 1972 World Heritage Convention, individual sites on UNESCO's World Heritage List can play an important role in spearheading change. Below are several key areas where World Heritage sites can provide leadership toward better science for decision-making, mitigating impacts, and adapting to changes.

3.1. Documenting change to improve decision making and reach global targets

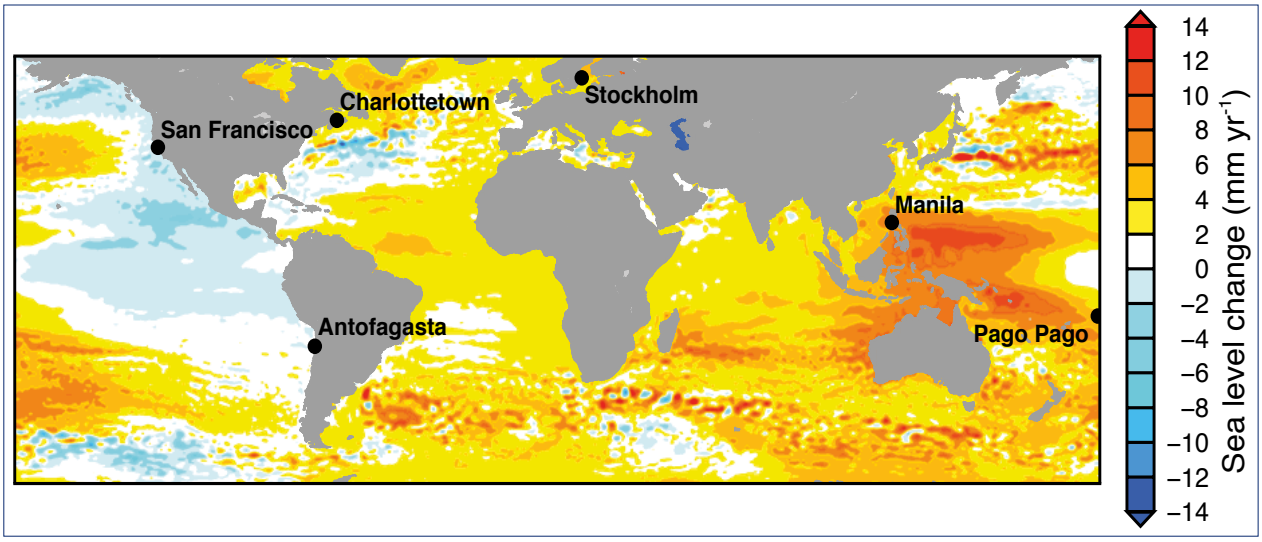
Over the past decades, substantial investments have been made around the world to document core aspects of our changing climate within the framework of the Global Climate Observing System and its Global Ocean Observing System (GOOS). International cooperation allowed the development of reliable and quality controlled global databases. These provide reliable records of how much the sea rises annually, how warm or cold the water is at various times of the year, and how acidic our ocean and seas are becoming. In most publications global averages are presented which are indispensable for understanding global trends in climate variables and for modelling global-scale impacts on nature. The regional interpretation is often more complex and less certain but critically important for decision makers at local levels.

Table 1. Top 10 countries according to 2014 emissions of fossil fuel use and industrial process emissions (cement production, carbonate use of limestone and dolomite, non-energy use of fuels and other combustion).

Country	2014 Ktons CO_2
China	10,540,749.59
United States of America	5,334,529.74
EU-28	3,415,235.46
India	2,341,896.77
Russian Federation	1,766,427.27
Japan	1,278,921.81
Iran, Islamic Republic of	618,197.22
Korea, Republic of	610,065.60
Canada	565,991.53
Brazil	501,102.85

Source: EDGARv4.3, European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.3. http://edgar.jrc.ec.europa.eu/, 2015 forthcoming

Figure 3. Map of rates of change in sea surface height (geocentric sea level) for the period 1993–2012 from satellite altimetry.



Source: IPCC Chapter 13, 2013.

Global averages of sea level and water temperatures are now well understood, but sea level at a regional scale is far more complex, and water temperatures vary greatly from one location to another. Over the past 100 years, we have seen 20 centimeters of sea level rise globally (Figure 3) but some places, like the Western Tropical Pacific that hosts World Heritage sites like East Rennell (Solomon Islands), are seeing rises up to three times greater, and some are seeing none. The same is true for temperature. iSimangaliso Wetland Park in South Africa has not seen an increase in water temperature, but Aldabra Atoll in the Seychelles and Phoenix Islands Protected Area in Kiribati are experiencing ocean warming at unprecedented scales since first recordings took place.

The absence of local data at most World Heritage sites makes it difficult for managers to create targeted action plans to protect their sites from climate impacts, and to make a clear case for support to local officials. More detailed data will help inform adaptive management and equip managers to advocate for the resources and action they need. Individual sites can take steps to reduce other stressors and boost resilience to climate change.

The UNESCO World Heritage List includes 49 marine sites in 37 countries, spread across all regions of the world. These sites are experiencing a range of climate change effects, from less sea ice in the Natural System of Wrangel Island Reserve in the Russian Arctic to cyclones in Australia's Ningaloo Coast and Socotra Archipelago in Yemen. This

Dying palm trees due to rising lake levels in East Rennell, Solomon Islands.
© UNESCO/Robbert Casier

Phoenix Islands Protected Area, Kiribati.
© Keith Ellenbogen / New England Aquarium

global network of sites is uniquely positioned to serve as reference points, and help document ocean change that allows understanding of the regional and local dynamics of a changing climate.

Not only would such information allow understanding of what is happening at a particular site and facilitate decision-making, it would also provide a significant contribution toward measuring more comprehensively whether or not global targets such as the sustainable development goals are being met. Through the Sustainable Development Goals 13 and 14, nations are committed to conserve and sustainably use the oceans, seas and marine resources for sustainable development but it remains a question how to measure progress. The World Heritage marine network could serve as additional reference points for evaluating progress. In this way, the global network of marine World Heritage sites could contribute indispensible value to ocean observation and contribute to a more complete account of regional and local variations that are crucial for effective management and decision-making.

3.2. Moving toward carbon free marine World Heritage sites

Marine World Heritage sites around the world are piloting solutions designed to boost resilience. These efforts are central to the work of the World Heritage Convention with respect to climate change. The World Heritage Committee is

A bleached coral reef in the Maldives.

charged with the oversight of every site on UNESCO's World Heritage List. Each year, the Committee reviews the state of conservation for about 100-150 sites, and recommends steps to encourage more sustainable practices in the world's flagship marine protected areas. As climate change impacts are being felt around the world, the Committee is looking for opportunities to mitigate other stressors so sites become more resilient and capable of recovering after damaging climatic events. In recent years, an increasing number of sites have created large no-take zones in an effort to minimize fishing impacts and improve their health and resilience. Earlier this year, for example, the Galápagos National Park rezoned its marine reserve to make about a third of the park fully off limits for fishing.

But apart from reducing harming pressures to boost resilience, marine World Heritage sites are making big strides to reduce their CO_2 emissions, showing that it is economically feasible to lighten our carbon footprints while enhancing visitor experiences and quality of life for local communities. For example, in Everglades National Park, tour buses run on biofuel, and lights and hot water are powered by the sun. In the Wadden Sea, communities are using wind energy and waste-to-energy, and the area is marketing itself as carbon neutral to attract tourists. Aldabra Atoll runs its management and research facilities for nearly 100 percent carbon free. Electric cars for tourism visitation are now the norm in West Norwegian Fjords – Geirangerfjord and Nærøyfjord and are part of a bigger "Green Fjord" initiative that envisions to market the World Heritage brand of the site as a zero-emissions quality destination. Glacier Bay National Park and Preserve[8] has also created a model for sustainable cruise ship visitation that led to lower sulfur fuel usage and reduced emissions in the World Heritage site and home to some of the world's most spectacular glaciers.[9]

Of course, these initiatives remain small considering the global scope of the problem and won't change the world by themselves. Yet because of their high profile and branding, marine World Heritage sites can play a very powerful role in driving innovation toward carbon free areas and setting new global standards and become beacons of hope and early implementers of ambitious mitigation efforts. Their efforts to limit fishing and other stressors can be replicated at other marine protected areas, and their successes in limiting carbon emissions and pollution can catalyze similar programs around the world.

3.3. Leadership in vulnerability mapping and adaptation

As temperatures and sea levels continue to rise, various marine World Heritage sites – and marine protected areas more generally - will increasingly illustrate the damaging effects of climate change. Most sites are already observing the immediate and visible effects of a changing climate, but many lack a comprehensive view of the overall vulnerability of their Outstanding Universal Value that make up the core characteristics of their World Heritage recognition. Recording and reporting the problem is only the first step; sites need to rapidly transition to an understanding about what the future holds, and what can be done to minimize impacts. A priority for all sites is to develop awareness of the different dynamics of climate change and how they interact with other pressures affecting their values as a basis for strategically building resilience. Some sites, such as the Great Barrier Reef, have led early efforts to develop Vulnerability Assessments (Johnson and Marshall, 2007) and Climate Change Adaptation Strategies (GBRMPA, 2007). But more sites need adaptation plans, and all of them require a comprehensive and sustained program of action aimed at building resilience if we want some change for them to survive in the long term.

Considering the extent to which marine World Heritage sites are affected by climate change and scientists' prediction that more severe and more frequent extreme events are awaiting us, an essential immediate next step is to build capacity so individual sites can develop appropriate adaptation plans and measures. Through a concerted effort to build awareness, provide tools and increase capacity, marine World Heritage sites can become leaders in the global effort to understand and respond to climate change.

8 Part of Kluane / Wrangell-St. Elias / Glacier Bay / Tatshenshini-Alsek. http://whc.unesco.org/en/list/72

9 See also Part 6: The green dream: Balancing economic development with conservation of universally outstanding places: A cruise shipping model of success

4. Conclusion

The threats marine sites on UNESCO's World Heritage List are facing are increasingly apparent. While some sites among this global network have so far been spared from devastating effects and serve as a refuge for species, most others are experiencing noticeable changes, some at an alarming rapid rate. In 2016, an unprecedented amount of sites have experienced coral bleaching events and loss of corals. Others have seen record temperatures and scientific evidence suggest that this might be only the beginning. Extreme weather events will become more frequent and further reduce the chances for these global ocean icons to recover.

Yet despite this gloomy forecast, marine World Heritage sites are uniquely positioned to be sentinels of change. They can be both our early warning systems (through increased observation) and serve as a catalyst where emerging science and best practices are tested and tangible strategies for addressing the challenges of climate change demonstrate leadership. Without doubt, climate change is the most pressing challenge our global marine World Heritage is facing today and will continue to do so for many years to come.

Acknowledgments

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3

PART 3
Protecting marine World Heritage from space

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Fishing effort, as calculated by Global Fishing Watch, in the Phoenix Islands Protected Area World Heritage site (Kiribati) in the six months after the park was closed to fishing.
Source: Global Fishing Watch ❋

1. Introduction


© Jose Alejandro Alvarez / Fundación Amigos de la Isla del Coco

It is difficult to imagine a global resource that is more important and more challenging to monitor than the world's oceans. In addition to feeding humanity—nearly three billion people get at least one-fifth of their animal protein from seafood (FAO, 2014)—the oceans also harbour countless treasures. Today, 49 ocean areas across 37 countries are considered of Outstanding Universal Value (OUV) and are inscribed on UNESCO's World Heritage List. They range from coral reef systems in the tropics to kelp forests in the temperate latitudes and grey whale feeding grounds above the Arctic Circle. But despite their importance, oceans and the iconic marine World Heritage sites are among the least observed places on Earth.

The lack of observation, coupled with human need for marine resources, have put our oceans at risk from overfishing. According to the Food and Agriculture Organization of the United Nations (FAO), 85 percent of the world's fisheries are overfished or fully exploited. Even World Heritage sites are vulnerable to this problem. Though some sites ban any extractive industry, many allow some form of fishing activity that exposes the biodiversity at these invaluable sites to the same risks of overexploitation.

Limitations in our ability to monitor the oceans have led to large gaps in effective management of these critical resources. A recent detailed reconstruction of catch data showed that actual annual ocean catch has been as much as 50 percent higher than that reported by the FAO (Pauly and Zeller, 2016). While some fishing vessel operators wilfully misreport their catch, most of the discrepancy is due to a simple lack of reporting.

In response to these challenges, many organizations, companies, and governments are harnessing new technologies, such as satellite radar, high-resolution imagery, or even drones, which allow detailed tracking of fishing vessels. While these monitoring techniques offer great promise, many are expensive, require substantial training and ongoing maintenance, and do not provide global coverage. For instance, a high resolution single satellite image costs thousands of dollars, making regular monitoring challenging. Drones are cheaper than helicopters, but they remain prohibitively expensive for monitoring large pelagic parks.

In contrast, one technology, the "Automatic Identification System" (AIS), is already widely adopted by large fishing vessels around the globe and provides a relatively straightforward way to monitor vessels while requiring little additional effort by ship captains or regional organizations. Although there are limitations, AIS data, when combined with new "big data" analytic techniques, could allow a significant step forward in our ability to monitor fishing in the world's oceans. This article showcases how this technology works in practice and how it could improve the monitoring and surveillance of fishing in marine World Heritage sites.

2. Satellite technology to track fishing activity

In order to improve marine safety, in the 1990s engineers developed the "Automatic Identification System," or AIS, enabling any vessel to broadcast its coordinates, heading, speed, and identity to nearby vessels. The result was a significant increase in safety, as captains could consult their AIS devices, determine if other vessels were in their path, and thus decrease the chance of collision.

AIS is an open source, un-encrypted technology broadcast over radio, meaning that anyone with a transceiver can view nearby boats' locations. While the signals are limited to line of sight, and thus the horizon, they are also visible to satellites flying overhead. Over the past few years, a few satellite companies have started collecting this data, making it possible to ascertain the positions of the world's ocean-going vessels. Because an AIS device broadcasts as often as a few times per minute, the movement of a vessel can be recorded fairly accurately provided there are enough satellites flying overhead and receiving the signals.

In addition to AIS, most countries also require larger ships to carry some type of Vessel Monitoring System, or VMS, so they can track vessel movements within their waters. Much like AIS, VMS records a vessel's position and broadcasts it to satellites. Unlike AIS, though, the positions are usually encrypted and accessible to only the government requiring the VMS. Also, VMS systems vary between countries, making it challenging, although not impossible, to compare data across different parts of the world.

One key advantage of monitoring through AIS is that increasing global adoption of the technology is allowing for a more comprehensive picture of fishing efforts. Since 2004, the International Maritime Organization (IMO) has required AIS usage by all ships of 300 gross tons and greater on international voyages and vessels of more than 500 gross tons on all voyages (a 300-ton fishing vessel is generally around 30 to 35 metres long). Most countries of the world have either adopted IMO regulations or regulations that are even stricter. For instance, the United States of America recently mandated that all vessels longer than 19 metres carry AIS, and the European Union requires all fishing vessels larger than 15 metres to do so. Some countries, such as Mauritius, mandate the technology on all fishing vessels regardless of size. As more countries have required the device on smaller vessels and as the cost of transceivers has dropped, the number of vessels carrying AIS has increased. In 2014 alone, the number of fishing vessels broadcasting AIS increased by 14 percent (McCauley et al., 2016). As a result, the quality of AIS satellite coverage improves every year.

> "This article showcases how this technology works in practice and how it could improve the monitoring and surveillance of fishing in marine World Heritage sites."

However, not all fishing can be monitored by AIS at this time. The vast majority of the world's fishing vessels are small artisanal boats that do not carry AIS. Many smaller industrial vessels also do not carry the devices. Of an estimated 2.7 million fishing vessels with motors (FAO, 2014), only about 35,000 to 45,000 are currently traceable using AIS. Nonetheless, these vessels with AIS represent a majority of the fishing vessels longer than 24 metres (McCauley et al., 2016). It is also important to note that because, per vessel, larger vessels catch much more fish than smaller ones, AIS covers a higher proportion of the world's fishing than these numbers alone suggest. Moreover, smaller vessels mostly stay close to shore, meaning that a much higher portion of vessels on the high seas have AIS.

Despite its limitations, AIS currently has the ability to track a significant portion of the world's fishing effort, and likely a majority of the fishing in parts of the high seas.

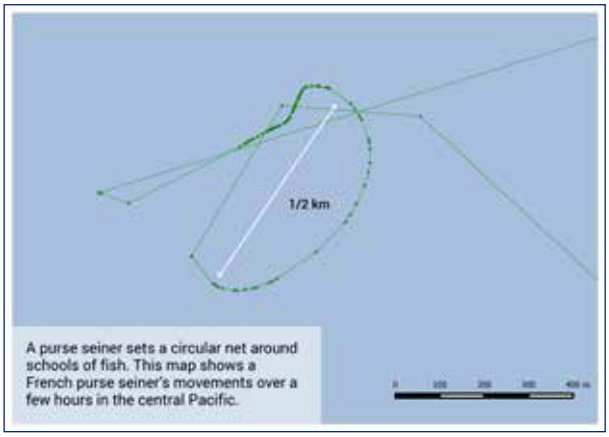
3. Monitoring fisheries through Global Fishing Watch

In recent years, a number of initiatives have started using AIS data to track fishing effort of larger vessels. One of these efforts is Global Fishing Watch, a partnership between SkyTruth, a remote sensing nonprofit, the nonprofit organization Oceana and Google Earth Outreach, a division of Google that engages with nonprofits and research institutions to leverage geospatial tools for the greater good.

Using Google's cloud computing technology, as well as recently developed big data techniques, Global Fishing Watch ingests billions of data points on the locations of vessels. Through a series of algorithms based on fishing vessel tracks and behaviour, Global Fishing Watch can distinguish vessels by type and determine when they are fishing versus simply transiting through a given area.

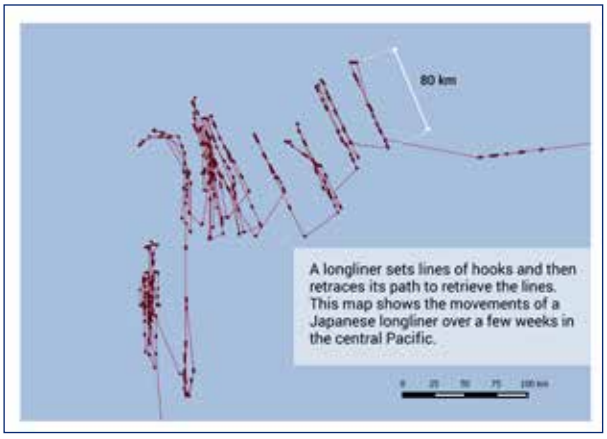
These algorithms rely on the fact that there are common fishing techniques, each with a specific gear type and associated movements. For instance, purse seiners are vessels that encircle schools of fish with nets that they then draw closed. Figure 1 shows the movements of a 67-metre French purse seine vessel in the Pacific as it sets a circular net roughly half a kilometre in diametre over the course of a few hours, likely entrapping a school fish. The dots are where the vessel reported its position, and the lines connect the dots to show the most likely path between these points. By comparison, Figure 2 shows the movements of a longliner over a few days. A longliner sets lengths of cable or line, often many kilometres or tens of kilometres long, with hooks attached at various intervals. The vessel then retraces its path to retrieve its catch along with the hooks. This longliner, a 50-metre Japanese vessel, can be seen setting its lines, which are over 80 kilometres long, and then traveling back along the lines to retrieve them. Pattern-matching algorithms can recognize these distinct movements, classify these vessels by type and estimate where they are setting their gear.

Figure 1. The tracks of a French Vessel, a 67m Purse Seiner Operating in the Pacific.



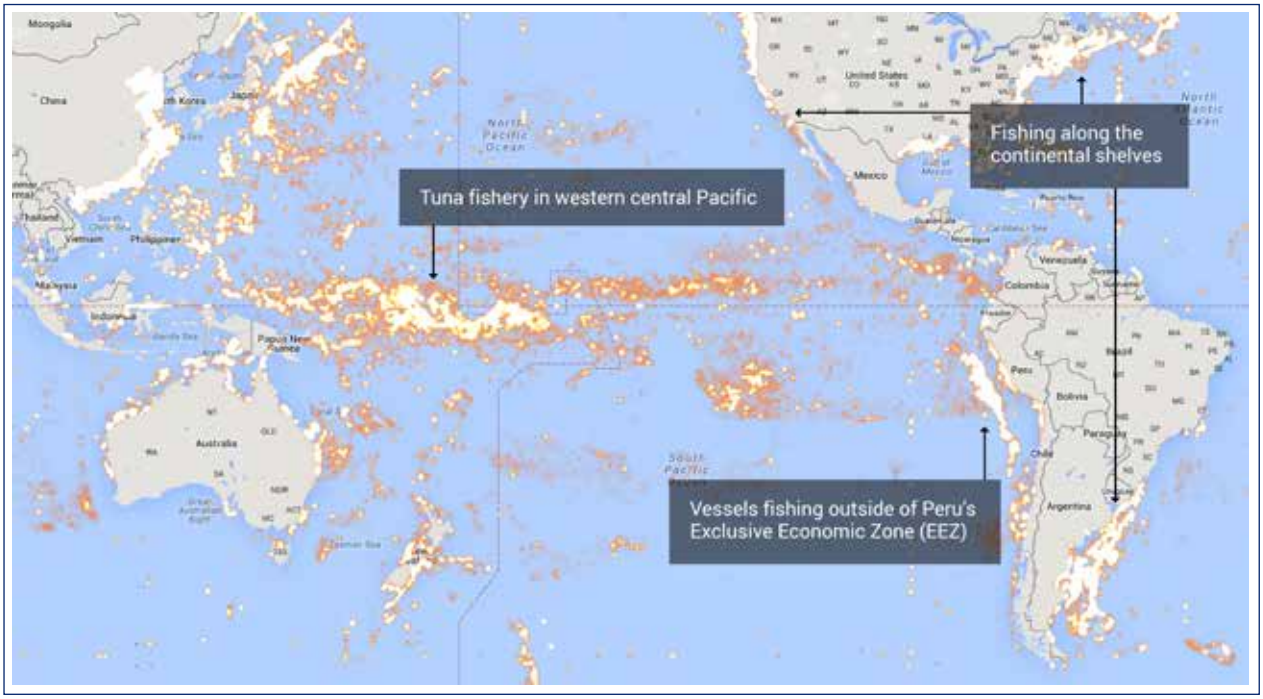
Source: Global Fishing Watch (globalfishingwatch.org).

Figure 2. The tracks of a Japanese Vessel, a 50m Longliner Operating in the Pacific.



Source: Global Fishing Watch (globalfishingwatch.org).

Figure 3. Fishing Effort as Measured by Global Fishing Watch.



Source: Global Fishing Watch (globalfishingwatch.org).

Global Fishing Watch's algorithms are categorizing this activity and building a database of when fishing is occurring for more than 35,000 likely fishing vessels across the globe. Figure 3 shows Global Fishing Watch's website, which was recently made freely available to the public[1]. The map shows all the places where the algorithms believe vessels carrying AIS were fishing between January 2014 and July 2015. Brighter areas indicate a higher intensity of fishing. A recent comparison showed a strong correlation between the fishing effort estimated by Global Fishing Watch and the estimate of catch in the central Pacific made by the Western and Central Pacific Fisheries Commission (WCPFC) (McCauley et al., 2016). In other words, the map is likely a reasonable estimation of where vessels are fishing.

Figure 3 shows many patterns of industrial fishing in the world's oceans. It illustrates clearly that fishing effort is concentrated along the often nutrient-rich continental shelves. It highlights intense fishing in the western central Pacific, focused on high margin tuna populations. The figure also shows political boundaries at work. Due to the Humboldt Current and strong upwelling, Peru's coastal waters are rich with nutrients and marine life, but foreign vessels are not permitted to fish in the country's waters. The map reflects this by illustrating a more intense fishing effort just outside the Exclusive Economic Zone (EEZ) of Peru.

By revealing where fishing is concentrated, it becomes possible to monitor compliance with national and international legislation. Combined with other data sources, AIS-derived tracks can be traced back to individual fishing vessels, which increases public transparency and helps nations hold fleets accountable. Global Fishing Watch algorithms continue to be refined and the tool will be further enhanced as more satellites come online and more vessels adopt AIS technology. This improved monitoring and tracking system is indispensable for managing marine protected areas and the oceans at large.

"By revealing where fishing is concentrated, it becomes possible to monitor compliance with national and international legislation."

1 www.globalfishingwatch.org

4. Protecting marine World Heritage with AIS: The success story of Phoenix Islands Protected Area in Kiribati

The potential for AIS technology to protect our oceans is well illustrated by recent events in the Phoenix Islands Protected Area (PIPA). The Phoenix Islands, the world's largest UNESCO World Heritage site, are a string of seamounts and almost entirely uninhabited islands in the central Pacific. Just south of the equator between Hawaii and Australia, they are hundreds of miles from any populated area. One scientist described the reefs as being in a state that they would have been in "thousands of years ago," before human exploitation (Stone and Obura, 2012). The protected area is a haven for biodiversity. The islands host over 800 known species of fauna, including 200 coral species, 500 fish species, 18 types of marine mammals, and 44 species of birds (UNESCO, 2016). PIPA was inscribed on the UNESCO World Heritage List in 2010 for its unique and irreplaceable ecosystems and natural phenomena.

The underwater seamounts are particularly remarkable features. Carondelet seamount, for instance, is an underwater mountain that rises about 5,000 metres from the seafloor to a peak that lies a mere six metres below the surface of the water. On this isolated seamount in the middle of the Pacific biodiversity thrives. Hundreds of miles of ocean stretch to the horizon in every direction, and yet a vibrant reef teems with marine life just below the surface.

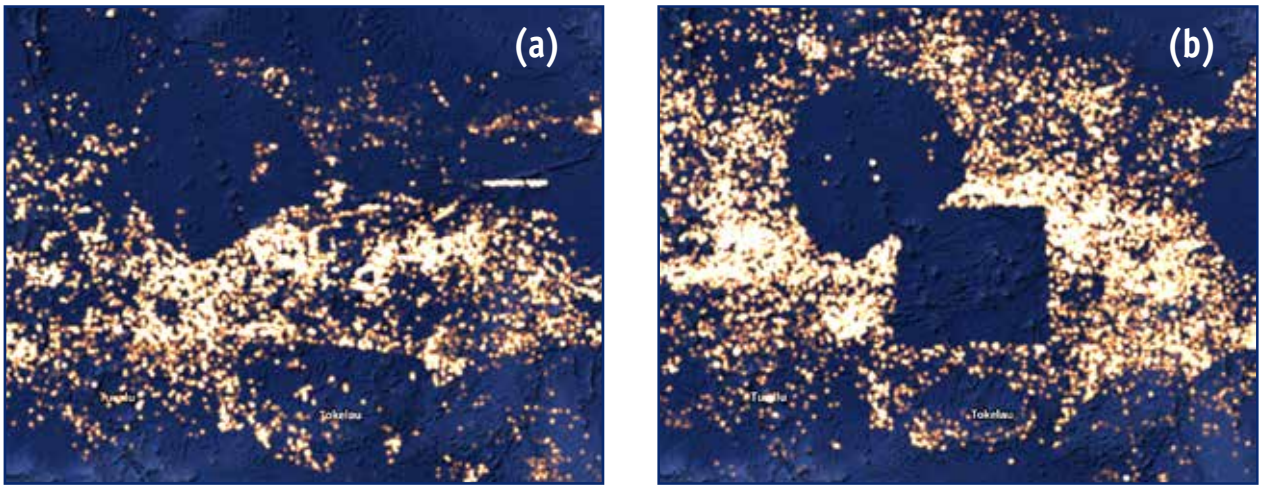
Recognizing that their country had one of the world's last untouched ecosystems, the Government of Kiribati worked with UNESCO to declare the region, which is about the size of California, a World Heritage site in 2010. Industrial fishing remained legal at the time of inscription on the World Heritage List, and some experts estimated that about 50,000 tons of tuna were extracted from PIPA every year (Pala, 2014). Concerns of fishing pressure were also an important concern for the World Heritage Committee at the time of inscription on the World Heritage List[2]. One reason why fishing was allowed is that the Government of Kiribati derives about half of its revenue directly from granting fishing licenses (Bell et al., 2015). With assistance from Conservation International, the New England Aquarium, and the Waitt Foundation, Kiribati set up the PIPA Conservation Trust to help offset the costs of closing its World Heritage area from fishing. On January 1st 2015, the Government of Kiribati officially banned industrial fishing in PIPA. In closing the world's largest UNESCO World Heritage site from industrial fishing extraction, the Government of Kiribati set a major precedent.

Once PIPA was declared off limits for industrial fishing, a key challenge remained: How to monitor and manage this vast reserve, which is roughly the size of California? Kiribati is a nation of 33 tiny islands with limited human and financial resources to patrol this enormous marine park. According to the International Monetary Fund (IMF), the country—which has a population of approximately 100,000 —has the second smallest gross domestic product (GDP) in the world. Yet its islands are spread across five thousand kilometres of ocean.

The application of the Global Fishing Watch methodologies proved an efficient and cost effective tool. Using AIS data, it was possible to show fishing effort in PIPA before and after the closure of the area on January 1, 2015. The results are remarkable. In the two months before January 2015, 61 industrial purse seiners and longline vessels cast their fishing gear in PIPA. As shown in figure 4a, there is no difference in fishing effort within and outside the World Heritage area. After the closure, however, the area was cleared of industrial fishing vessels. As shown in figure 4b, the boundaries of PIPA World Heritage area are now clearly visibility with fishing vessels operating in its vicinity but no longer within. (McCauley et al., 2016).

2 WHC-10/34.COM/8B. Brasilia, 31 May 2010, p. 4. http://whc.unesco.org/archive/2010/whc10-34com-8Be.pdf

Figure 4a and 4b. Fishing effort, as calculated by Global Fishing Watch, in the Phoenix Islands Protected Area (PIPA) in the six months before January 1st, 2015 (a), and the six months after (b), when the park was closed to fishing.



Source: Global Fishing Watch (globalfishingwatch.org).

AIS has also helped with enforcement. In June of 2015 a tuna purse seiner crossed into the northwest corner of PIPA. The vessel was carrying Kiribati's VMS, which alerted officials that the vessel had entered the World Heritage area. Kiribati sent its lone patrol boat, *the Teanoai*, to investigate. After four days at sea, it was able to connect with the purse seiner and escort it to port, several hundred miles away. It was challenging, though, to prove whether the vessel had been fishing within PIPA. The VMS data recorded a position about once every four hours, which was too infrequent to identify whether the ship's movements suggested fishing. The AIS data, however, recorded positions every few minutes and clearly showed the vessel circling near the park's boundary. Partially because of this more accurate data, the government pursued charges against the vessel and won a $2 million settlement—an amount that is more than one percent of Kiribati's GDP (PIPA Newsletter, 2015).

"…the boundaries of PIPA World Heritage area are now clearly visibility with fishing vessels operating in its vicinity but no longer within."

(McCauley et al., 2016)

Phoenix Islands Protected Area (Kiribati).
© Keith Ellenbogen / New England Aquarium

5. Monitoring fisheries in marine World Heritage sites

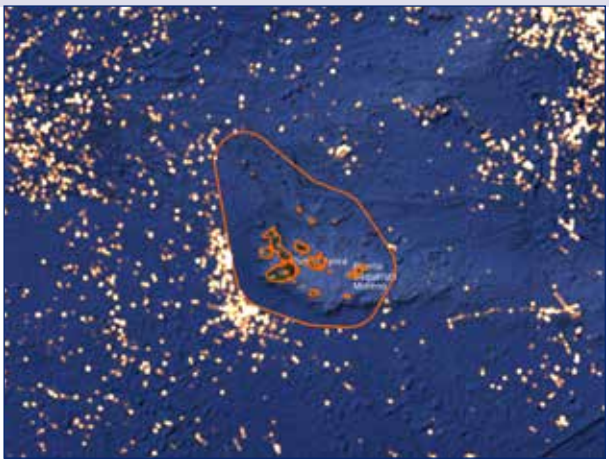
The Global Fishing Watch tool allows anyone in the world with an internet connection to visualize and identify where vessels are fishing near, and in, World Heritage sites. It is freely available online. Given that humanity as a whole has the responsibility to protect World Heritage sites as part of our common legacy, such public access could be critical to preserving these iconic places.

In many World Heritage sites fishing is allowed to some extent, although it is usually regulated. The Global Fishing Watch platform provides an important tool for monitoring and understanding fishing pressure around these sites. In the Galápagos Islands (Ecuador), for instance, industrial fishing is prohibited within the park, but some artisanal fishing is permitted. Figure 5 shows fishing effort around the Galápagos Islands and clearly illustrates that industrial vessels with AIS are obeying park boundaries and the regulations in place for the protection of the World Heritage area. Researchers at Dalhousie University, in partnership with Global Fishing Watch, are currently comparing AIS derived fishing effort data with official observer logs and finding a strong correlation. However, the visualization of fishing effort shown in figure 5 is limited because neither artisanal vessels nor smaller industrial vessels are equipped with AIS.

"The Global Fishing Watch tool allows anyone in the world with an internet connection to visualize and identify where vessels are fishing near, and in, UNESCO World Heritage sites. It is freely available online."

The future of AIS data in the Galápagos Islands is promising, however. The Ecuadorian government recently announced the intention to require all fishing vessels to carry AIS regardless of size and fishing type (Bigue, 2015). These policy changes will create a more comprehensive and accurate view of fishing in World Heritage sites such as the Galápagos Islands.

Figure 5. Fishing effort near the Galápagos Islands.



Source: Global Fishing Watch (globalfishingwatch.org).*

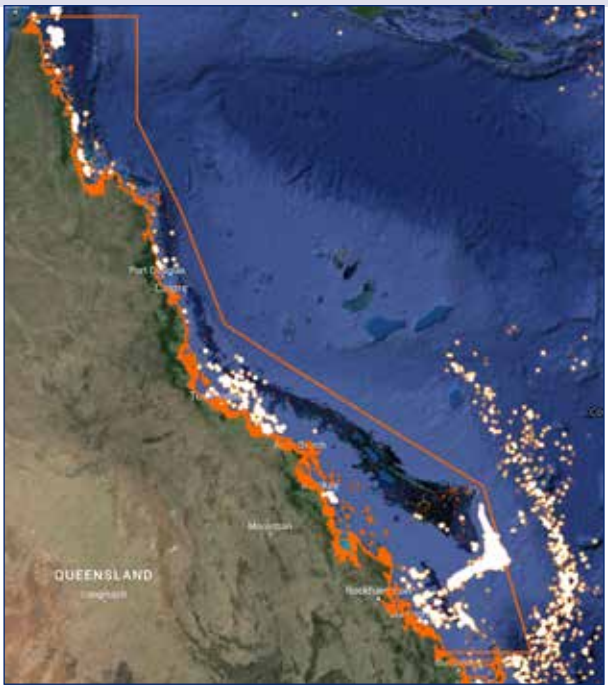
As another example, figure 6 shows the Great Barrier Reef off Australia's northeast coast. Fishing is permitted, but up to a third of the World Heritage area is off limits for fishing, and significant other restrictions apply. According to the Australian government, about 15,000 tons of seafood is harvested every year from the park (Great Barrier Reef Marine Park Authority, 2016).

Currently, only a small fraction of the fishing vessels operating in the Great Barrier Reef Marine Park carry AIS, so the majority of the fishing effort in this park is not visible in Global Fishing Watch. But as the platform continues to develop, new tools and algorithms are being built to incorporate the addition of local vessel registries and VMS data. (Other nations, including Indonesia have already committed to sharing this information to create a more complete picture of the fishing effort in their waters.)

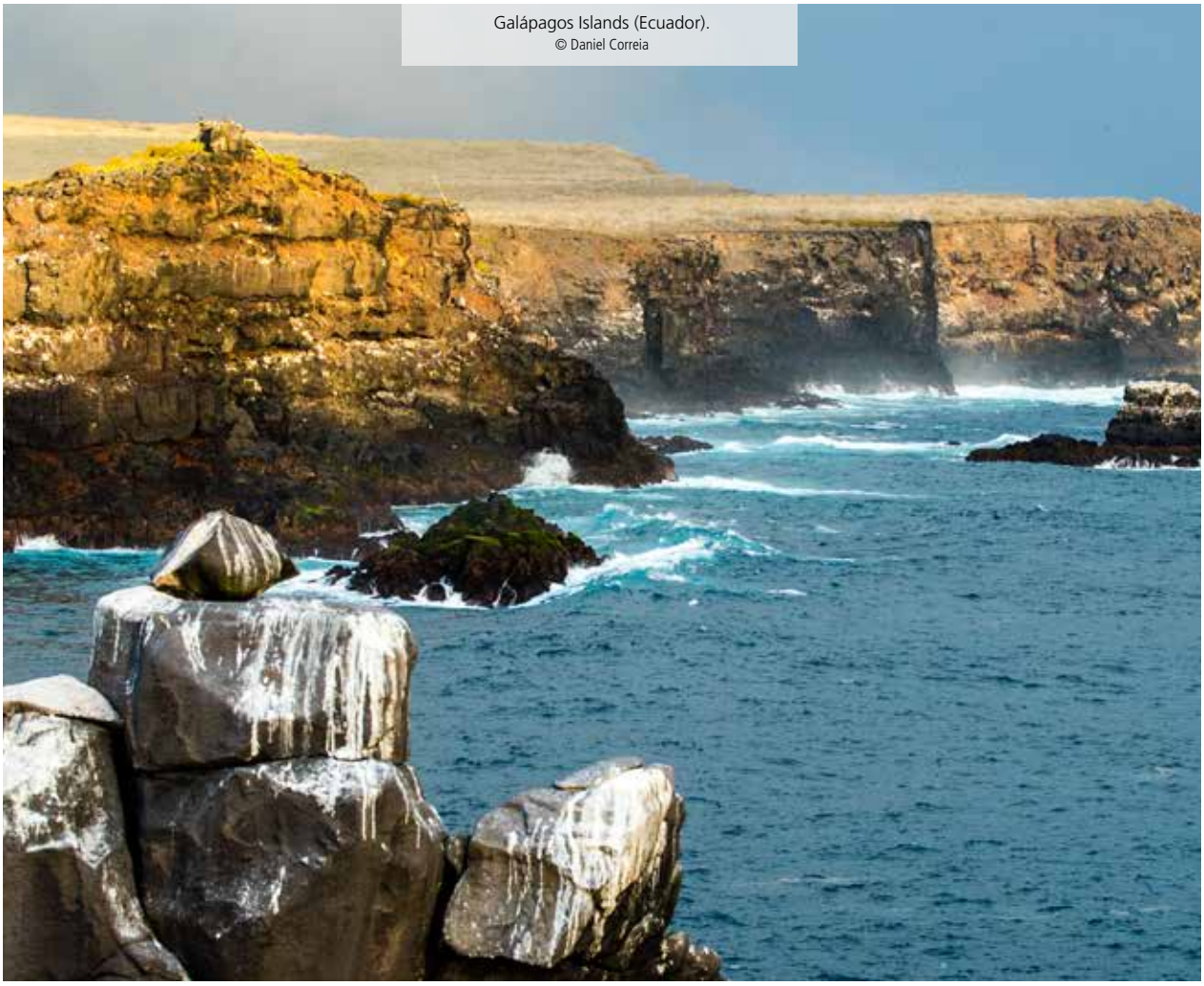
The Australian and Queensland Governments are considering a new VMS to monitor all commercial fishing vessels operating in Queensland waters, including the Great Barrier Reef Marine Park. If the political will for transparency exists and the decision were made to publish VMS tracks, the view of Australia's fishing effort would be much more complete, providing new tools to their constituents, and environmental and industry managers.

"Up to a third of the Great Barrier Reef is off limits for fishing, and significant other restrictions apply."

Figure 6. Fishing effort near the Great Barrier Reef.



Source: Global Fishing Watch (globalfishingwatch.org).



Galápagos Islands (Ecuador).
© Daniel Correia

6. What is needed to scale-up tracking of fisheries in marine World Heritage sites?

To apply this cost effective and promising technology to more World Heritage marine sites, a few technical, cultural, and legal obstacles must be addressed. Below we consider some of the challenges to using AIS and complementary technologies to monitor our oceans. If the right policies are enacted, and if technological progress continues at its current rate, in a few years we will have a much more comprehensive view of fishing activity in our oceans.

6.1. Improved AIS technology and policy

AIS has a number of pitfalls, including intentional disabling or tampering of AIS devices, which in turn limits our ability to track vessels at sea. Some of these pitfalls are being actively addressed, but they will require a combination of better technology and policy.

The first major challenge is that we need more satellites. Satellite-AIS broadcasts sometimes interfere with each other, making it difficult to track vessels in areas of dense marine traffic, such as off the coast of China or along much of Europe's coastline. In many of these areas, terrestrial antennas solve this issue, but farther off the coasts in these regions it is challenging to correctly track vessels. Fortunately, this challenge is being addressed, as some major satellite-AIS providers are launching additional receivers and developing new technologies that will come online in the next few years.

Another challenge with AIS is that some devices report false locations. This is seen in only a small percentage of vessels and is believed to be caused by deliberate tampering or faulty equipment. It seems to be associated with specific fleets, and although these false locations are challenging, they present as a regular pattern of offsets, which means we have been able to identify and correct these location errors. Similarly, multiple vessels sometimes broadcast the same unique identifier to hide their identity. The resulting data then looks like a single boat that is jumping back and forth across the globe. Fortunately, an algorithm can break the multiple signals into individual tracks of different vessels. These new algorithms make it more and more difficult for a vessel that carries AIS to hide its movements.

Perhaps the more serious and common challenge with AIS, though, is that it can be turned off, hiding a vessel's activity entirely. Global Fishing Watch is tracking when vessels intentionally disable their AIS, which can lead to further investigation and potential legal action. For example, in July of 2013, a Colombian purse seiner was observed shutting off its AIS while in Colombian waters. It reappeared many months later off the coast of Costa Rica (Hess and Savitz, 2015). That same vessel was listed on the Inter-American Tropical Tuna Commission (IATTC) Illegal, unreported and unregulated fishing (IUU) vessel blacklist in 2006 for fishing in IATTC waters during a closed season. While it cannot be proven where the vessel went or what it did while its AIS was off in July of 2013, such observations can prevent the vessel from getting off blacklists, and may raise flags for investigation.

While these technologies identify potentially nefarious AIS use, only more stringent AIS policy can enforce the use of AIS around the globe. Despite the fact that many countries require AIS to be constantly broadcast on vessels carrying the device, Global Fishing Watch has identified thousands of instances of vessels disabling their AIS for many days while at sea. We know it is possible to have regulations that prevent the disabling of such devices. Iceland has a strict policy in effect, and, in Global Fishing Watch Data, we see almost no gaps in broadcasts from the countries' roughly 1300 vessels that use AIS.

In addition to regulating the consistent use of AIS, another important policy is to increase the number of vessels required to carry the device. Many countries adopt the IMO regulations that vessels over 300 tons must carry AIS, which roughly corresponds to vessels approximately 30 to 35 metres in length. Although important, these regulations miss much of the fishing activity of smaller vessels. If the entire world

adopted the European Union's regulation mandating that all vessels over 15 metres carry AIS devices, we would increase the number of vessels with AIS globally by several-fold.

Every State Party that signs up to the World Heritage Convention takes up the responsibility to help protect all sites on the World Heritage List—not just those located in their own territories. The parties to the World Heritage Convention can help protect these sites by increasing the number of vessels required to carry AIS, encouraging regular use of AIS, and holding vessels accountable when they disable the devices.

6.2. New norms around sharing data

In many nations, a significant portion of the fishing vessels are already tracked using the nation's VMS system. In other words, the positions of many of these vessels are already available to many governments, but the data is not available to the public, thus limiting our ability to monitor activity in marine World Heritage sites. A far more robust monitoring system would incorporate both VMS and AIS data. Such a system would enable each device to compensate for data gaps in the other.

Fortunately, though, these norms around data sharing may be changing. The government of Indonesia has lead the way by pledging to make data from its VMS system—the second largest such system in the world—publicly available through Global Fishing Watch. While the government still has both political and technical hurdles to overcome before this can be done, the hope is to achieve a more accurate view of their waters, drawing on both AIS and VMS data. Such initiatives provide tremendous potential for the preservation of the oceans—and more specifically World Heritage sites, which, despite their status, remain vulnerable to illegal and unregulated fishing.

Open use of AIS and VMS data has led to discussions of the privacy rights of fishing vessel operators. However, fishing vessels are extracting resources from a public, globally shared resource, generally for a private gain. To maintain the long term sustainability of this common resource, we need comprehensive and collaborative management that is supported by solid and reliable monitoring. Additionally, numerous other industries have decided that the benefits of these observation technologies greatly outweigh the costs of keeping industrial activity private. For instance, the marine shipping industry has adopted AIS as its standard for monitoring vessel movements. Similarly, the United States Department of Transportation will soon require all interstate trucks to carry a device to log their positions and report them to satellites, and the Federal Aviation Administration (FAA) requires airplanes to be publicly tracked (McCauley et al., 2016). It may just be a matter of time before international regulations demand the same of all fishing vessels, regardless of size. Such regulations would greatly improve the ability to monitor the use of shared ocean resources.

6.3. Complementary technologies

In addition to better AIS and VMS, there are a number of other technologies that significantly augment our ability to monitor the oceans, including imagery or radar. Although many of these technologies are currently too expensive for wide scale monitoring, they can be adopted in some specific cases. Also, we should prepare for a future in which the costs of these technologies drop, allowing more widespread adoption.

Satellite imagery is an example of a technology that is not yet cost effective to monitor the entire ocean, but which can be effective in specific cases. The main challenge is that any satellite image that has a high enough resolution to identify a vessel—requiring a pixel size of smaller than one metre—covers only a small swath of the earth. And only a handful of civilian satellites are capable of taking such imagery, meaning that only a very small fraction of the world can be imaged on any given day. It is also very challenging to photograph a specific boat from space. Boats move, and because there is a gap of a few hours between the time one tasks a satellite to image the earth and when the satellite actually takes the image, any target vessel will have moved by the time the satellite is overhead.

Nonetheless, there are several examples of successful monitoring of the oceans with imagery. In April of 2015, the nonprofit SkyTruth started working with the Associated Press (AP) to track the movements of few large fish carrier vessels in Southeast Asia. These vessels meet up with other smaller vessels at sea, which in turn load their catch onto the fish carriers. By offloading their catch, the smaller vessels can avoid quotas and other legal obligations required in port.

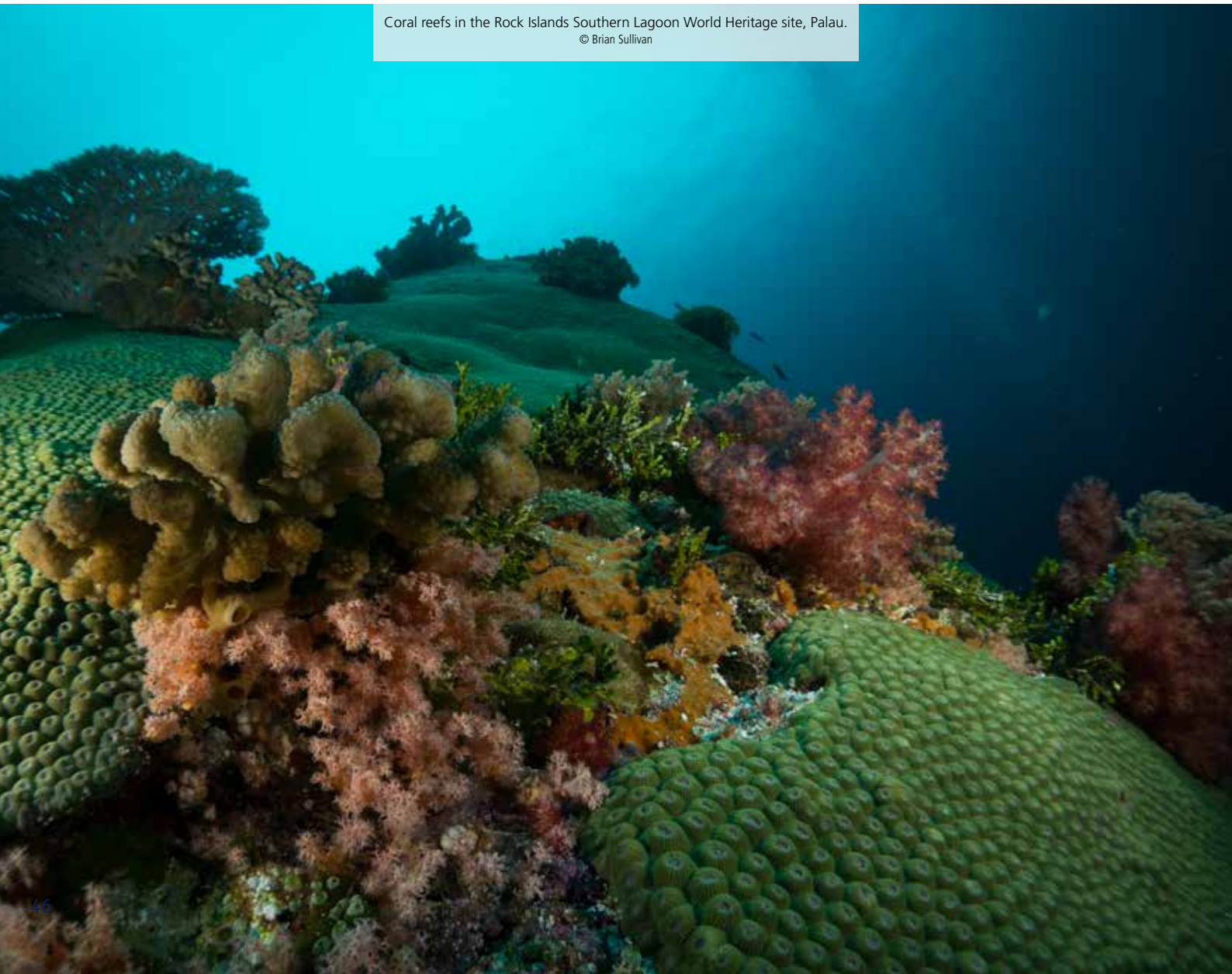
Through the partnership with the AP, SkyTruth analysts helped identify when and where larger vessels may have been receiving fish from trawlers. Because the carriers stay at anchor for multiple days in order to meet up with the smaller vessels, it is possible to record their position with AIS, task a satellite to image the location, and capture an image of a potentially illegal rendezvous before the vessel moves on.

There are also other helpful technologies, such as satellite-based radar, which can be used to count the number of vessels on the water. These technologies are good for identifying the number of vessels in any part of the ocean, but they are also prohibitively expensive for most organizations—it can cost over $2,000 for a single image—and they are difficult to scale across the entire globe. Nonetheless, occasional images by these radar satellites can be useful to verify the accuracy of AIS measurements.

7. Conclusion

Some of Global Fishing Watch's greatest successes have come not from algorithms, but from individuals looking at vessels over the internet and then acting on the information. In January of 2015, a SkyTruth analyst was monitoring vessels in the Pacific when he saw a Taiwanese-flagged fishing boat that appeared to be fishing in Palau's waters, home to the prestigious Rock Islands Southern Lagoon inscribed on UNESCO's World Heritage List in 2012. The detected vessel was not on the analyst's list of vessels permitted to fish in Palau. SkyTruth contacted Palau's authorities, and a chase ensued. Palau apprehended the vessel shortly thereafter and found it was filled with illegally caught shark fins and tuna.

Technologies will continue to improve in coming years, increasing the accuracy of tracking and monitoring of fishing efforts in the ocean. In the next decade, it may be possible to take high resolution images of the entire globe every day, allowing the monitoring of even small fishing vessels. With the proper policy and sufficient funding, every fishing vessel on the ocean could be equipped with AIS, allowing real-time



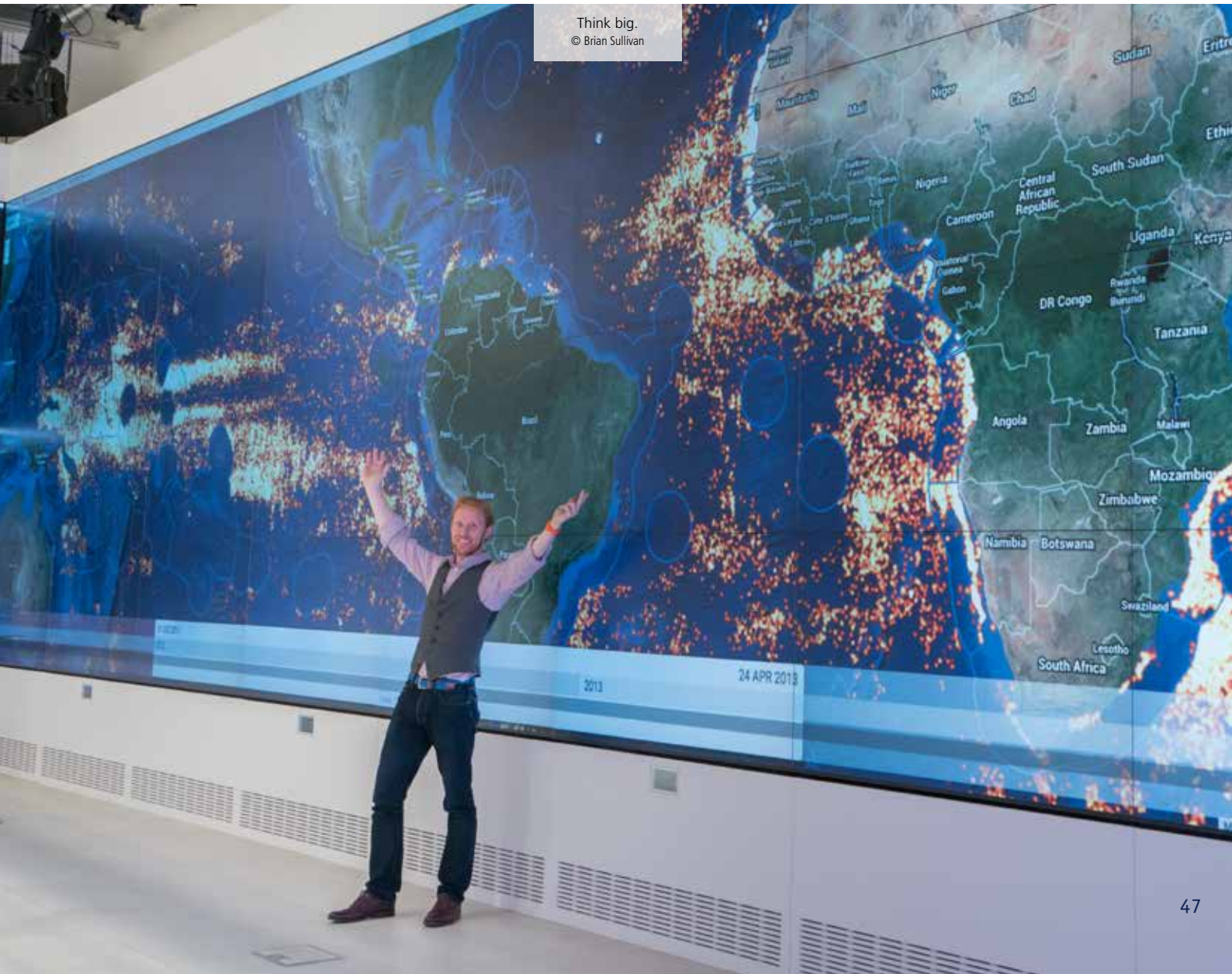
Coral reefs in the Rock Islands Southern Lagoon World Heritage site, Palau.

tracking and monitoring of how ocean resources are used and managed.

Ultimately, though, the full potential of these tools can only be achieved if the technology becomes user friendly enough for anyone who has an internet connection to help identify when and where fishing is taking place. In other words, this technology must make it easier for individuals to serve as the observers for our shared oceans. Transparency and broad public access make it more difficult for vessels to operate illegally or for officials to turn the other way—accepting bribes or ignoring offenses. When it is known more clearly where and when fishing is occurring, it becomes possible to set more accurate fishing quotas and enable better management of the oceans.

World Heritage sites ensure the preservation of the ocean's most special places. Tools such as Global Fishing Watch will ultimately empower every person, from government officials, to individual fishers and average citizens to uphold their share of responsibility for protecting these places and ensuring the sustainability of humankind's common heritage. Today's technology provides an unprecedented opportunity to preserve the unique legacy of ocean places for future generations.

"Tools such as Global Fishing Watch will ultimately empower every person to uphold their share of responsibility for protecting and ensuring the sustainability of humankind's common heritage."



Think big.
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4

Part 4
Towards a positive Outlook for marine World Heritage

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Scuba diver conducting research.

1. Introduction

In 2014 IUCN launched the IUCN World Heritage Outlook – the first global assessment of conservation prospects of all natural and mixed World Heritage sites, including all marine and coastal ones. Back in 2014 the study concluded that while the conservation outlook for about two-thirds of all natural sites was positive, the outlook for one third of sites was of significant concern. In the two years since the release of the study, marine sites have been facing unprecedented pressures. The longest recorded global coral bleaching event has affected marine World Heritage sites in different parts of the world and its impacts are still unfolding. With global pressures on oceans increasing, it is now more important than ever to focus our efforts on ensuring that effective conservation programmes are in place in all sites and that threats are being addressed and minimized. In order to be able to measure the progress towards ensuring effective conservation of all marine World Heritage sites, it is crucial to be able to assess their state of conservation over time in a comprehensive manner. With the next global assessment planned for 2017, the IUCN World Heritage Outlook provides such a unique monitoring tool for tracking our progress towards achieving a positive conservation outlook for natural World Heritage.

Lagoon in the Great Barrier Reef, Australia.
© XL Catlin Seaview Survey

2. Methodology for developing the IUCN Conservation Outlook

The IUCN World Heritage Outlook consists of Conservation Outlook Assessments of all natural and mixed World Heritage sites. Each individual site assessment is based on three elements:

- Current state and trend of values for which the site was inscribed on the World Heritage List and which constitute the site's Outstanding Universal Value
- Threats affecting those values
- Effectiveness of protection and management

The overall Conservation Outlook category (Good; Good with some concerns; Significant Concern or Critical) is assigned by combining the assessment of these three elements and their interrelationships and represents a projection of the potential for a natural World Heritage site to conserve its values over time.

Figure 1. The four possible categories for natural World Heritage sites in the IUCN Conservation Outlook.

Source: Osipova et al., 2014.

Conservation Outlook Assessments are developed by independent experts who complete standardized assessment worksheets based on a range of information sources. These include official and publicly available World Heritage Committee documents (State of Conservation reports, World Heritage Committee Decisions, reports of reactive monitoring missions), scientific articles, management plans, management effectiveness evaluations as well as information gathered through consultation with a wide range of stakeholders. Once the information is compiled, each assessment goes through a comprehensive review process which includes review by several external experts. Site managers and relevant national management authorities are also consulted and given an opportunity to provide comments on the assessments[1]. Combined, all individual assessments provide an overall conservation outlook for natural World Heritage sites.

The first IUCN World Heritage Outlook report was launched at the World Park Congress in 2014 and will be updated every three years. The next issue is expected in 2017 and will enable a first comparison and the identification of a positive or negative trend in the overall outlook of natural World Heritage. The 2017 IUCN World Heritage Outlook will evaluate all changes occurred between 2014 and 2017 in each natural and mixed site, will take into account all new information that has become available and will also ensure even broader review of each assessment by a wider range of experts.

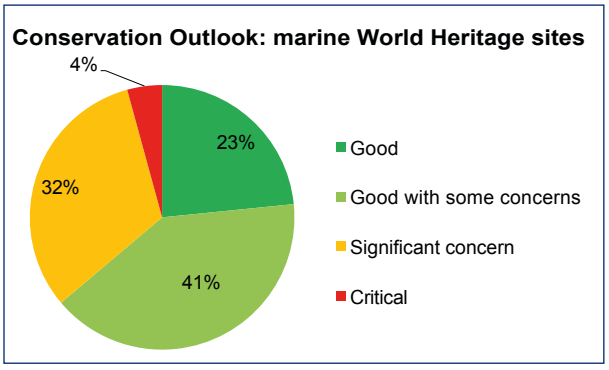
1 For more information on the methodology please visit: http://www.worldheritageoutlook.iucn.org/about-the-world-heritage-outlook

3. The IUCN World Heritage Outlook 2014: Key findings

This article includes some key findings from the 2014 IUCN World Heritage Outlook, including conclusions regarding main threats and conservation challenges that marine World Heritage sites are facing.

Out of 47 marine sites on the UNESCO World Heritage List as of 2014, for nearly two-thirds the conservation outlook was evaluated as either "good" or "good with some concerns." The conservation outlook of about a third of all marine sites was considered of "significant concern". The conservation outlook of 2 sites was considered to be "critical" (fig. 2).

Figure 2. Conservation Outlook: marine World Heritage sites.



Source: IUCN World Heritage Outlook.

In addition to providing an overall picture of the conservation prospects of natural World Heritage sites, the IUCN World Heritage Outlook also compiles information on key threats and conservation issues that natural sites are facing and can therefore be used to guide conservation efforts.

In order to evaluate the overall effectiveness of protection and management of a site, the IUCN World Heritage Outlook assesses different management aspects. For marine World Heritage sites, the management aspects that were most often assessed as being of concern in 2014 included sustainable use, legal framework and enforcement, sustainable finance and staffing.

As for threats affecting marine World Heritage sites, the most widespread current threats identified in 2014 included overfishing, invasive species, water pollution and climate change. With the impacts of climate change already being visible in many sites, it was also assessed as by far the most significant potential threat in the longer term, and the massive ongoing coral bleaching event indicates that climate change is already becoming a current threat in many more sites.

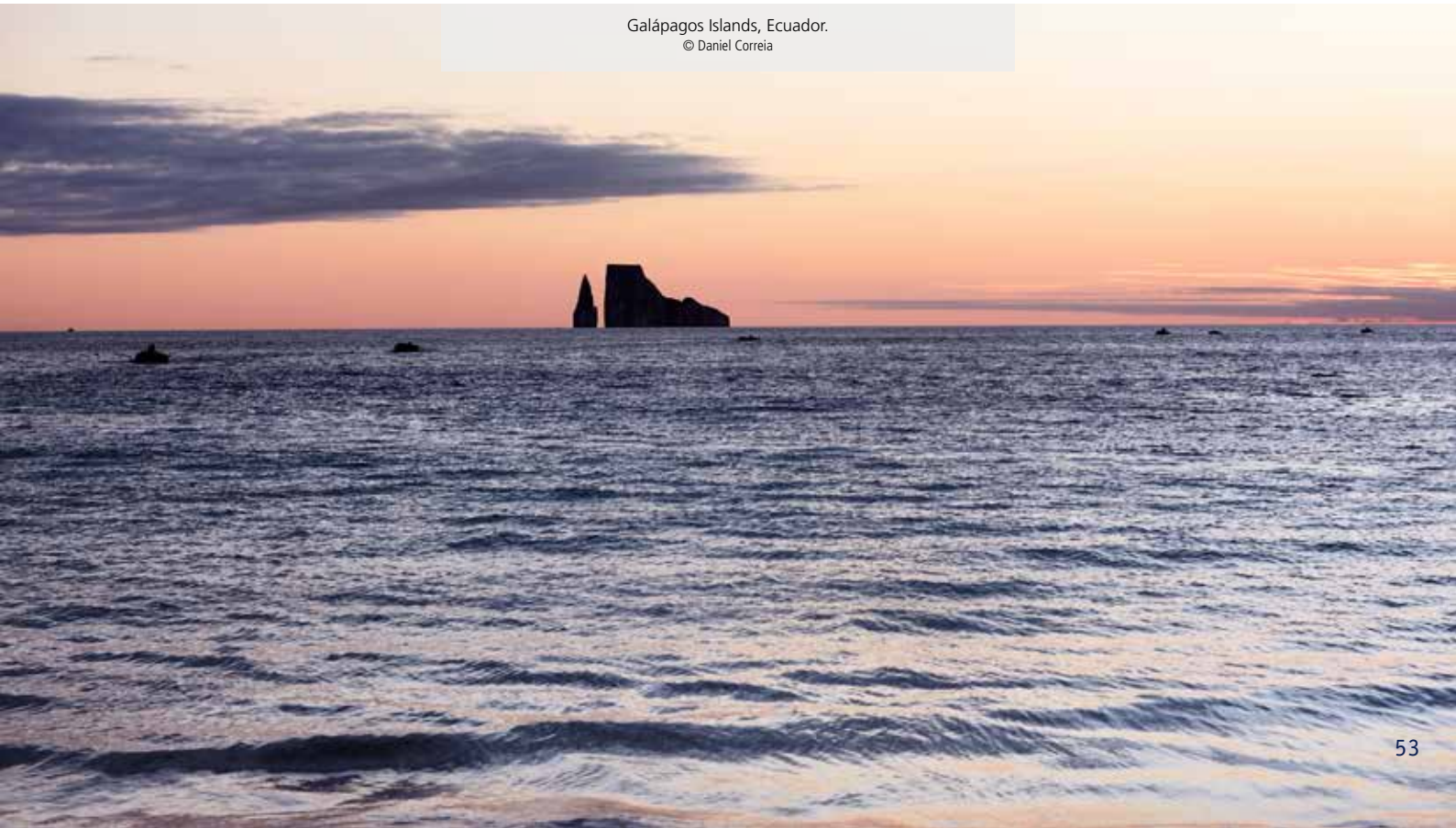
The overall conservation outlook for a site is based on the assessment of the identified threats and the effectiveness of protection and management in responding to them. Even though most of the marine World Heritage sites have been impacted to some degree by one or more threats described above, the overall conservation outlook for many marine sites still had been assessed as either being good or good with some concerns. This was either thanks to effective protection and management, like in the cases of The Wadden Sea (Denmark/Germany/Netherlands) or Ningaloo Coast (Australia), or due to the fact that the impacts of these threats have to date been rather limited, including thanks to the remoteness of some sites. However, with global threats, such as climate change, ever increasing, even the most remote marine sites are becoming vulnerable and therefore preserving their Outstanding Universal Value will require additional efforts.

"With the impacts of climate change already being visible in many sites, it was also assessed as by far the most significant potential threat in the longer term."

4. Towards a positive Outlook for marine World Heritage

In addition to identification of key conservation issues, one of the objectives of the IUCN World Heritage Outlook is to highlight well-managed sites with good conservation outlook and, by compiling information on their conservation successes, foster distribution and application of best-practice examples (see Box 1). Given their flagship status, marine World Heritage sites seem obvious candidates for the development of innovative approaches, which can then be replicated not only in other World Heritage sites, but also across protected areas in general. Combining and matching these best practice examples with the identified threats and problems can provide a strategic roadmap for improving conservation outlook of each site and of natural World Heritage overall.

Such a strategic roadmap can be used as a crucial tool to guide conservation activities in each site. While it is essential that we continue our efforts to collectively combat global issues, such as climate change, it is now more important than ever to also address the key issues affecting marine World Heritage at site level, including the most widespread threats to marine sites identified in the IUCN World Heritage Outlook 2014, such as overfishing, invasive species and water pollution. In the face of the unprecedented challenges facing our oceans, resolving both these and global issues and achieving a positive outlook for marine World Heritage will require unprecedented combined efforts by all stakeholders, including governments, civil society and private sector. The next IUCN World Heritage Outlook to be launched in 2017 will for the first time show the trends in the conservation of natural World Heritage. Future reports, released every three years, will show if and how humanity is progressing towards a positive outlook for all natural World Heritage sites globally.



Galápagos Islands, Ecuador.
© Daniel Correia

Box 1.
Examples of conservation successes

The Wadden Sea – a World Heritage site shared and jointly managed by Denmark, Germany and the Netherlands – is not only a world-renowned example of a well-managed transboundary World Heritage site, but also an example of international cooperation that stretches across regions. In 2014 a Memorandum of Understanding (MoU) was signed between the Wadden Sea and Banc d'Arguin National Park – a marine World Heritage site in Mauritania and an important site for migratory birds on the East Atlantic Flyway. The MoU provides a framework for cooperation between the sites in a number of fields related to the conservation of migratory birds, including research activities to strengthen sites' mutual understanding in migratory birds trends, communication and awareness raising as well as the establishment of maritime pollution measures under the International Maritime Organisation (IMO).

The Wadden Sea (Denmark, Germany, Netherlands)
© Jan van de Kam / Common Wadden Sea Secretariat

Another successful cooperation was officially recognized in 2009 when a "sister site" agreement was signed between the Phoenix Islands Protected Area (Kiribati) and Papahānaumokuākea (United States of America). Joining two of the world's largest marine protected areas, this partnership agreement is aimed at enhancing cooperation and knowledge exchange and developing innovative initiatives. In their respective countries, both protected areas are also good examples of partnerships between different organisations and agencies who jointly manage these sites.

Papahānaumokuākea (United States of America)
© SeaPics / James Watt

Aldabra Atoll (Seychelles) has seen its green turtle population go from near extinction to one of the largest on Earth since it was inscribed on the UNESCO World Heritage List in 1982 (Douvere, 2015). Due to the strict protection of nesting beaches around the Aldabra Atoll, the number of turtles nesting annually increased from 500-800 in the late 1960s to 3100-5225 in 2011 (Mortimer et al., 2011). Aldabra Atoll's green turtle population is now the largest in the Western Indian Ocean region and growing every year. The management of Aldabra Atoll is run very professionally by the Seychelles Island Foundation (SIF) and the atoll is very well protected, legally and in practice.

Aldabra Atoll (Seychelles).
© UNESCO / Ron Van Oers

Macquarie Island (Australia) is one of the few islands in the world where invasive species have been successfully eradicated. Thanks to a seven year, 25 million AUD eradication project, the Macquarie Island Pest Eradication Plan resulted in the complete eradication of introduced rabbits and rodents (mice and rats) since 2014. Vegetation has been re-established and seabirds returned to breed in previously affected areas. Earlier this year, the Australian Government announced a 50 million AUD investment to establish a permanent scientific research station on Macquarie Island.

Group of King Penguins on the beach of Lusitania Bay, Macquarie Island (Australia).
© Hullwarren - Wikimedia

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Part 5
Tracking iconic migratory species among UNESCO World Heritage sites in the Eastern Tropical Pacific

5

Archipiélago de Revillagigedo: Yellowfin Tuna and Silky Shark
© Rodrigo Friscione Wyssmann

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1. Introduction

The Eastern Tropical Pacific is rich with ocean predators such as large schools of scalloped hammerhead sharks. This ocean region, which stretches down the Pacific Coast from the Gulf of California to Ecuador, is known as a treasure trove of wonders by divers, wildlife enthusiasts, and eco-adventurers. It is home to a host of endemic, native and migratory species, some of which are threatened with extinction.

The region is home to four UNESCO marine World Heritage sites: Cocos Island National Park in Costa Rica, Coiba National Park and its Special Zone of Marine Protection in Panama, Galápagos Islands in Ecuador, and Malpelo Fauna and Flora Sanctuary in Colombia (fig. 1). All four are designated safe havens for marine wildlife, many of which move between protected zones to feed, congregate, mate or give birth. All four sites were inscribed on UNESCO's World Heritage List for their unique and irreplaceable marine ecosystems and biodiversity. This article shows, however, that the ecological insights provided by groups such as the Migramar Network are indispensable to secure the long-term conservation of these World Heritage sites.

2. Understanding interconnectivity among marine World Heritage sites

The ocean surrounding these World Heritage sites is teeming with life, ranging from schools of hammerheads, to elegant manta rays, foraging endangered sea turtles, giant whale sharks that regularly traverse thousands of kilometres, and Galápagos sharks that dart between reefs and open waters. The combination of oceanic currents in this region, with high seasonal productivity along the Equatorial Front from July through October, and the upwelling Cromwell Current bringing nutrient-rich waters to the surface in the western Galápagos Islands, provide a diverse and changing set of oceanographic conditions throughout the region.

Sadly, marine life in this biodiverse region is under threat primarily from commercial fishing, but also from coastal development that destroys mangrove nursery grounds and sea turtle nesting beaches.[2] Scientists have recorded an astounding 88 species of sharks within the region[3] of which many, including the scalloped hammerhead, silky and whale sharks, are listed as endangered or threatened under international agreements, treaties and laws.

Over the last two decades there has been growing concern over the depletion of shark populations globally, particularly in this region. Given their slow growth rates, late onset of sexual maturity, and relatively small number of offspring, sharks are particularly vulnerable to overfishing. It is estimated that over 100 million sharks are killed globally each year, many only for their fins (Worm et al., 2013). As top predators, sharks drive natural selection processes and many species are key to maintaining the overall health of marine ecosystems. Commercial fishing, including both legal and illegal longlining, drift gillnets, and purse seining capture sharks for their fins. This pushes them and other migratory species to unhealthy levels in the Eastern Tropical Pacific, and as such provide an impact on the Outstanding Universal Value (OUV) of all four World Heritage sites.

2 Coastal development and loss of mangrove habitat is also a serious threat as it impacts the nursery ground of certain fish species and sharks.
3 www.migramar.org

To address these concerns, in 2004 the Governments of Ecuador, Colombia, Costa Rica and Panama signed the Declaration of San Jose, creating the Eastern Tropical Marine Corridor (or CMAR for its Spanish initials). This ambitious initiative encompasses the four UNESCO World Heritage sites, which are ecologically linked by the surrounding pelagic waters. The CMAR aims to conserve and protect the unique ecosystem and biodiversity of the Eastern Tropical Pacific, and to promote sustainability and science-based collaboration within the region.

A key aspect of the CMAR is to promote collaborative research to address regional concerns. One of the successes of this approach was the creation of the Migramar Network in 2006. The mission of Migramar is to provide a platform for researchers to jointly study the movement patterns of migratory species in the region, and to use this information to drive science-based conservation policy. Migramar is made up of researchers from diverse groups, such as universities, government agencies and non-profit organizations including Equilibrio Azul, Universidad San Francisco de Quito and Parque Nacional Galápagos (Ecuador), Fundación Malpelo (Colombia), PRETOMA and Misión Tiburón (Costa Rica), Pelagios-Kakunjá (Mexico), Smithsonian Tropical Research Institute (Panama), and Turtle Island Restoration Network, the Leatherback Trust and University of California, Davis (United States of America).

Through its work, the Migramar network was rapidly able to show that the protected UNESCO World Heritage sites, while formed separately, are in fact part of the same large marine ecosystem. For instance, a green sea turtle named 'Sanjay' by researchers was tracked swimming from Cocos Island National Park in Costa Rica to the Galápagos Islands in Ecuador. 'Sanjay' the sea turtle was one of three green sea turtles tagged at Cocos Island, Costa Rica in June 2014 during Turtle Island Restoration Network and PRETOMA's joint 10-day research expedition. The expedition set out to understand where these endangered sea turtles migrate to and how they use Marine Protected Areas (MPAs). 'Sanjay' was tagged with a satellite transmitter and his migration track can be seen in fig. 2.

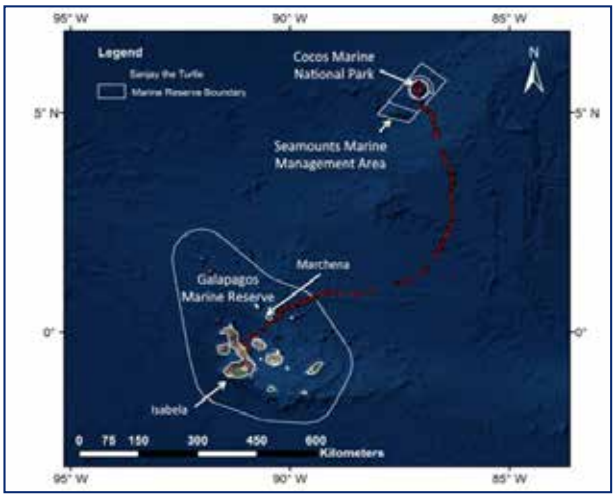
The connection between Cocos Island and the Galápagos Islands is strong and can even be seen in genetic studies of sea turtles. Costa Rican biologists used genetic data from turtles in both locations to evaluate the connectivity of the region, and found that there was over 90 percent genetic overlap between green sea turtles in both sites (Heidemeyer, 2015).

Given that very few green turtles nest in Cocos Island, these results suggest that the majority of green turtles found at Cocos Island were born in the Galápagos Islands. In addition to genetic evidence, turtles carrying ultrasonic transmitters tagged at Cocos Island were detected at receiving stations installed around Malpelo, proving that movements occur between all three oceanic island groups.

Figure 1: The Eastern Tropical Pacific encompasses a vast area of ocean where the Migramar network uses an array of underwater receivers to detect migration of marine species between protected areas.

Source: Migramar

Figure 2: Track of green turtle swimming from Cocos Island National Park (Costa Rica) to the Galápagos Islands (Ecuador) in 2014.



Source: Turtle Island Restoration Network (https://seaturtles.org/wp-content/uploads/2014/06/sanjay-map-v3.jpg)

Similarly, scientists working in the Galápagos Marine Reserve tagged scalloped hammerhead and silky sharks at Darwin and Wolf islands with acoustic tags. These tags are attached to the shark's back and 'ping' whenever the shark swims by an underwater receiver. The receiver then records a time-stamp whenever a tagged shark swims nearby. An array of such receivers placed around the marine reserve has revealed patterns of residency in each location and daily movements between locations.

To the Galápagos researchers' surprise, the Costa Rican science team reported 'pings' from sharks tagged in Galápagos Islands on their Cocos Island receivers. Two of the hammerheads had appeared at Cocos Island on the same day in March 2007, only 14 days after one of them was last detected at Darwin Island – a straight-line distance of nearly 700 km (435 miles). The sharks remained at Cocos Island for approximately one month and one was subsequently detected once more at Darwin Island. This was the first solid evidence of a migration between these World Heritage sites (Ketchum et al., 2014).

Several months later, one of the silky sharks tagged in Galápagos Islands was detected by Mexican Migramar researchers at receivers placed at Clipperton, a remote coral atoll, over 2000 km northwest of Galápagos Islands. This shark remained close to the atoll for two months and then returned to Galápagos Islands after an absence of eight months. It has since returned yet again to Clipperton.

Back at Darwin Island, the science team detected a hammerhead that had been tagged by Colombian Migramar scientists at Malpelo. But this shark had also passed through the Cocos Island National Park before arriving in Galápagos Islands and taking up residence for several months. This was the first of several hammerhead sharks that moved from Malpelo to other World Heritage sites in the region.

Completing the World Heritage connectivity panorama, Colombian scientists tagged several giant whale sharks in Malpelo using satellite transmitting tags. Two of these behemoths travelled to Coiba National Park in Panama, whereas another one was tracked across its route southwards to the Galápagos Islands[4]. Conversely, a large pregnant whale shark tagged in Galápagos travelled east, passing within 50 km of Cocos Island before entering the Malpelo Fauna and Flora Sanctuary, where the tag became detached (Hearn et al., 2016).

4 Unpublished data generously provided by Fundacion Malpelo

Turtle in the Cocos Island National Park.
© Fundación Amigos de la Isla del Coco

3. Implications for effective protection of World Heritage sites in the Eastern Tropical Pacific

In total, Migramar has tagged over a thousand migratory marine animals, including over 450 hammerhead sharks, over 100 Galápagos sharks and around 80 silky sharks. Other species have also been tagged: whale sharks, tiger sharks, blacktip sharks, hawksbill and green sea turtles, southern ocean sunfish, wahoo and yellowfin tuna. These other species have confirmed that marine wildlife move between UNESCO World Heritage sites in the Eastern Tropical Pacific.

These findings show the importance of how not only the individual UNESCO World Heritage sites serve as key feeding and cleaning areas for sharks and other species, but also the critical importance of protecting migratory animals as they travel between protected zones. Sharks that swim between the four UNESCO marine World Heritage sites in the Eastern Tropical Pacific face very real threats as soon as they exit the

A school of scalloped hammerhead sharks at Darwin Island, Galápagos Islands.
© Jonathan Green

protected zones, and sadly in some instances even within the boundaries[5], in the form of industrial fishing.

The ocean's top predators, sharks, have been steadily declining over the past several decades. A shocking 25 percent (Dulvy et al., 2014) of sharks are currently at risk for extinction due to over, unregulated and illegal fishing. Behind this rapid decline is the Chinese demand for shark fins that drives vessels to pursue sharks.

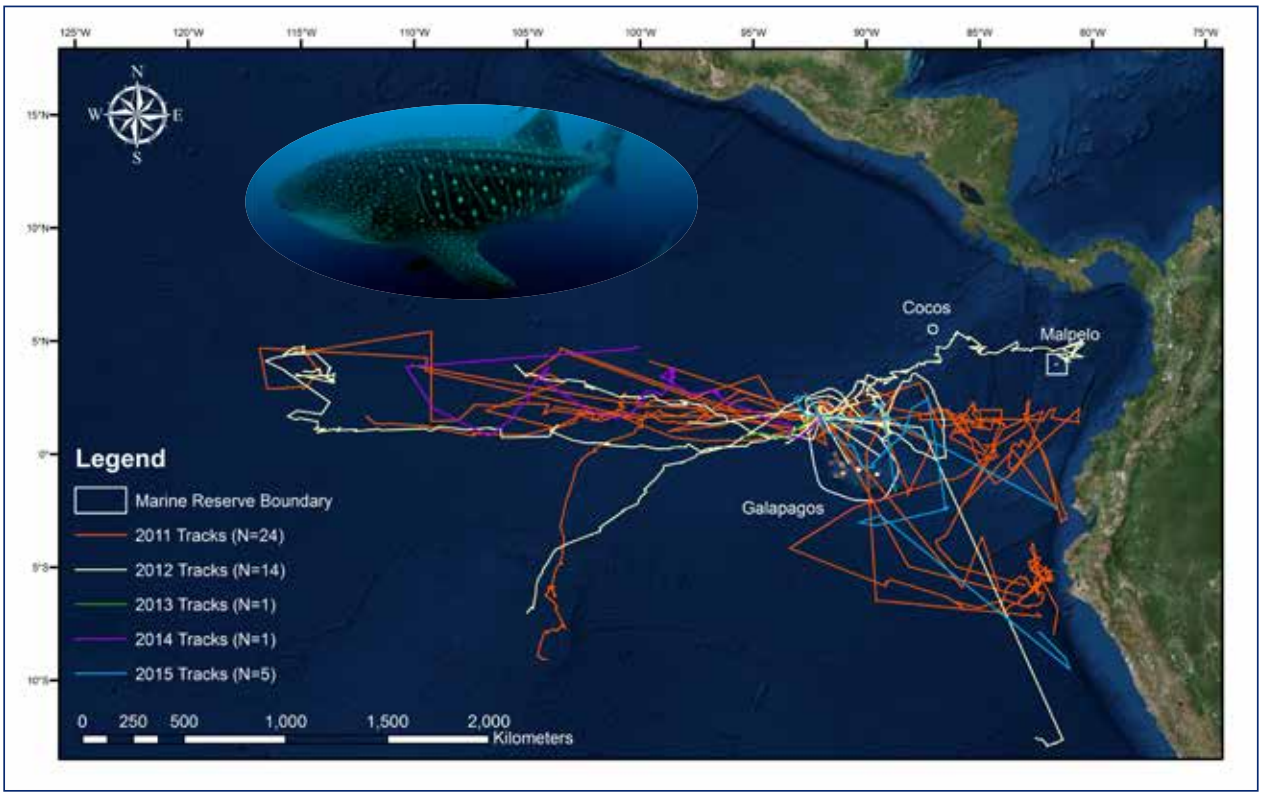
Migrating sharks, like the scalloped hammerhead, are captured by longlines or driftnets as they move back and forth across netted and baited waters to feed and socialize.

Scalloped hammerheads are listed on the United States Endangered Species List and as globally endangered by the IUCN Red List, which notes that, the "species is heavily exploited through its range in the Eastern Pacific. Of particular concern is increasing fishing pressure at adult aggregating sites such as Cocos Island (Costa Rica), Galápagos Islands (Ecuador) and Archipiélago de Revillagigedo (Mexico), and along the slopes of the continental shelf where high catch rates of juveniles can be obtained."[6]

These expert observations reveal the crucial importance of managing marine Word Heritage sites within the context of their broader ecosystem. In other words, management actions focused only on the protection of species within MPA boundaries are insufficient to protect the Outstanding Universal Value (OUV) and integrity of these precious icons. An ocean-wide approach to species management is needed in order to protect sharks, sea turtles and marine wildlife in the Eastern Tropical Pacific across their entire range. The UNESCO World Heritage marine sites in the Eastern Tropical Pacific are biodiversity hotspots used by more than 33 species of sharks, four species of sea turtles, and countless other marine organisms (Peñaherrera-Palma, 2016), but they are only that — 'spots' within a broader ecosystem fabric that requires coordinated regional action to ensure their outstanding natural value is retained for posterity.

Although some species' migratory routes are reasonably well documented, others, such as whale sharks are in early stages of discovery. In 2011 researchers in Galápagos Islands tagged 24 whale sharks in a span of 40 days with satellite tags and learned that these species travel great distances within the Eastern Tropical Pacific, but also thousands of kilometres west across the open ocean on the equator and back (see fig. 3). Interestingly, many whale sharks visiting the four discussed UNESCO World Heritage marine sites were adult females with swollen abdomens. The researchers estimated that these pregnant whale sharks might be using the World Heritage marine sites as a stopover on their way to give birth nearby.

Figure 3: Tracks of 45 whale sharks tagged at Darwin Island, Galápagos Islands 2011-2015.



Source: Hearn et al., 2016.

5 A 2015 study published in Conservation Biology (available here) investigates Costa Rica's ability to adequately enforce and protect it's crown jewel of marine protected areas (MPAs) – Cocos Island National Park – from illegal longline fishing.
6 http://www.iucnredlist.org/details/39385/0

4. Informing management

Migramar's collaborative effort has produced exciting new scientific findings about where sharks and other migratory species travel and rest within the Eastern Tropical Pacific. This information has paved the way for more effective conservation action, including recent decisions to create a no-take sanctuary inside Ecuador's Galápagos Islands surrounding Darwin Island and Wolf Island, and Costa Rica's Seamounts Marine Management Area, (also known as 'Las Gemelas') surrounding Cocos Island National Park, Costa Rica. The President of Colombia recently announced plans to expand the protected waters around Malpelo Fauna and Flora Sanctuary from less than 7,000 km^2 to 27,000 km^2. Earlier, in 2015, specifically to protect marine migratory species, Panama created the Coiba Ridge MPA, which covers an area of more than 17,000 km^2 (Executive Decree Nº2, 22 September 2015). These and other accomplishments, such as regional action plans approved by the inter-governmental Permanent Commission of the South Pacific's Shark and Turtle Action Plans are the result of effective collaboration between previously isolated researchers that focused primarily on single sites and nations.

The science generated by the Migramar network feeds directly into the management of each of the UNESCO marine World Heritage sites, through collaboration with the respective National Park Services, some whose own staff researchers are members of the network. Through regular communication among the Migramar network, local MPAs are able to access regional points of view regarding the status and management requirements of the Eastern Tropical Pacific's threatened migratory species.

Thanks largely to the research carried out by scientists, Costa Rica, Colombia and Ecuador have all sponsored bills to successfully place scalloped hammerhead sharks, silky sharks and manta rays on international treaties such as the Convention for International Trade of Endangered Species (CITES) and the Convention on Migratory Species (CMS).

Whale shark tagging in the Galápagos Islands.

Archipiélago de Revillagigedo (Mexico): Giant manta ray.

5. Conclusion

The future of highly migratory species conservation in the Eastern Tropical Pacific will depend on data from networks such as Migramar that are connecting the dots, undertaking collaborative research between sites and are providing coordinated, scientifically rigorous advice to stakeholders and decision makers throughout the region, while at the same time training the current and future generation of marine scientists and managers.

To ensure the OUV that Ecuador, Costa Rica, Panama and Colombia aimed to enshrine when they applied for World Heritage status for their emblematic MPAs, these governments will have to increase cooperation to ensure the waters that ecologically connect Galápagos Islands, Cocos Island National Park, Coiba National Park and its Special Zone of Marine Protection and Malpelo Fauna and Flora Sanctuary receive the management measures required to more effectively protect migratory species. As shown on the map at the start of this article, the MPAs listed as World Heritage sites cover only a tiny fraction of the Eastern Tropical Pacific, on which highly threatened and migratory species depend. Effective migratory species conservation demands decisive action beyond the boundaries of marine reserves and cooperation across all four marine World Heritage sites.

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Part 6
The green dream
Balancing economic development with conservation of universally outstanding places

6

Cruise ship in Glacier Bay National Park and Preserve.

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1. Cruise tourism and World Heritage

In 1844, the Peninsular and Oriental Steam Navigation Company, the predecessor to P&O Cruises, initiated a novel idea: rather than using large ocean liners for the purpose of transporting passengers from one place to another, the company started taking passengers on 'sea tours' explicitly for leisurely purposes. In fact, a primary destination of these initial cruises was Valletta, Malta, which, nearly 140 years later, would be designated a UNESCO World Heritage site. The concept of sea cruising to visit maritime sites of cultural significance or natural beauty rapidly spread across the globe, and by the late 1880s, the Pacific Coast Steamship Company, based out of San Francisco, began taking passengers on 'cruises' to Alaska. While still serving the purpose of transporting mail and other supplies to coastal communities, these ships regularly stopped in Glacier Bay so that passengers could experience the massive tidewater glaciers. In 1979 Glacier Bay would also be inscribed on the World Heritage List as part of the Kluane/Wrangell-St. Elias/ Glacier Bay/Tatshenshini-Alsek site[1]. Visitation by cruise ships to World Heritage sites is thus as old as, and intricately linked with, the cruising industry.

Cruise ship tourism is a popular means by which people access and enjoy World Heritage sites all over the world. Cruise ships travel adjacent to, or make ports of call in at least half of all 49 marine World Heritage sites – although ship size, amenities, and passenger capacity have changed dramatically since the turn of the century. For example, in the 1840's Cunard Line began placing cows below decks on the 63-metre ocean liner Britannia to provide fresh milk for passengers. This in contrast to the 333-metre MV Britannia, launched in 2015 by P&O Cruise Lines, which includes over 13 different restaurants and cafés to provide dining diversity for 4000+ passengers. Likewise, in 1900 Hamburg America Line commissioned the 124 metre Prinzessin Victoria Luise, considered the first ship constructed specifically for

Passengers on the deck of the steamship Ancon while on a cruise to visit the tidewater glaciers in Glacier Bay, circa 1886. Public Domain.
Source: Partridge Photography, Boston, Massachusetts.

1 http://whc.unesco.org/en/list/72

'cruising' because all 120 passenger cabins were moved from cramped bunks in the hull to first-class quarters within the superstructure. Nearly 110 years later, Royal Caribbean International launched the 360-metre Allure of the Seas, which has 18 decks and where the more than 6000 passengers can shop in seven different 'neighbourhoods', eat ice cream under large (live) trees, and ice skate, all while visiting tropical ports.

The large ship size and diverse amenities has resulted in a soaring popularity for cruising with more than 25 million people expected to take a cruise in 2016. While statistics are not collected consistently at marine World Heritage sites, Glacier Bay provides an excellent example of the connection of cruising with World Heritage. In 2016, nearly 485,000 people visited Glacier Bay aboard a cruise ship, constituting over 95 percent of all visitors to the site. On most summer days, there may be several cruise ships travelling to, or manoeuvring in front of, one of the park's tidewater glaciers allowing passengers to experience the same feeling of wonderment as those over a century before. Importantly, many of these passengers might not have otherwise been able to experience the Outstanding Universal Value (OUV) of Glacier Bay, owing to physical or other limitations in visiting a site with no road connections.

Obviously, cruise shipping can negatively impact a site's natural or cultural resources and OUV because they are, in effect, floating cities that produce large volumes of waste water, air pollutants, and underwater noise. Cruise ships also have the potential for introducing exotic or invasive species via ballast water or hull fouling, creating turbidity by manoeuvring in shallow areas (Jones, 2011), disturbing sensitive marine wildlife (Young et al., 2014), and being involved in oil spills. In addition to impacts to marine and terrestrial ecosystems, ships can also impact the experience of other visitors to a site and, owing to the large volume of passengers, increase congestion, strain visitor services, and degrade the infrastructure of a gateway community. Thus, management of cruise ships and their passengers at World Heritage sites requires well-informed decisions that carefully balance negative impacts with their experiential and economic benefits.

In 2010 the World Heritage Marine Programme hosted the first-ever meeting of managers from all 43 (at the time)

Passengers on the deck of the MS Volendam while on a cruise to visit the tidewater glaciers in Glacier Bay, 2014.

marine World Heritage sites to explore opportunities for collaboration among sites with common management issues. At this meeting, it was quickly discovered that cruise tourism is a common concern, and several ad-hoc meetings were organized with other site managers to share management strategies, identify research and monitoring programs, and build the foundation for multiple-site collaboration.

Since that initial meeting, two sites in particular, Glacier Bay (United States of America) and West Norwegian Fjords - Geirangerfjord and Nærøyfjord (Norway), have advanced this collaboration. Both sites are remarkably similar in their management issues and biophysical make-up, constituting high latitude fjord landscapes frequented by hundreds of cruise ship visits each summer. Both sites also share the overarching goal of maintaining levels of cruise ship visitation while increasing their environmental, economic, and programmatic sustainability. Collaborative efforts have thus far included sharing information on cruise ship impacts and operations, learning about the suite of initiatives and programs that have successfully increased the sustainability of cruise ship visitation, and looking for opportunities to adopt those initiatives when appropriate and possible.

In this paper, a brief review is provided of the ideas and information shared between managers of Glacier Bay and the West Norwegian Fjords, highlighting how variation in ship operations may impact a site's resources and values. A focus is placed on impacts from air and water pollution because clean air, pristine waters, and exceptional natural beauty are common values that characterize many marine World Heritage sites. It is detailed via several initiatives, developed over the past 30 years, in which managers at Glacier Bay have successfully increased the sustainability of cruise tourism by decreasing impacts while simultaneously increasing financial support for monitoring, research, and interpretation programs. As some of these approaches to sustainable cruise ship visitation may be applicable at other sites, we jointly introduced these ideas at the third meeting of marine World Heritage site managers (27 to 31 August 2016, Galápagos Islands)[2] with the goal of building a coalition of sites working together to increase cruise ships sustainability occurring in all marine World Heritage sites.

2 http://whc.unesco.org/en/future-marine-world-heritage-2016

Managers of West Norwegian Fjords - Geirangerfjord and Nærøyfjord and Glacier Bay at third World Heritage marine managers conference.
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2. Pollution concerns from cruise ship visitation and impact on Outstanding Universal Value

2.1. Air pollution

As part of their normal operations, cruise ships produce a suite of air pollutants, including oxides of sulfur and nitrogen, particulate matter, and CO_2. While pollutants are produced through the operation of on-board incinerators, gas turbines, and oil-fired steam boilers, the largest volume of air pollutants are produced by the set of 4 to 5 large diesel engines which power the ship.

The level of air pollutants produced by these engines is primarily a function of two factors: the volume and quality of fuel burned. The volume of fuel burned is dependent upon the energy needs of the ship which can be generally

Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek World Heritage site.
© UNESCO/Mark Kelley

classified into the 'propulsion load' and the 'hoteling load'. The propulsion load is the power needed to propel the ship at a given speed although fuel consumption increases non-linearly with speed. Consequently, a small increase in speed creates an incrementally larger increase in fuel consumption (Ronen, 1982). This is the reason speed limits for large ships serve as an effective policy for lowering emitted pollutants (Lindstad et al., 2011).

The 'hoteling load' is the power needed for all other operations, such as the restaurants, air conditioning, lights, etc. While the propulsion loads can vary dramatically depending upon ship speed, the hoteling load is more constant because the energy demands for hoteling the passengers occurs regardless of whether the ship is moving or not. As a rule of thumb, the hoteling load is typically less than 30 percent of the total power needs of the ship while under way.

Combined, these two power demands result in a large volume of fuel burned per day. For example, an average sized, 2000-passenger cruise ship that regularly visits Glacier Bay may burn 20,000-30,000 gallons of fuel per day which equates to approximately 0.02 miles per gallon burned or, about 5 passenger miles per gallon. By comparison, the average fuel efficiency for new, 4-passenger cars produced in the United States is about 36 miles per gallon of gas burned (U.S. Department of Transportation, 2016) or about 144 passenger miles per gallon. Consequently, the amount of energy to transport and hotel a passenger aboard a cruise ship has been estimated to be 12x that compared to similar modes of access and use of land-based hotels (Howitt et al., 2010).

In addition to the amount of fuel burned, fuel type can also dramatically influence the level of pollution. Cruise ships have historically used intermediate or heavy fuel oil (IFO/HFO) which is the cheapest of available fuel products but characterized by high levels of impurities and by-products. When burned, this low quality fuel creates large amounts of air pollution including high levels of oxides of sulfur. For example, cruise ships operating on HFO with 3 percent sulfur by weight, may produce during a day of cruising the equivalent of an average day's emissions from over 300,000 heavy-use diesel trucks (PWS Regional Advisory Council, 2015).

It is important to note that recent international regulations have made tremendous advances in addressing concerns related to air pollution by the commercial shipping industry. The International Maritime Organization (IMO), part of the United Nations, Marine Environmental Protection Committee recently amended the International Convention for the Prevention of Pollution from Ships (MARPOL), Annex VI, to include regulations that limit emissions of nitrogen oxides

West Norwegian Fjords – Geirangerfjord and Nærøyfjord

(NO_x), sulfur oxides (SO_x) and Particulate Matter (PM). Annex VI established an engine certification process, limits sulfur content in fuel, and established Emission Control Areas (ECAs) where all ships (including cruise ships) are required to meet emission reduction standards. Within these ECAs, which include the North Sea, the Baltic, most of coastal North America, and the United States Caribbean Sea, ships must either use low sulfur fuel (0.1 percent sulfur by weight) or install 'abatement' technologies that achieve similar emission reductions. Thus, World Heritage sites within ECAs may experience reductions in oxides of sulfur by more than 90 percent assuming high levels of compliance. For World Heritage marine sites outside designated ECAs, cruise ships are still allowed to emit high levels of sulfur until 2020, and perhaps later depending upon resistance to emissions standards and slated agreements.

The extent to which emitted pollutants affect air quality is, however, contingent upon local atmospheric conditions. For example, the steep-walled fjord landscape characterizing Glacier Bay and West Norwegian Fjords produces frequent air inversions that act to trap emissions and create haze (Mölders and Gende, 2015). Haze affects visibility (Mölders et al., 2013) and thus visitor experience, a particularly impactful result for a site with scenic beauty listed as part of their OUV. However, on windy days, when air exchange is high, visibility is due almost exclusively to atmospheric conditions. Thus, the air quality impacts by the same ship producing the same amount of emissions for the same amount of time may be dramatically different from day to day depending upon the weather.

2.2. Water pollution

In addition to producing a large volume of air pollutants, cruise ships also produce large amounts of wastewater as part of their normal operations. Wastewater originates from toilets ('black water'), sinks, showers, laundries, and kitchens ('grey water'), although it is also produced from engine coolant water, ballast water, and oily bilge water, which is the mix of water, oily fluids, lubricants, and other wastes that accrue in the lowest part of the ship. And similar to air pollutants, the volume of wastewater produced by cruise ships is large. In Alaska, estimates of the total combined black and grey water produced for cruise ships varied from 37 to 146 gallons (140 – 553 litres) per passenger per day (EPA, 2008). Thus, an average-sized ship carrying 2000 passengers may thus produce >150,000 gallons (>50,0000 litres) of black and grey water per day (EPA, 2008). Ships may also produce over 5000 gallons of oily bilge water per day (ADEC, 2000).

The pollutants in these waste streams are diverse and may include 'conventional' pollutants, such as suspended solids and chlorine, metals, such as copper, mercury, and lead, pathogens, such as fecal coliform and E. coli, and/or volatile and semivolatile organics, such as phenol and chloroform. Many of these pollutants, even at low concentrations or cumulated over time, can impact water quality and marine biota.

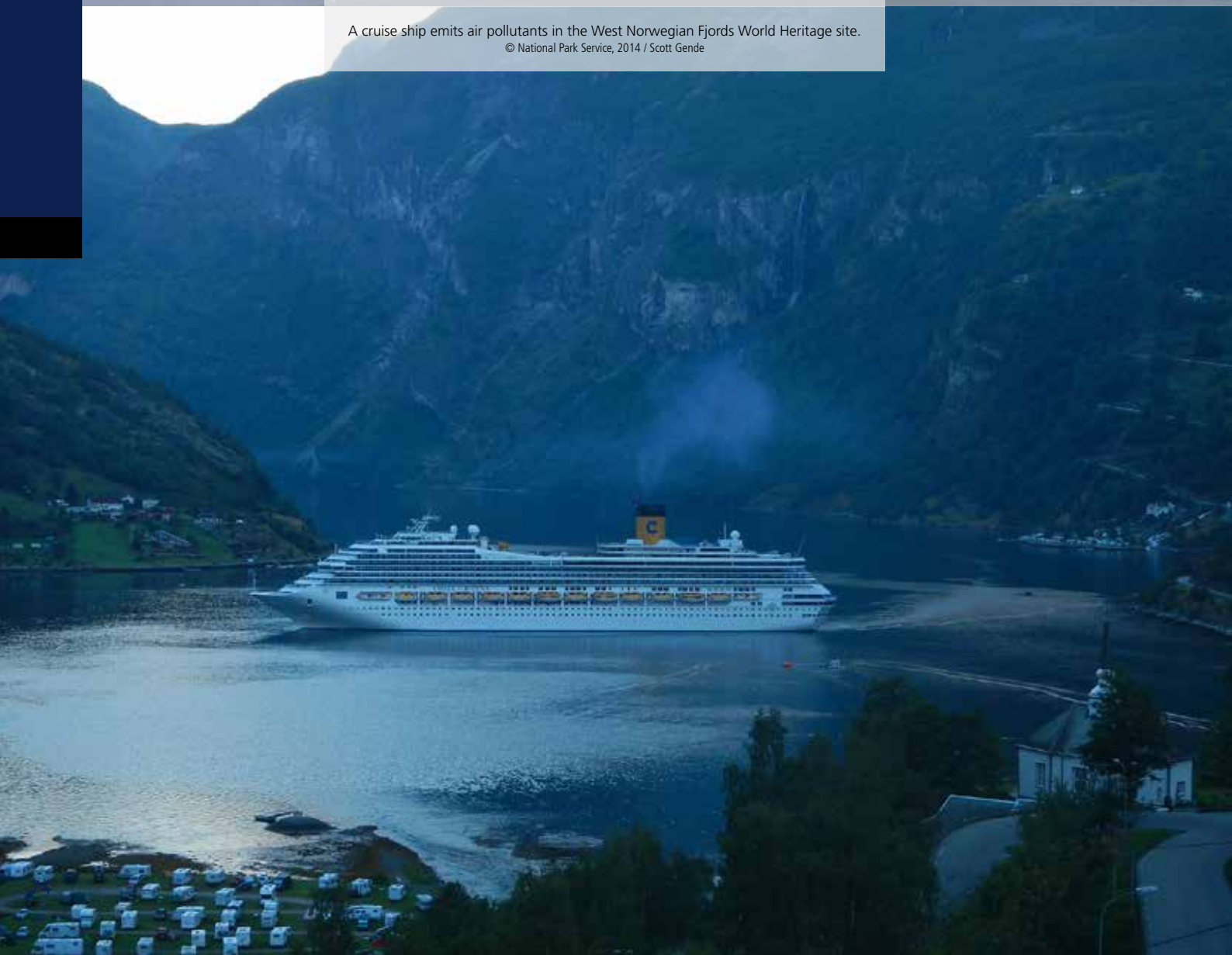
Most national laws or international conventions generally prohibit the discharge of untreated wastewater near shore. As cruise ships typically do not have the capacity to store the large volume of wastewater for more than a few days, most are now equipped with Advanced Wastewater Treatment Systems (AWTS). When operated properly, these systems can effectively remove many pollutants and harmful compounds to concentrations where the discharged wastewater is safe for receiving marine ecosystems (ADEC, 2012).

Ironically, regulatory efforts intended to reduce air pollution may end up increasing water pollution. Many cruise ships, rather than utilizing costly low sulfur fuel to meet stringent IMO-mandated air emission standards in ECAs, have instead installed exhaust gas cleaning systems, commonly known as 'scrubbers'. Scrubbers are a relatively new, and largely untested, abatement technology whereby water is used to 'capture' the pollutants in the engine exhaust gases. Trial studies indicate that, particularly for 'open loop' scrubbers, these systems require a large amount of seawater: up to $45m^3$ of this 'wash water' per megawatt-hour of energy produced. Thus, a typical 10 MWh engine can generate nearly 3 million gallons of wash water per day (EPA, 2011).

Not surprisingly, the wash water is acidic because sulfuric and nitric acid is created when the seawater mixes with the exhaust gas. According to IMO standards, the wash water discharge must be within 2 pH units of surrounding seawater when manoeuvring or in transit, or be at any pH level as long as it recovers to a pH of 6.5 within a distance of 4 m from the ship's discharge pipe, commonly termed the 'mixing zone'. Recent studies have demonstrated that discharged wash water contained residual oil, metals, and nitrate (Li et al., 2015), and alkalinity was reduced up to 98 percent. Site managers should thus remain appraised of how many ships utilize scrubber technology to meet IMO emissions standards (rather than using low sulfur fuel) because of the potential impacts on water quality and the OUV of a site.

Finally, while we focused on black and grey water, we note that cruise ships can also impact water quality and marine ecosystems through the use of ballast water and from sloughing anti-fouling paint. Ballast water is used for stability and to ensure propellers are at optimal operating depths. However, the use and exchange of ballast water can result in the introduction of pathogenic bacteria and pollutants, or affect ecosystems via introduction exotic or invasive species. While some treatment options for ballast water are now available (Jing et al., 2012), the regulatory framework requiring treatment may vary among nations and sites. Likewise, most antifouling paints used on the hulls of many cruise ships may have toxins or heavy metals such as copper. Hull leachate at sites where cruise ships regularly make ports of call can thus load tons of copper to the receiving aquatic system per year (Srinivasan and Swain, 2007).

A cruise ship's emissions trapped by air inversion in the upper fjords of Glacier Bay.
© National Park Service / Bill Eichenlaub



A cruise ship emits air pollutants in the West Norwegian Fjords World Heritage site.
© National Park Service, 2014 / Scott Gende

3. The Glacier Bay 'model' for sustainable cruise ship visitation

Located in the south-eastern archipelago of Alaska, Glacier Bay National Park and Preserve is part of the transboundary Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek World Heritage site which spans nearly 100,000 km^2. The site was inscribed on the World Heritage List in 1979 in recognition of the fjord inlets, abundant wildlife, and active glaciers which have shaped the landscape through a series of rapid advances and retreats, providing a globally unique opportunity to view, study, and enjoy a landscape driven by recent glacial dynamics. Glacier Bay includes 6 000 km^2 of marine ecosystems that are unusually productive (Reisdorph and Mathis, 2014) owing to strong oceanographic currents over shallow glacial sills producing constant mixing, and high levels of upwelling (Etherington et al., 2007). The highly productive conditions, in turn, attract large aggregations of marine wildlife (Womble et al., 2010; Mathews et al., 2012; Saracco et al., 2013). Importantly, Glacier Bay continues to be a site where people can see and experience tidewater glaciers.

3.1. Limited entries (quotas)

In the early 1970s, visits to Glacier Bay by large cruise ships began to increase substantially prompting the United States National Park Service (NPS), which has jurisdictional authority over the marine waters, to develop management plans and initiatives for sustainable cruise ship visitation. In 1980 the NPS established a permit entry system that limited the allowable number of cruise ship entries across the summer (89), and introduced, in 1984, a maximum daily limit of 2 ships per day. These initial limits were based on concerns over impacts to marine wildlife, such as humpback whales, although concerns over other park resources and values developed over time. Since then, the daily quota has remained at 2 ships per day, although the seasonal quota is now split into a 'peak' season (1 June – 31 August = 92 days), and a 'shoulder' season (May and September = 61 days). Unlike the daily quota, the seasonal quotas are designated annually by the park Superintendent, with the current peak and shoulder season quota set at 153 and 122 entries, respectively. The decision regarding the appropriate seasonal quota is complex because it represents a trade-off between providing high quality visitor experiences and the inevitable impact to park resources and values.

3.2. Regulation of cruise ship operations

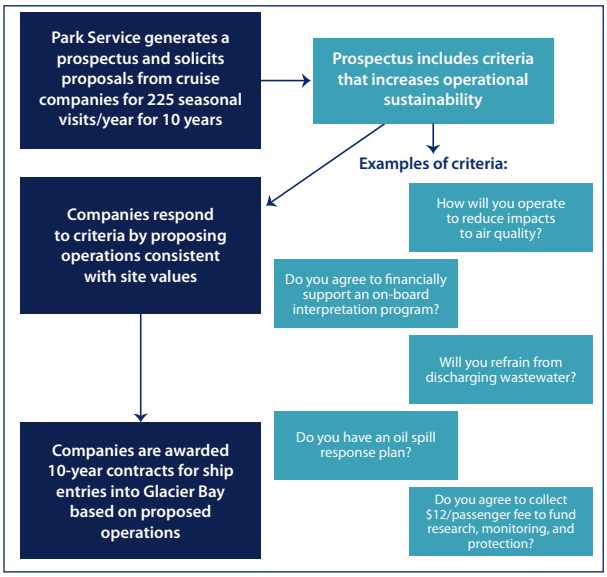
In addition to limiting the number of allowable ships, park managers also increase sustainability by regulating ship behaviour, such as speed. Glacier Bay is a primary summer feeding location for humpback whales, and the narrow mouth of the fjord results in high spatial and temporal overlap between cruise ships and whale aggregations (Gende et al., 2011). Thus, to reduce the chance of lethal ship-whale collisions, park managers require ships to slow to 13 knots in areas where whales are aggregated based on daily monitoring surveys (Neilson et al., 2015). Ships are also required to keep a mid-channel course to minimize the chance of lethal ship-whale collisions.

Time-area closures are also utilized to meet conservation goals. Cruise ships are also prohibited from entering one of the largest inlets in the park – Johns Hopkins Inlet – until after 31 August. Johns Hopkins Inlet is the location of a large aggregation of harbour seals that haul out on icebergs to rest, give birth, and nurse young. Studies have shown that cruise ships in the inlet can disturb seals from large distances away (Young et al., 2014) so park managers prohibit cruise ships from entering the inlet during this critical period.

3.3. Concession contracts

While limits to the volume and operating conditions address some of the facets of sustainable cruise ship visitation, a market-based mechanism using concession contracts has been developed to sustain a viable research, monitoring, and interpretation program.

Figure 1. Schematic demonstrating the process by which Glacier Bay increases the sustainability of cruise ships during their operations in the park using a concessions prospectus. The prospectus has a number of criteria which ship companies respond to with proposals. If companies are awarded entries into Glacier Bay, they are then contractually obligated to operate based on their proposals.



Source: National Park Service

The system of concession contracts developed over the past several decades is conceptualized in Figure 1, and can be summarized as follows: Every 10 years park managers issue a 'prospectus' to solicit proposals from cruise companies to provide commercial services in Glacier Bay. The prospectus contains a number of criteria that mirror the values of the site. For example, one criterion listed in the most recent prospectus asked ships how they would reduce the impacts to air quality while operating in Glacier Bay. Another asked whether ship companies would agree to refrain from discharging treated wastewater while in the park. Yet, another asked whether companies would agree to financially support an interpretation program whereby personnel trained by the NPS would be transported to the ships to conduct educational and outreach efforts while the ship spent the day in Glacier Bay[3].

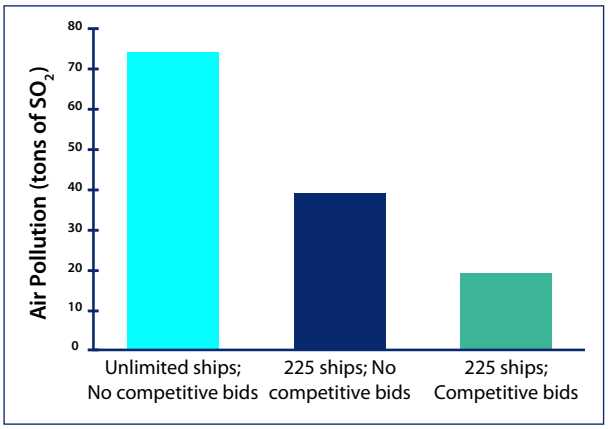
Cruise companies seeking entries into Glacier Bay respond to the criteria in the prospectus with proposals, which contain responses to each of the criteria. These proposals are then evaluated by expert panels and those deemed most consistent with the park's values, such as conserving air and water quality, are awarded contracts for entries. The result is that cruise ships become legally (contractually) obligated to operate in a more sustainable manner based on their own proposals to do so.

3 A list of the existing contracts, and their related criteria, can be found at: https://www.nps.gov/glba/learn/management/cruise-ships.htm.

The effectiveness of this market-based approach can be quantified by comparing cruise operations that occur while in Glacier Bay with those outside the park and at other ports of call. For example, Figure 2 demonstrates that, as a result of some companies proposing to use cleaner Marine Gas Oil and low sulfur fuel while in Glacier Bay, the annual reduction in oxides of sulfur emitted inside the park compared to the same number of kilometres travelled by the same number of cruise ships outside of Glacier Bay exceeds 20 metric tons. Compared to over 400 ship visits (unlimited volume) operating for the same amount of time near Glacier Bay and with no impetus to use lower sulfur fuel, the reduction exceeds 50 metric tons. Likewise, as a result of the concessions contracts, the annual reduction in ships refrained from discharging over 40 million gallons of treated wastewater while in Glacier Bay annually.

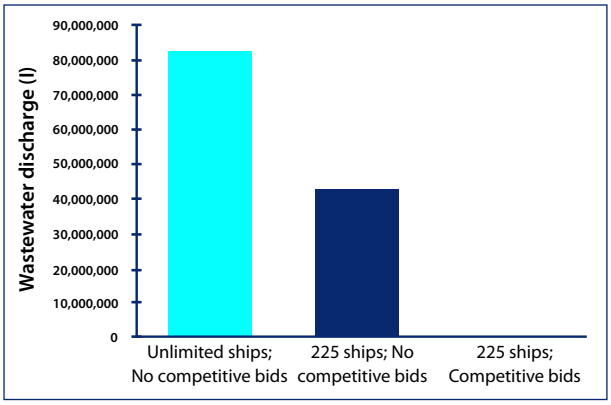
The competition for limited entries into Glacier Bay has also generated significant funding for research, monitoring and, importantly, interpretation and education. All cruise ship companies awarded a contract (entry) in 2009 agreed to financially support an on-board interpretation program. Cruise companies reimburse the cost to the NPS for hiring and training 'Interpretive Rangers' that are transported to the ships as they enter Glacier Bay, and conduct educational activities such as presentations in the auditorium and providing interpretive materials. These programs are extraordinarily well received by passengers, resulting in both improved visitor experience, which ship companies covet, and an opportunity for park managers to develop the narrative connecting passengers to the site.

Figure 2. Comparison of the annual volume of sulfur dioxide (SO_2, in metric tons) emitted by cruise ships in 2014 while operating for 10 hours in (light blue bar) Stephens Passage, which is approximately 115 kilometres east of Glacier Bay, where ship volume is unlimited (400+ ships transits; Webb and Gende, 2015) and no concessions contracts are solicited; in (dark blue bar) Glacier Bay assuming limited entries of 225 ships annually but no concessions contracts and thus ships operated on the same fuel quality as other areas; and in (green bar) Glacier Bay based on limited entries (225) and while operating on low sulfur fuel or utilizing gas turbines based on proposals in response to the prospectus.



Source: National Park Service

Figure 3. Comparison of the annual volume of treated wastewater (litres) discharged from cruise ships operating for a day while in (light blue bar) Stephens Passage, where ship volume is unlimited (400+ ships transits; Webb and Gende, 2015) and no concessions contracts are solicited; in (dark blue bar) Glacier Bay assuming limited entries of 225 ships annually but no concessions contracts and thus ships continually discharged treated wastewater; and in (green bar) Glacier Bay based on limited entries (225) and, based on proposals in response to the prospectus, no wastewater discharged.



Source: National Park Service

Finally, all cruise companies awarded entries into Glacier Bay agreed to a criterion in the prospectus to collect a per passenger fee ($12), a portion of which would fund efforts to protect park resources and implement studies and monitoring necessary to understand the impacts of visitation. This fee structure has resulted in more than $2 million dollars annually provided to Glacier Bay and is used to assist the conservation of the World Heritage site. Some examples of recent research completed using these funds include studies on the impacts of varying ship visitation levels to air quality (Molders and Gende, 2015), humpback whales (Gende et al., 2011; Harris et al., 2012), visitor experience (Swanson and Vande Kamp, 2011), underwater sound (Kipple, 2004), marine contaminants (Tallmon et al., 2012), and disturbance to wildlife including marine mammals (Young et al., 2014) and seabirds (Marcella et al., in press). These studies are reviewed annually by park managers to help make informed decisions with respect to allowable ship quotas. Importantly, the park Superintendent has the discretion to spend these funds based on information needs or the need to monitor ship impacts to different resources.

In summary, Glacier Bay elevates the sustainability of cruise ship visits by regulating ship volume and operations, but also through market competition. The result is that the 225 annual ship visits to Glacier Bay, and their 450,000 passengers, occur with reduced air and water pollution, lower impacts to sensitive wildlife, and with a robust interpretation and education program. This adaptive system represents a balance between maximizing the number visitors seeking to experience this special place and conservation of the site's OUV.

"Competition for limited entries into Glacier Bay has also generated significant funding for research, monitoring and, importantly, interpretation and education."

A National Park Service Interpretive Ranger presenting an interpretive program while in the theatre of a large cruise ship in Glacier Bay.

National Park Service Interpretive Rangers conduction outreach and educational efforts while aboard a large cruise ship in Glacier Bay. As a result of the concessions prospectus, all cruise ship companies that enter Glacier Bay agree to pay for the interpretive efforts.

A researcher stationed at the bow of a cruise ship in Glacier Bay conducting a whale survey.

A team of researchers studying the impacts of passing cruise ships to sea bird behaviour in Glacier Bay.

4. The Green Fjord Initiative: West Norwegian Fjords – Geirangerfjord and Nærøyfjord

Similar to Glacier Bay, the West Norwegian Fjords – Geirangerfjord and Nærøyfjord (WNF) World Heritage site was inscribed on the World Heritage List based on criteria (vii) and (viii) which recognize the distinct fjord landscapes, natural beauty, biodiversity, and active geological processes. The site includes two separate areas, the Geirangerfjord to the north and more southern Nærøyfjord, representing some of the most spectacular fjord landscapes in the world. Similar to Glacier Bay, the WNF encompasses a significant amount of marine area, encapsulating more than 100 km^2 of ocean as part of the 1 200 km^2 site.

The management challenges of the WNF are also remarkably similar to Glacier Bay. In 2015, there were nearly 180 large cruise ship ports of call to Geiranger, and 132 ports of call in Flåm (Nærøyfjord) reflective of the 225 ports of call by over 15 different ships in Glacier Bay. In fact, 7 of the ships that visited the WNF in 2015 also visited Glacier Bay in the previous several years. By extension and like Glacier Bay, cruise ships provide an extraordinarily important means by which visitors access and enjoy the WNF's exceptional natural beauty and OUV.

A site visit by Glacier Bay management authorities to West Norwegian Fjords, August, 2015.
© UNESCO/Hyperthese Productions

There are some key differences among the sites. Whereas in Glacier Bay cruise passengers remain on the ship during their entire visit, passengers in the WNF disembark and participate in land- and sea-based tours, ride buses to visitor centres, and spend funds at restaurants, shops, and taverns. Any conflict between site OUV and community values will thus be at the forefront of decisions affecting ship volume or operations, particularly if it has negative impacts to the local economy.

Perhaps more importantly, management of the WNF occurs under multiple entities at national, regional and local levels. For example, the WNF have two fundamentally important national authorities managing marine activity within the site including the Norwegian Coastal Administration (NCA) and the Norwegian Maritime Authority (NMA). The NCA is an agency responsible for services related to maritime safety, maritime infrastructure, transport planning and efficiency, and emergency response to pollution. The NCA is thus engaged with cruise tourism inasmuch that cruise ships affect navigation, the environment, transfer of goods from shore to sea, and sustainability of coastal communities, among others.[4] The NMA is likewise governed by national and international legislation, agreements, and political decisions, and focuses on safety of life, health, material values, and the environment for Norwegian-flagged vessels and foreign ships, including many large cruise ships that operate in Norwegian waters. The NMA is an active participant in international organizations, such as the IMO and the European Maritime Safety Agency, promoting Norway's values related to shipping policies and legislation. Importantly, the NMA helps initiate the development of new international regulations, and ensures proper follow-up and national adaption of international rules that are to be implemented in Norwegian law.[5]

In addition to the national level, the WNF also have regional and local authorities that are involved in the management of the marine activity within the site, each of which may have different policies and practices that vary among ports, an aspect confounded by the geographic diversity of the site. For example, the Nærøyfjord area is currently included in the North Sea Emission Control Area (ECA) and thus cruise ships visiting the southern fjord must meet IMO's stringent emission standards. In contrast, ships visiting Geirangerfjord do not. Thus, efforts to reduce air pollution impacts, or concerns over water quality impacts, will vary among areas within the site.

While the diversity of management authorities at the WNF prohibits site managers from unilaterally limiting the volume of ships allowed into the fjords, the WNF, like many other World Heritage sites, has characteristics that may enable a more market-based approach to increasing sustainability. For example, while both fjords are coveted destinations for cruise ships, each is limited in infrastructure and berthing space, and cannot accommodate more than several large cruise ships at a time. In general, demand by the 20+ companies that operate cruise ships in Europe and the Mediterranean region exceeds the capacity for them to visit the WNF. Just as important, the diversity, and growing number, of ship's environmentally friendly operations and technology, suggests that a market-based approach to limited capacity could decrease impacts while maintaining ship visitation. For example, in the spring of 2016, the Hamburg-based AIDAprima will be launched, the first ship of the new AIDA generation which includes shore-based power connection technology, a comprehensive system for exhaust gas treatment, and a dual fuel engine that can be operated with conventional fuel or LNG, depending on availability.[6]

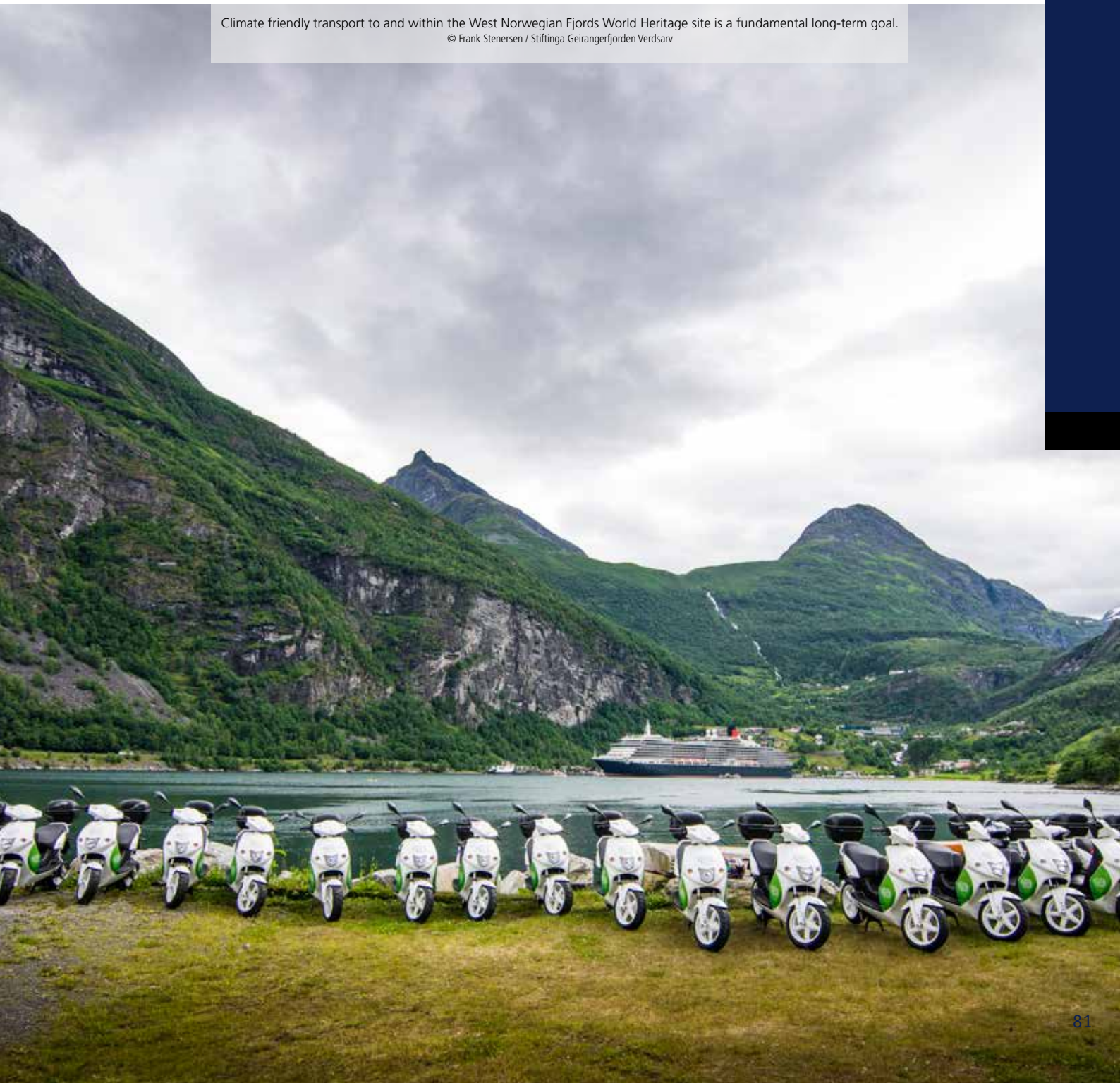
4 See http://kystverket.no/en
5 See https://www.sjofartsdir.no/en/
6 See https://www.aida.de/en/aida-cruises/responsibility/aida-cares/our-environmental-protection/significant-reduction-of-pollutants.24764.html

Management authorities from Norway meet with concessions managers to learn about the market-based approach to increasing cruise ship sustainability developed in Glacier Bay.

A site visit by Norwegian management authorities to Glacier Bay, July, 2016.

Consequently, following a 2015 site visit to the WNF, managers at Glacier Bay invited representatives from all levels of cruise ship management in Norway, including the NMA, local municipalities, trade organizations, and site managers, to travel to Alaska in 2016 to better understand the different programs that promote sustainable practices of cruise ship visitation. The visit included, among other things, meetings with officials from the local municipalities, reviews of the concession contract system and interpretation programs in Glacier Bay, and viewing the hook-up to shore-based power in Juneau while aboard the Island Princess.

Norwegian site managers also provided an overview of the multi-layered management of cruise ship tourism in Norway, and communicated how income generating activities for ship passengers while making port to the communities in the WNF becomes a strategic component in the future conservation of the site. Termed the 'Green Fjord Initiative', the effort seeks to safeguard the site's OUV by engaging with a cooperative group of local and regional enterprises and organizations whose purpose is to generate profitable, yet eco-friendly development climate-friendly transport.



Climate friendly transport to and within the West Norwegian Fjords World Heritage site is a fundamental long-term goal.

5. Building a global coalition of marine World Heritage sites

Since the first meeting of marine World Heritage sites, managers from Glacier Bay and the West Norwegian Fjords have conducted site visits, shared monitoring protocols and management plans, and consulted on their respective initiatives that have successfully elevated the sustainability of cruise ship visitation. Yet our shared values and common goals mirror those expressed by the global community of World Heritage marine site managers affected by cruise ship visitation. We thus have two overarching goals in the coming years.

Foremost, we hope to share what we have collectively learned with managers at other sites with similar issues by building a coalition of marine World Heritage sites with shared values. We feel that attributes of these different approaches to managing cruise ships in World Heritage sites are not just applicable to northern hemisphere sites characterized by mountainous terrain and deep fjords. Cruise ship visitation impacts a myriad of lower latitude and equatorial sites, some of which have management structures which may benefit from implementing some of the approaches described above. It is noted that the goal is not to advocate for a set level of ship visitation, or establishing when, or to what degree, that cruise ship volume or behaviour should be regulated. Rather we seek to expand the tools that empower managers to meet economic objectives while still conserving their site's OUV.

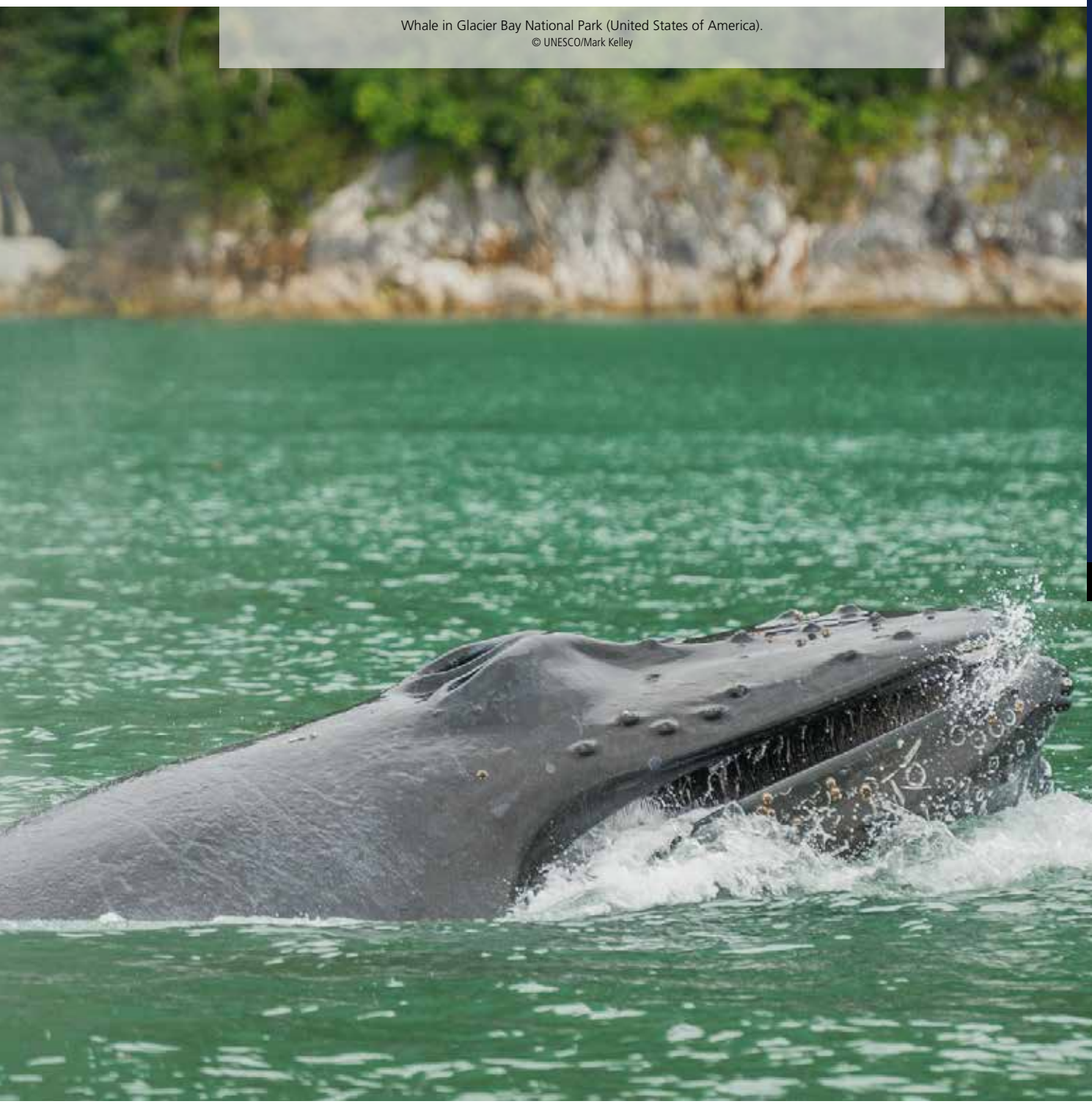
Once this coalition is established, we hope to increase the collective understanding, via webinars, listservs, and future meetings, of practices that have been successfully implemented globally that increase sustainability including areas not defined by a World Heritage designation. For example, lowering fairway transit fees or port or pollution taxes has proved to an effective means by which other aspects of the shipping industry increases sustainable operations (Carr and Corbett, 2015). Working collaboratively with the industry to develop 'best practices' has also proved to be effective; successful efforts of the Association of Arctic Expedition Cruise Operators (AECO)[7] and the Arctic Marine Tourism Project Best Practices Guidelines (AMTP, 2015) are two such examples. In our experience, we have found that some cruise companies consistently take the lead on programs that promote sustainability, particularly when they do not require the installation of any new technologies or operating in such a manner that is untenable. Companies recognize that World Heritage sites are coveted destinations to visit which further increases the economic incentive to have a site on an itinerary. This can equate to powerful leverage when working with the industry to increase the sustainability of operations.

Second, recognizing the diverse jurisdictional, regulatory, and management structures that limits the ability of some sites to regulate visitation, we seek to develop and promote the World Heritage 'brand' that can serve as leverage by which sites can use when negotiating operations at a site. One idea is to develop the West Norwegian Fjord's Green Fjord Initiative as a global program wherein ship companies agree to certain standards or practices when they visit a World Heritage site. We feel this is possible because cruise companies are selling the experience of these remarkable places and thus are amendable to operations that result in good stewardship that will not deleteriously impact a site.

Ultimately, however, managers at marine World Heritage sites must decide the extent to which the impacts from cruise ship visitation is still consistent with conservation of the site's resources and values. In many areas, such as the WNF, cruise ship passengers disembark at local gateway communities, which can result in significant economic benefits to the local economy (e.g., Chang et al., 2016). Limiting ship visitation to meet socio-economic objectives may only work if the alternative for keeping the same level of visitation occurs from a less optimal means of transport, such as more buses. For example, using buses to bring in the thousands of passengers that normally arrive via cruise ships would further congest the narrow (and few) roads into and out of Geiranger, and possibly dramatically degrade the site's OUV. Likewise, the experience of visiting Glacier Bay would likely be fundamentally changed if 480,000 cruise ship passengers instead arrived aboard smaller, more numerous tour vessels. Large numbers of visitors aboard a single vessel may thus provide an optimal way to maximize visitation while minimizing impacts.

7 See www.aeco.no

We have provided details on the successful use of market based methods at Glacier Bay as one model for addressing and mitigating multiple concerns. We recognize that, owing to complex management structures, the degree of coordination required to implement this approach at other sites is high. Any attempts at limiting ship volume or curbing operations will undoubtedly be faced with opposition. Thus the first step is a better understanding of the benefit-impact trade-offs that are central for balancing cruise ship visitation with the conservation of these outstanding universally places and reaching the green dream.



Whale in Glacier Bay National Park (United States of America).
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7

Part 7
Marine gaps on the UNESCO World Heritage List

Tens of thousands of Sardines in a bait ball in the ocean.
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1. Introduction

The World Heritage Convention was always intended to include the oceans, as evidenced by marine references in the Convention's first operational guidelines dating from 1977, and especially the early inscription of iconic sites such as the Everglades National Park (1979, United States of America)[1] and the Great Barrier Reef (1981, Australia)[2]. Natural marine World Heritage sites, the focus of this chapter, are recognized for their universally outstanding natural ocean features. Some of these – so-called mixed World Heritage sites – are also inscribed on the World Heritage List for their outstanding cultural heritage in addition to their natural values, celebrating humanity's links with the oceans. A prime example of this is Papahānaumokuākea, centred on the Northwestern Hawaiian Islands (2010, United States of America)[3]. In addition, there are also purely cultural World Heritage sites that include marine areas, further recognizing humanity's ocean heritage. The latter are not taken into consideration in this chapter.

Marine areas under national jurisdiction are codified in the United Nations Convention on the Law of the Sea (UNCLOS), and cover just under 40 percent of the world's oceans, representing about one quarter of the planet's surface. Since inception of the World Heritage Convention, its focus has been on areas under jurisdiction of countries, reaching out to the boundary of the Exclusive Economic Zone (EEZ) at 200 nautical miles (or 370 kilometres) offshore. This chapter concentres on that area. World Heritage in areas beyond national jurisdiction is discussed in a separate chapter of this publication.

A more strategic focus on oceans in the World Heritage Convention started with a marine strategy for 2003-2008 (UNESCO/WCPA, 2003) and a marine heritage workshop in Hanoi in 2002 (Hillary et al., 2003). The strategy made initial steps in identifying marine features of potential Outstanding Universal Value (OUV), establishing a more strategic approach to identifying ecological and social rationales for conserving significant marine features, and identifying the need for a dedicated marine programme to support this effort at the World Heritage Centre. The Hanoi workshop used a large scale biogeographic approach to identify sites of potential OUV. These outlined a pathway for further action by concerned State Parties, with particular attention to establishing better representation of the oceans on the World Heritage List, and the need for ecosystem-based approaches and novel site designs such as serial and/or transboundary sites. As a next step, workshops were undertaken to develop a serial transboundary site in the Central Pacific (UNESCO, 2003; Kokkonen, 2004) and implement a more strategic approach to the possible selection of sites. While they did not lead to nomination or inscription of a transboundary site at the time, they provided the foundation for a series of actions leading to new large marine World Heritage sites in subsequent years, as well as a more robust scientific framework to guide States Parties in the identification of potential new marine World Heritage sites. In 2010, as a result of these efforts marine areas protected as World Heritage doubled with the inscription of Phoenix Islands Protected Area and Papahānaumokuākea.

Fish in a tropical reef.
© Brian Sullivan

1 http://whc.unesco.org/en/list/76
2 http://whc.unesco.org/en/list/154
3 http://whc.unesco.org/en/list/1326

2. Building blocks toward a more balanced and representative marine World Heritage List

UNESCO's World Heritage Marine Programme was established in 2005 in part to provide support toward a more balanced, credible and representative World Heritage List with regard to marine ecosystems and ocean features of OUV (UNESCO/WCPA, 2003). Building on the lessons from the Hanoi workshop and Central Pacific project, and completion of the timeframe of the 2003-2008 Strategy, the need for a more robust strategy was identified, resulting in development of the Bahrain Action Plan (IUCN, 2009). The plan formulated two key goals: to build capacity to deliver technical support for marine World Heritage nominations, and to undertake a global thematic review of marine World Heritage. Additionally, work geared toward building greater management capacity in marine World Heritage sites highlighted the emerging need to design the boundaries of marine World Heritage sites so that they are compatible with the actual ecosystem functioning of a site's ocean features (Ehler and Douvere, 2010; Douvere, 2015). Using an ecosystem approach in defining boundaries of new marine World Heritage sites helps assure their integrity and protection once they are inscribed on the World Heritage List.

"Using an ecosystem approach in defining boundaries of new marine World Heritage sites helps assure their integrity and protection once they are inscribed on the World Heritage List."

Box 1.
How World Heritage marine sites are selected

World Heritage sites are selected through a rigorous, multi-year nomination, evaluation and inscription process. Outstanding Universal Value is the central premise upon which World Heritage is built. Natural sites must respond to at least one of the following criteria:

1. Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
2. Outstanding examples of major stages in the earth's history, including the record of life, significant on-going processes in the development of landforms or significant geomorphic or physiographic features;
3. Outstanding examples of significant, ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and plant and animal communities, and
4. The most important and significant natural habitats for in-situ conservation of biological diversity, including threatened species that are considered of Outstanding Universal Value from the point of view of science or conservation.

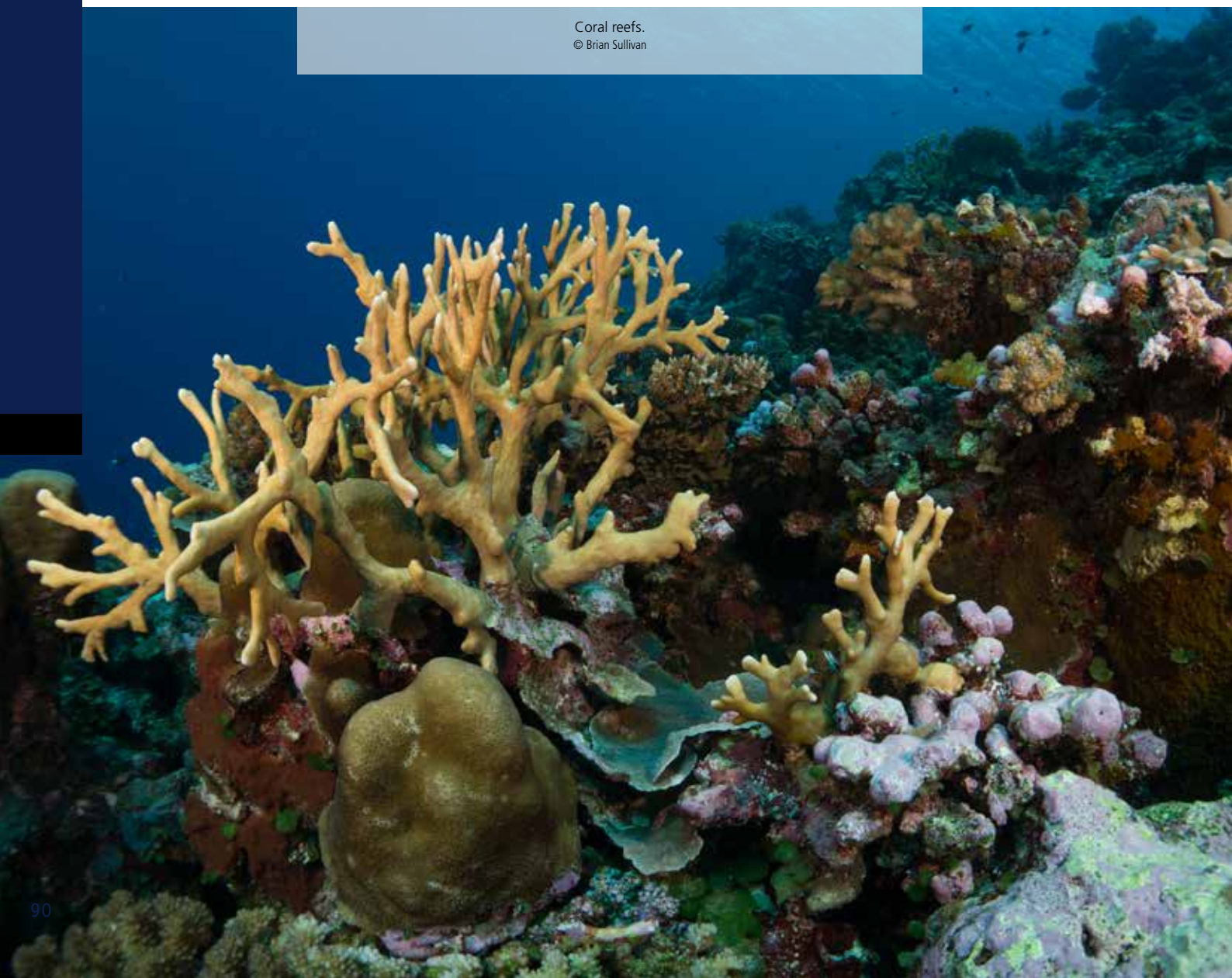
A site must also meet requirements for integrity and have an adequate protection and management system in place to ensure the conservation of the site's outstanding features.

2.1. The current portfolio of marine World Heritage sites

As of 1 August 2016, 49 marine sites from 37 countries are inscribed on the World Heritage List (fig. 1, Appendix 1). Marine sites represent just 4.7 percent of all 1052 World Heritage sites, and 20.6 percent of the 238 natural and mixed World Heritage sites. By surface area, however, they cover 55.5 percent of the total area of all natural and mixed World Heritage sites, mainly due to the large size of recent listings in remote ocean regions (Box 2). Since 2005, 16 marine sites were added to the World Heritage List, resulting in more than doubling of the marine area protected under the 1972 World Heritage Convention (Table 1, fig. 2).

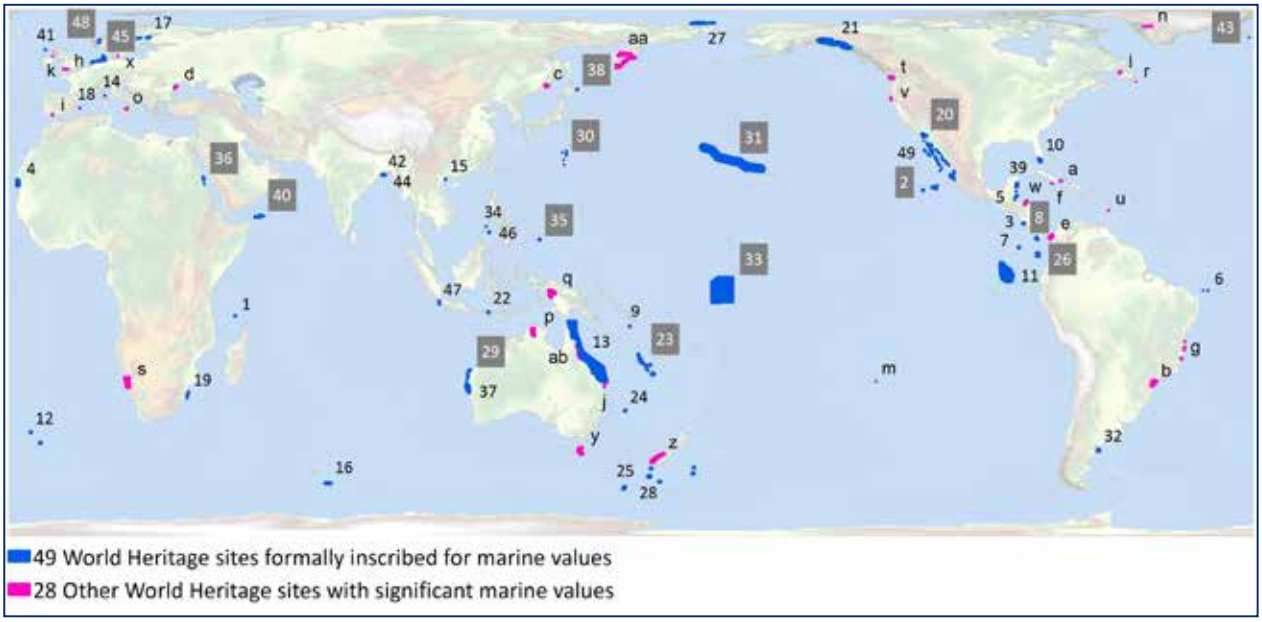
Marine World Heritage sites cover a broad range of sizes and configurations, from the equator to the polar regions, ranging from very large marine sanctuaries (Box 1) to smaller sites important for specific marine features (Box 2). Many of them are also important for interactions between people and nature, and recognized for their cultural, as well as natural, heritage. In addition, twenty-five other natural and mixed World Heritage sites include a marine or coastal component (fig. 1, Appendix 2).

> "Since the inception of the World Heritage Marine Programme, marine areas protected under the 1972 World Heritage Convention more than doubled."



Coral reefs.
© Brian Sullivan

Figure 1. Global distribution of the 49 natural and mixed World Heritage sites that are formally inscribed for marine values, highlighting in grey boxes those inscribed since 2005 (derived from Abdulla et al., 2013). The 28 other natural and mixed World Heritage sites with significant marine or coastal components are also shown (updated from Spalding, 2012). See Appendices 1 and 2 for more information on the two groups of sites.



Source: Abdulla et al., 2013

Table 1. Marine sites inscribed on the World Heritage List from 2005 to 2016.

2005	Coiba National Park and its Special Zone of Marine Protection (Panama)
2005	Islands and Protected Areas of the Gulf of California (Mexico)
2005	Shiretoko (Japan)
2005	West Norwegian Fjords – Geirangerfjord and Nærøyfjord (Norway)
2006	Malpelo Fauna and Flora Sanctuary (Colombia)
2008	Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems (France)
2008	Socotra Archipelago (Yemen)
2008	Surtsey (Iceland)
2009	Wadden Sea (Denmark / Germany / Netherlands)
2010	Papahānaumokuākea (United States of America)
2010	Phoenix Islands Protected Area (Kiribati)
2011	Ningaloo Coast (Australia)
2011	Ogasawara Islands (Japan)
2012	Rock Islands Southern Lagoon (Palau)
2016	Sanganeb Marine National Park and Dungonab Bay – Mukkawar Island Marine National Park (Sudan)
2016	Archipiélago de Revillagigedo (Mexico)

Source: Abdulla et al., 2013

Figure 2. Cumulative number and area of marine World Heritage (mWH) sites by year, since the first World Heritage sites were inscribed in 1978.

Source: David Obura and Bastian Bertzky

Effective protection and management that maintain the integrity of World Heritage sites in the context of their surrounding seascapes are key requirements for World Heritage designation, and thus many World Heritage sites are already among the best-protected and well-managed marine protected areas globally (Douvere, 2015). The success of World Heritage sites can be seen as a litmus test of broader efforts in marine conservation, and World Heritage sites should play a flagship role in setting global standards for marine conservation. Given their global recognition as well as their coverage of a significant proportion of the global marine protected area, marine World Heritage sites can make a substantial contribution to achieving international protected area targets such as Aichi Target 11 of the Convention on Biological Diversity or the Sustainable Development Goals – in particular in delivering effective protection and management.

2.2. Understanding the natural World Heritage criteria in the marine context

The concept of OUV and the World Heritage criteria as written in the Convention texts have always required careful interpretation and application, but until recently very limited guidance has been available especially for the marine environment. This was likely a factor in the challenges of implementing recommendations from the 2002 Hanoi workshop (Hillary et al., 2003) and identification of the need for both a marine programme and an Action Plan (Laffoley and Langley, 2010). Indeed, the first application of the criteria at a regional scale using the ecosystem-based approach (in the Western Indian Ocean, Obura et al., 2012) found lack of clarity and consistency in applying them to be a significant problem.

Publication of the thematic guidance by IUCN (Abdulla et al., 2013; 2014) followed the approaches developed in other thematic areas (e.g. geology and karst systems, Dingwall et al., 2005; Williams, 2008), and will help to streamline future nominations. Sixteen broad marine themes were identified and described (Table 2), and the document paid particular attention to classifying these under the natural criteria (viii), (ix) and (x) as follows:

a. Marine geology and oceanographic features should be addressed under criterion (viii); and
b. Consistency in applying criteria (ix) and (x) across different components of biodiversity is needed. Guidance was formulated in accordance with a simultaneous analysis of the same issue in terrestrial systems (Bertzky et al., 2013), with (ix) referring to 'ecological and biological processes' and (x) to species and the most critical habitats for species conservation.

Table 2. Broad marine themes for recognizing Outstanding Universal Value under the World Heritage Convention. From Abdulla et al. (2013, 2014). As criterion (vii) is rarely used on its own, it is tabulated after the other criteria.

Criterion (viii)		Criterion (ix)	Criterion (x)	Criterion (vii)
Geology	Oceanography	eEcological and biological processes	Species and biodiversity	Superlative phenomena and/or exceptional beauty
1) Plates and tectonic features	5) Water masses	10) Biogeochemical cycles and productivity	13) Diversity of marine life	16) Marine phenomena and spectacles
2) Hotspots, seamounts	6) Ocean currents	11) Connectivity	14) Biogeography and components of diversity	
3) Sedimentary processes (slope, rise and deep seabed, submarine canyons)	7) Waves and other phenomena	12) Marine ecosystem processes and services	15) Threatened and flagship species	
4) Vents, seeps, and other hydrogeological features	8) Coastal processes and land-sea interactions 9) Ice			

Source: Abdulla et al., 2013, 2014

2.3. A regional, ecosystem-based approach to marine World Heritage

To implement the Bahrain Action Plan (Laffoley and Langley, 2010), a more strategic gap-filling approach to identify potential new World Heritage sites was developed. It was based on scientific approaches that classify the global ocean into 62 coastal (from coastline to 200 metres depth) and 37 pelagic provinces (surface waters beyond the coastal provinces greater than 200 metres depth, and covering the open ocean) (Spalding et al., 2007; 2012). These provinces are highly distinctive on the basis of their geology and oceanography, relevant to criterion (viii), and as a result host many unique plants, animals, natural processes and other features, relevant to criteria (ix) and (x). This enabled a regional ecosystem-based approach to be developed to first assess the potential for features of OUV at a biogeographic province or higher level – i.e. comparing the province to global marine features. After this, sites are identified that most superlatively express those globally unique phenomena and are of sufficient size and design to assure ecological integrity. In the future, other classification systems could similarly be applied to assess coverage and gaps for deep-sea habitats (Watling et al., 2013) and, under criterion (viii), geomorphic features of the seafloor (Harris et al., 2014).

This approach was applied in the Western Indian Ocean (WIO), where principle physical features corresponding to plate tectonics, hotspots, currents and connectivity were assessed, which influence the patterns of species diversity through processes such as connectivity (Obura et al., 2012). Based on unique regional characteristics of geology, oceanography and biogeography, sites that support the highest levels of potential OUV within the WIO (and therefore globally) were identified, based on 'regular' World Heritage characteristics such as diversity, endemism and ecological and biological processes. One of the sites

Ha Long Bay (Viet Nam) was inscribed on the World Heritage List for, among others, Criterion (vii): to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
© Vincent Ko Hon Chiu

Gulf of Porto: Calanche of Piana, Gulf of Girolata, Scandola Reserve (France) was inscribed on the World Heritage List for, among others, Criterion (viii): to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.
© UNESCO/ Agne Bartkute

Archipiélago de Revillagigedo (Mexico) was inscribed on the World Heritage List for, among others, Criterion (ix): to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.
© Erick Higuera

Cocos Island National Park (Costa Rica) was inscribed on the World Heritage List for, among others, Criterion (x): to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.
© Jose Alejandro Alvarez / Fundación Amigos de la Isla del Coco

identified was very large, and to ensure connectivity, a serial site design was put forward incorporating 6 separate areas[4]. Other priority sites for the region were of a more 'classic' individual-site design. This regional ecosystem-based approach was further consolidated in the IUCN guidance (Abdulla et al., 2013), with greater attention on how to apply criteria (viii), (ix) and (x) to marine features with greater consistency (and see Bertzky et al., 2013). By the end of 2015, further applications of this regional approach were underway, focusing on the Arctic region and areas beyond national jurisdiction. The latter are currently not covered by the World Heritage Convention, and related challenges and opportunities are described in a separate chapter of this publication.

4 At the time of the study, this site design was not feasible for further action by State Parties. However individual parts of the serial site, if designed appropriately to meet the protection, management and integrity criteria, may themselves have potential for nomination to the World Heritage List.

2.4. Protection, management and integrity requirements for new World Heritage nominations

The Convention's operational guidelines stress that, to be deemed of OUV, a natural site must not only meet one or more of the World Heritage criteria but also specific requirements with regard to their protection, management and integrity. Integrity is defined as a measure of the wholeness and intactness of the site and its natural features. Specifically, a site needs to 1) include all elements necessary to express its OUV, 2) be of adequate size to ensure the complete representation of the features and processes that underpin its OUV, and 3) be relatively intact, i.e. free from adverse effects of development and/or neglect. However, the guidelines also recognize that human activities, including those of indigenous peoples and local communities,

often occur in natural areas, and that these activities may be consistent with the OUV of the area where they are ecologically sustainable.

The protection and management of natural sites must also ensure that their OUV, including the conditions of integrity at the time of inscription, are maintained or enhanced over time. Therefore, each site must have adequate long-term legislative, regulatory, institutional and/or traditional protection and management to ensure their safeguarding. Each site must also have an appropriate management plan that specifies how its OUV will be maintained, preferably through participatory means, for present and future generations.

Sites must also have adequately delineated boundaries and, where appropriate, buffer zones. Boundaries of marine sites should be defined in the context of their surrounding seascapes so that they make sense from an ecosystem perspective and facilitate effective protection and management. Specifically, boundaries should reflect the spatial requirements of habitats, species, processes or phenomena that provide the basis for their inscription on the World Heritage List, and also include sufficient areas immediately adjacent to the area of OUV to protect these values and their integrity.

Over the years the Convention's standards and IUCN's rigorous evaluation of new nominations has helped to considerably improve the status of many World Heritage sites before inscription as countries worked hard to meet the requirements (Thorsell, 2003). Such improvements have included substantial extensions, better management or protection, including creation or extension of no-take areas, additional funding, and the prevention of major development projects. The List of World Heritage in Danger is applied to sites where the OUV of a site is under grave threat. This List allows the World Heritage Committee to allocate immediate assistance from the World Heritage Fund to the endangered property, and alerts the international community to join efforts to save these endangered sites. Indeed, the mere prospect of inscribing a site on this List often proves to be effective, and can incite rapid conservation action and high level negotiations to mitigate threats, as is ongoing in the case of the Great Barrier Reef (Australia). Since 2005, four marine sites have been on the List of World Heritage in Danger: Galápagos Islands (Ecuador, 2007-2010), Belize Barrier Reef Reserve System (Belize, 2009-present), East Rennell (Solomon Islands, 2013-present), and the Everglades National Park (United States of America, 1993-2007 and 2010-present).

The stringent requirements underline that the core emphasis of the World Heritage Convention is the effective conservation of the world's outstanding natural and cultural heritage, not merely their recognition. Hence, in parallel with the focus on identifying possible new sites for inclusion in the World Heritage List, UNESCO's World Heritage Marine Programme has invested significantly in improving management at existing sites (Douvere, 2015), as discussed in a separate chapter of this publication.

"The protection and management of natural sites must also ensure that their OUV, including the conditions of integrity at the time of inscription, are maintained or enhanced over time."

3. Key findings of global gap analyses of marine sites on the World Heritage List

3.1. Identifying and prioritizing broad gaps

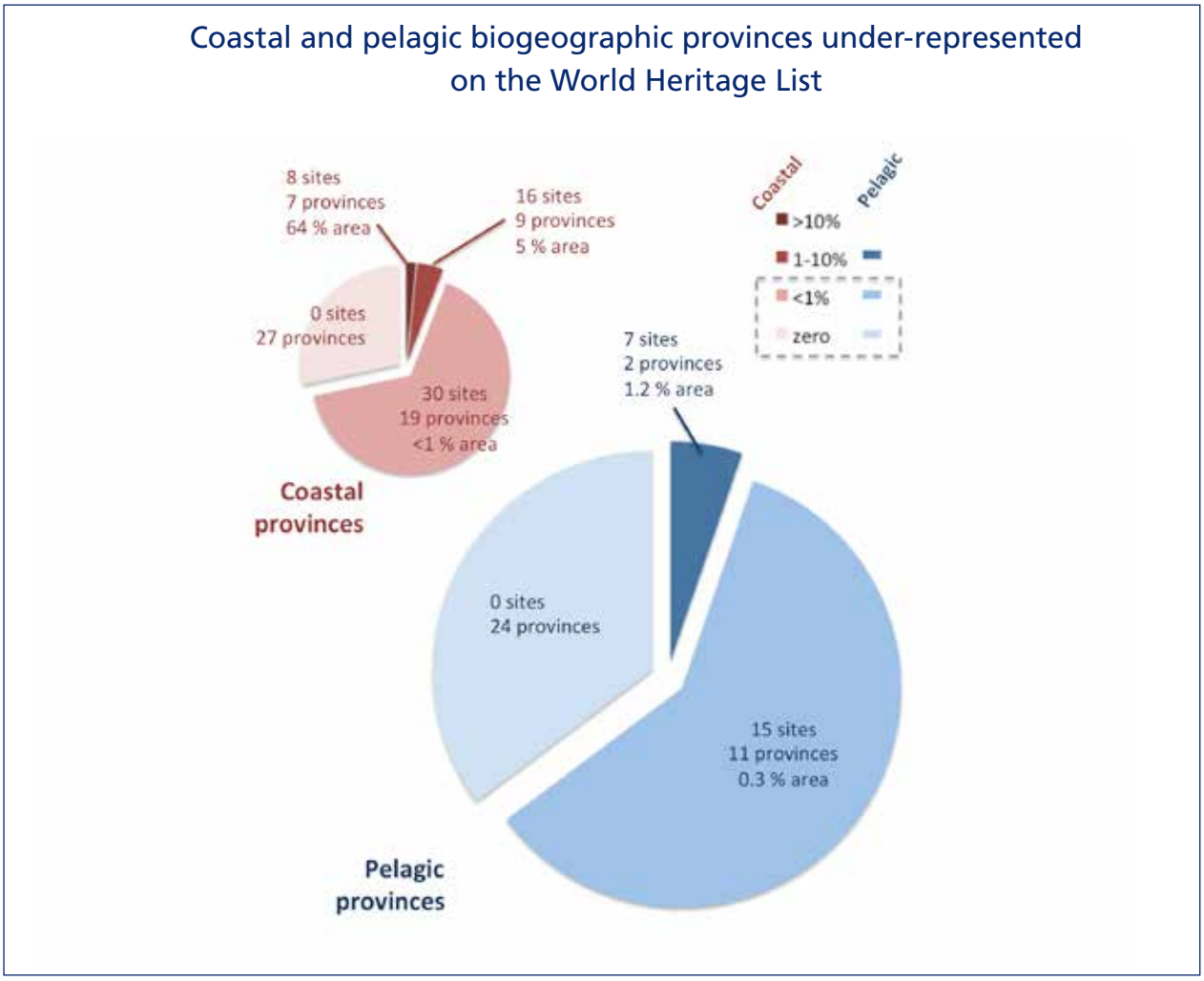
Broad gaps in the marine World Heritage List have been identified in Spalding (2012) and in particular Abdulla et al. (2013, 2014) in terms of representation of World Heritage sites in the biogeographic provinces of the global ocean. Both works together represent the most comprehensive gap analysis for marine sites on the World Heritage List to date. Abdulla et al. (2013, 2014) identified and mapped 27 coastal[5] and 24 pelagic provinces without any World Heritage sites (labelled as 'gap provinces'), representing over 50 percent of all provinces. The analysis also showed that the area covered by World Heritage sites is highly variable across coastal and pelagic provinces, reflecting differences in the design and size of individual sites (e.g. see text boxes 1 and 2) and the size of the provinces concerned. This coverage ranges from 100 percent for the Galápagos coastal province to <1% for 19 coastal and 11 pelagic provinces (fig. 3).

It should be stressed that the World Heritage Convention seeks to recognize only the most outstanding sites, thus not all provinces will necessarily contain sites that qualify for World Heritage. Nevertheless, it is instructive that around 44 percent (27) of all 62 coastal provinces and 65 percent (24) of all 37 pelagic provinces are completely unrepresented (0 sites) on the World Heritage List, and for another 31 percent (19) of coastal provinces and 30 percent (11) of pelagic provinces it is likely that the small area (<1 percent) covered by existing World Heritage sites is not adequate to include all features of potential OUV in the province. To illustrate key gaps on the World Heritage List, Spalding (2012) outlined some of the unique and exceptional natural features of 10 of the 27 coastal gap provinces.

5 The Lord Howe and Norfolk Islands coastal province was incorrectly identified as a gap province at that time because the Lord Howe Island Group (Australia), although inscribed on the World Heritage List in 1982, was only recognized as a marine World Heritage site in 2014.

Sea lions, Galápagos Islands
© UNESCO/Actua

Figure 3. The relative number and area of 62 coastal and 37 pelagic biogeographic provinces under-represented on the marine World Heritage List. The pie charts reflect total area in coastal (29 million km^2) and pelagic (371 million km^2) provinces across the whole ocean. The legend shows the proportion of a province covered by marine World Heritage sites, ranging from >10 percent to zero. Text in each slice shows the number of marine World Heritage sites, number of provinces and proportion of their total area in marine World Heritage sites. Note all coastal provinces lie within national jurisdiction, and about one quarter of the total area of pelagic provinces lies within national jurisdiction. Derived from Tables 4, 5 and 6 in Abdulla et al., 2014.



Source: Abdulla et al., 2014

A simple graphical analysis of the criteria descriptions in the OUV statements of all marine World Heritage sites highlights marine features that are strongly represented on the World Heritage List at present (fig. 4). Species and islands are the clear focus of statements of OUV, along with terms such as diversity and endemism, and a focus on mammals, birds, turtles and corals. Where other marine features that are not so well represented on the World Heritage List can be identified in the known gap provinces, these can provide guidance on priority gaps to be filled. Such priorities include pelagic, deep-sea and cold-water ecosystems, less iconic taxonomic groups, and geological and oceanographic features.

"The World Heritage Convention seeks to recognize only the most outstanding sites, thus not all provinces will necessarily contain sites that qualify for World Heritage."

Figure 4. Word cloud derived from the criteria descriptions in the statements of Outstanding Universal Value (OUV) for all 49 marine World Heritage sites. The size of each word is proportional to its frequency of use in the statements – of the almost 10,000 words used in the statements (with common and non-meaningful words removed, such as prepositions, words like 'property', 'site' and 'area') there were over 3,000 unique words with 256 occurrences of 'species', the most common word (analysed used www.wordle.net).

Source: David Obura and Bastian Bertzky

The existing gap analyses suggest that, outside the tropics that currently account for the majority of marine World Heritage sites, three major groups of gap provinces stand out:

a. major polar and temperature basins such as the Arctic, Scotia Sea, Warm Temperate Northwest Atlantic and Warm Temperate Southeast Pacific;

b. major current systems such as the Kuroshio, Humboldt, Gulf Stream, Benguela and Agulhas; and

c. remote and small island and marine systems such as Easter Island (already a cultural World Heritage site) and the Juan Fernández Islands in Chile, and the islands of the French Southern Territories in the South Atlantic. Pelagic, deep-sea and cold-water ecosystems are less represented than others on the World Heritage List, so could be prioritized in these gap provinces, together with outstanding geological and oceanographic features.

A significant difficulty in applying the global biogeographic classifications under the World Heritage Convention arises from the mismatch between the boundary between coastal and pelagic/deep-sea systems (the 200-m depth contour) and the political boundary between national jurisdictions and the high seas (200 nautical miles from the coastline, though 350 nautical miles where countries' applications to extend jurisdiction over extended continental shelves is approved). In the gap analysis presented here we use the whole ocean as the baseline for assessing representation of World Heritage sites in coastal or pelagic provinces, as any individual site must be assessed for its global uniqueness. However, application of the Convention to pelagic or deep-sea locations beyond national jurisdiction has not been possible to date (see separate chapter in this publication).

3.2. Identifying candidate sites to fill the broad gaps

Many of the unrepresented and underrepresented provinces identified above are likely to support a number of unique marine features of potential OUV (Spalding, 2012). However, not all gap provinces may necessarily have sites that meet the standards of the World Heritage Convention. Compared to a broad gap analysis, the identification of specific candidate sites needs to place much greater emphasis on defining potential OUV and finding those areas that include the most unique, diverse and/or representative features and processes of potential OUV, both within the broad gaps and beyond.

Various approaches can be employed to identify candidate sites within known biogeographic or thematic gaps. These range from global top-down approaches to regional bottom-up approaches and from data-driven approaches to expert-based approaches (Abdulla et al., 2013). Above we already discussed a regional, ecosystem-based approach. Whatever approach is used, it

is critical to identify candidate sites that have the potential to be deemed of OUV, i.e. meeting one or more of the World Heritage criteria plus the protection, management and integrity requirements discussed above. Eventually this needs to be demonstrated through the global comparative analysis required for all nominations, but 'upstream' work should already seek to realistically clarify the justification (or not) for OUV. This should include comparisons with comparable sites in the same broad biogeographic or thematic context (e.g. Tropical Pacific sites or coral reef sites), including existing World Heritage sites, sites on countries' World Heritage Tentative Lists, other marine protected areas and even unprotected areas.

Existing marine protected areas often provide a good starting point for the identification of candidate sites because they may already have been selected on the basis of outstanding features, and may fulfil some of the basic protection and management requirements of the World Heritage Convention. However, several of the recently inscribed World Heritage sites (e.g. Phoenix Islands Protected Area, Kiribati) have not had a long history as marine protected areas before their inscription on the World Heritage List, highlighting that even yet unprotected areas should be considered. As noted above, candidate sites must have adequately delineated boundaries from an ecosystem perspective, and they also need to be sufficiently large and intact to meet the integrity requirements.

Particularly appropriate to the marine realm, where ocean currents strongly influence ecological and evolutionary links between sites and regions, is the concept of serial sites – of multiple physically separated locations that together form a single World Heritage site. The process of identifying candidate sites should therefore consider, as appropriate, a design option of two or more spatially separate but 'connected' component parts (e.g. the New Zealand Sub-Antarctic Islands, New Zealand), transboundary and transnational sites involving two or more countries (e.g. the tri-national Wadden Sea, Denmark, Germany, Netherlands) or extensions to existing sites (e.g. the marine extension to the Galápagos Islands) to strengthen OUV and increase their protection, management and integrity.

Detail of a cup coral in Loch Madadh, St Kilda.

4. Conclusion

The next 10 years for marine World Heritage could transform the degree and effectiveness of protection and management of the best of the best sites in the world's oceans. In marine areas under national jurisdiction, marine World Heritage sites should act as models for broader efforts in marine conservation, setting and mainstreaming standards for management and protection of other marine protected areas. In particular, the focus of the World Heritage Convention on both natural and cultural heritage emphasises the human and social dimension, the interaction of people with nature, and how we value it. Innovative and broader application of natural, mixed natural/cultural and cultural seascape (landscape) criteria could lead to a sea change in global awareness of the value of the oceans to our planet and to us. World Heritage sites are flagship marine protected areas; however, despite recent progress in the identification and designation of marine World Heritage sites, from the above sections it is clear that significant marine gaps still exist on the World Heritage List.

"Marine World Heritage sites should act as models for broader efforts in marine conservation, setting standards for management and protection of other marine protected areas."

Successful nomination of a World Heritage site requires rigorous analysis of the OUV of a site, and States Parties are encouraged to expand the marine World Heritage List across the full range of features in the oceans, from tropical to polar regions, and from small to large scales, as appropriate. From existing analyses we identified three major groups of provinces with the greatest potential for new sites to fill critical gaps on the marine World Heritage List:

a. major polar and temperature basins such as the Arctic, Scotia Sea, Warm Temperate Northwest Atlantic and Warm Temperate Southeast Pacific;

b. major current systems such as the Kuroshio, Humboldt, Gulf Stream, Benguela and Agulhas; and

c. remote, small island and marine systems such as Easter Island (already a cultural World Heritage site) and the Juan Fernández Islands in Chile, and the islands of the French Southern Territories in the South Atlantic.

By reflecting the increasing attention to good governance of the seas, rights-based approaches, traditional tenure and cultures that have evolved with the sea, new nominations may consider mixed (natural and cultural) features, and the potential to qualify as cultural landscapes (Mitchell et al., 2009). In doing so, appreciation and respect for the diversity of cultures, and the diversity of marine biodiversity and geographies can be raised, with positive benefits from local to global levels. Continued success in establishing and managing World Heritage sites will further motivate and support the establishment and improved management of other marine protected areas and hence contribute both directly and indirectly to progress on Aichi Target 11 of the Convention on Biological Diversity and other international targets such as the Sustainable Development Goals, in particular Goal 14, on oceans.

Box 2.
Large tropical World Heritage sites

Since its inscription in 1982, for many years the Great Barrier Reef (Australia) stood out as the largest marine (and overall largest) World Heritage site, at 348,700 km^2. But in 2010, with interest in the management and protection of the most pristine and outstanding ocean locations growing around the world, two larger sites were added, the Phoenix Islands Protected Area in Kiribati, at 408,250 km^2, and Papahānaumokuākea in the United States of America, at 362,075 km^2. Together they doubled the marine area protected under the World Heritage Convention (fig. 2).

Phoenix Islands Protected Area, Kiribati.
© Keith Ellenbogen / New England Aquarium

The three inscriptions in 1982 and 2010 account for almost 75 percent of the total area of marine World Heritage sites (fig. 2), and are the largest contribution of any protected area system to marine protection globally. The importance of sufficiently large and intact areas is recognized in the World Heritage Convention's conditions of integrity required for OUV, especially with regard to criteria (ix) and (x). Integral to all three of these sites are their coral reefs, the iconic centrepieces of their OUV. However, they also contain many other features of OUV such as seamounts, deep-sea habitats and sites important for species' life histories such as nursery grounds.

Papahānaumokuākea, United States of America.
© Keith Ellenbogen / New England Aquarium

Photo caption – the remote islands and atolls of the Phoenix Islands Protected Area (Kiribati) and Papahānaumokuākea (United States of America) World Heritage sites provide undisturbed habitat for breeding and rearing young, such as of blacktip reef sharks (Carcharhinus melanopterus, above) and Noddies (Anous sp., below).

Marine iguana, Galápagos Islands (Ecuador).
© Daniel Correia

Box 3.
Smaller temperate and polar World Heritage sites

Other marine sites on the World Heritage List are much smaller than the "big three" (see Box 1) but still exceptional in their dense, unmatched combination of outstanding features. For instance, the Natural System of Wrangel Island Reserve (Russian Federation) in the Russian Chukchi Sea supports a unique diversity of habitats in the Arctic Ocean, partly because the area has not been covered by ice caps during the last 1.6 million years. The area has accumulated a high diversity of terrestrial fauna and flora, and is an aggregation point for migratory species of seabirds, walruses and grey whales.

Sea anemone covered vertical cliff below the kelp zone, Neil's Cave, St Kilda. © SNH/George Stoyle

Another example, St Kilda (United Kingdom of Great Britain and Northern Ireland), in the North Atlantic of Scotland, is a volcanic remnant from the opening of the Atlantic, with steep slopes and rough seas attracting a wide diversity and abundance of seabirds above-ground and benthic invertebrate communities underwater. As a World Heritage cultural landscape, St Kilda also shows evidence of how small human subsistence settlements adapted and persisted in severe conditions, having been inhabited on and off over several thousand years. In both sites the severe climates, unique geology and rich oceans have resulted in dense aggregations of species, and combined with their isolation, in genetic isolation and evidence of speciation in plants and animals.

Natural System of Wrangel Island Reserve, Russian Federation. © Alexander Gruzdev

St Kilda (United Kingdom of Great Britain and Northern Ireland) and Natural System of Wrangel Island Reserve (Russian Federation) World Heritage sites provide dramatic juxtapositions of geology, ocean and ice that provide unique habitats for invertebrates and kelp communities below the surface (above), and marine mammal breeding and haulout sites (below).

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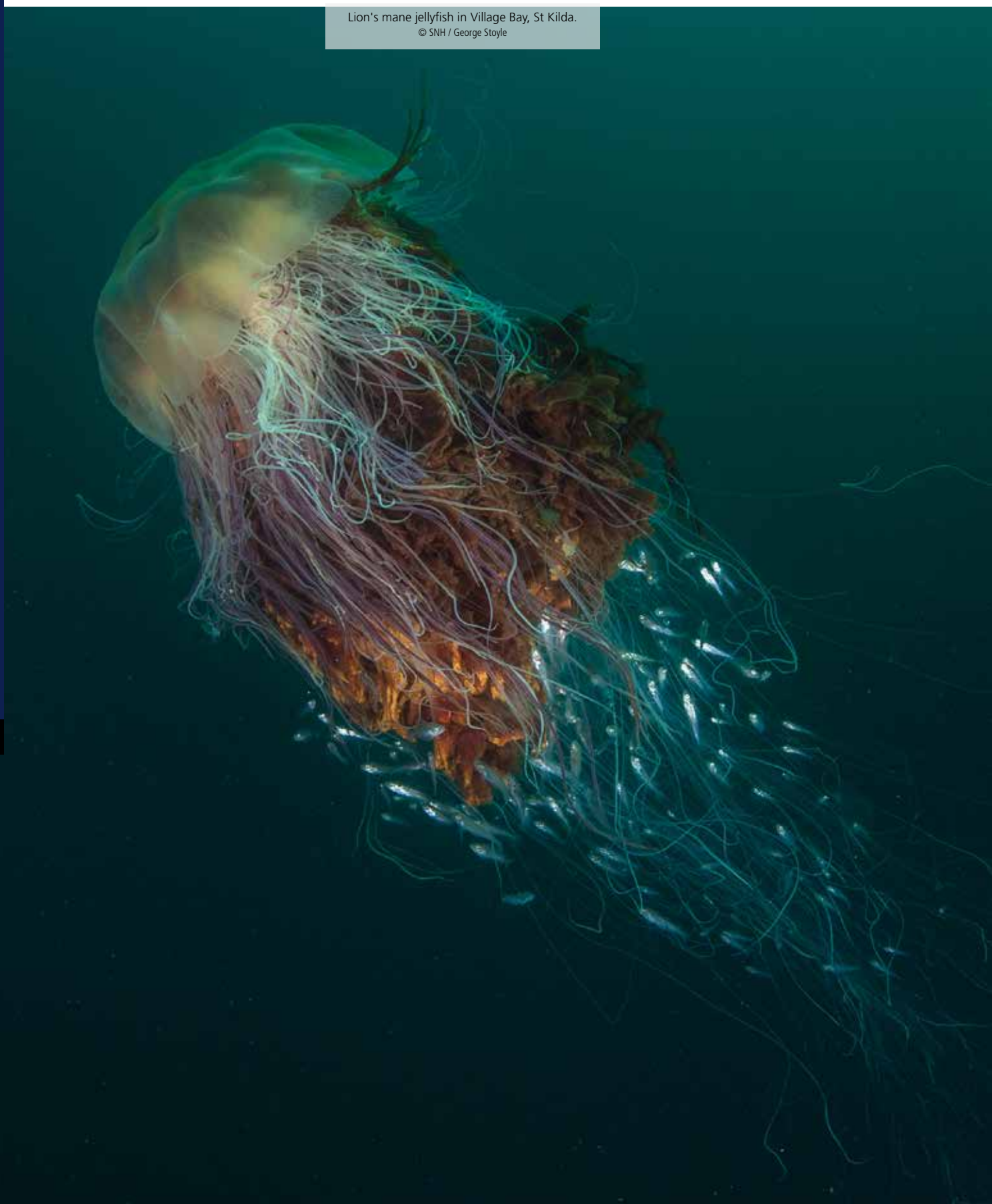
We thank Tim Badman for his valuable comments on this chapter. We also thank our colleagues Ameer Abdulla and Yichuan Shi for their contributions to the IUCN gap analysis and subsequent paper (Abdulla et al., 2013, 2014) that formed the basis for this chapter, and to Yichuan Shi for producing figure 1.



Lion's mane jellyfish in Village Bay, St Kilda.

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Part 8
Identifying candidate marine World Heritage sites in the Arctic

8

Polar bear on melting ice floe in Arctic sea.
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1. Introduction[1]

The Arctic region is home to more than 4 million people and supports globally unique species and ecosystems. The region also plays a crucial role in regulating our planet's climate. Yet the Arctic is undergoing profound change. This is particularly true in the Arctic Ocean, where warming, loss of sea ice, acidification and encroaching industrial development pose major challenges for Arctic marine ecosystems and the coastal communities that depend on them.

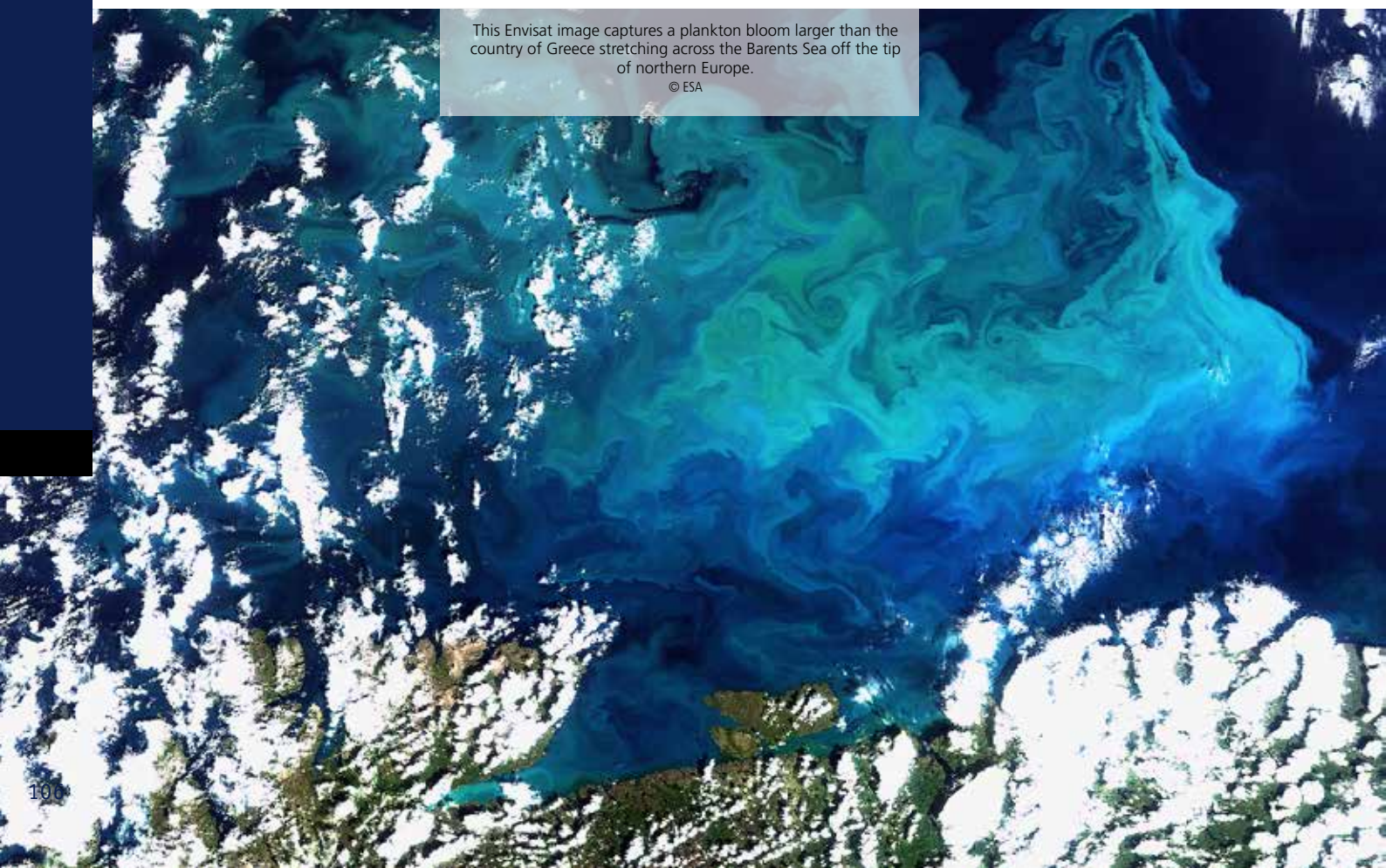
Several studies conducted by both the World Heritage Centre's Marine Programme and the International Union for Conservation of Nature (IUCN) found that the Arctic region is underrepresented on UNESCO's World Heritage List

"The Arctic region is being significantly underrepresented on the World Heritage List."

(Spalding, 2012), and recommended that a thematic study on natural heritage in the Arctic region be prepared[2]. In 2013, IUCN, the Natural Resources Defense Council (NRDC) and UNESCO's World Heritage Marine Programme, with

1 This article is largely based on the preliminary findings of the innovative multi-year project "Potential new marine World Heritage sites in the Arctic region" led by the International Union for Conservation of Nature (IUCN) in partnership with the Natural Resources Defense Council (NRDC) and UNESCO's World Heritage Marine Programme.

2 World Heritage Centre. 2007. World Heritage and the Arctic, International Expert Meeting, 30 November to 1 December 2007, Narvik, Norway. http://whc.unesco.org/uploads/activities/documents/activity-548-1.pdf



This Envisat image captures a plankton bloom larger than the country of Greece stretching across the Barents Sea off the tip of northern Europe.

the support of the Prince Albert II of Monaco Foundation and WWF Canada, started a project to identify candidate marine World Heritage sites in the Arctic that are potentially of Outstanding Universal Value (OUV) with respect to natural criteria. The goal of the project is to lay the scientific groundwork for further evaluation of possible marine World Heritage sites in the Arctic that States Parties could take forward for nomination. The project does not take into account possible cultural criteria of OUV, for which additional research is required.

The first International Expert Meeting on World Heritage and the Arctic took place from 30 November to 1 December 2007 in Narvik, Norway. The meeting coincided with the Arctic Council (Narvik, November 2007) when for the first time a representative of UNESCO spoke to the Arctic Council. Representatives from the eight States Parties of the UNESCO World Heritage Convention in the Arctic region, organizations of indigenous peoples, the Advisory Bodies (IUCN; ICOMOS), the Nordic World Heritage Foundation and the World Heritage Centre participated in this meeting to exchange information on the natural and cultural heritage of the Arctic region, with identification of potential sites of OUV for the World Heritage List (World Heritage Centre, 2007). During the meeting, IUCN put forward a proposal to prepare a thematic study on natural heritage in the Arctic region.

In 2012, the UNESCO World Heritage Marine Programme commissioned an initial overview of existing marine World Heritage sites to assess the extent to which major marine regions and marine ecosystems are represented on the World Heritage List (Spalding, 2012). The review suggested a number of potential gaps – regions and ecosystem types where there are few if any marine World Heritage sites, despite the presence of exceptional marine features. The analysis identified the Arctic region as being significantly underrepresented on the World Heritage List. IUCN's global gaps analysis for marine World Heritage (Abdulla et al., 2013) confirmed that only 0.1 percent of the Arctic enjoys World Heritage status, despite the fact that this area is vast, distinct and contains many exceptional marine features.

In 2013, IUCN, NRDC and UNESCO's World Heritage Marine Programme, with the support of the Prince Albert II of Monaco Foundation (Box 1) and WWF Canada, started a project to lay the scientific groundwork for further evaluation of possible marine World Heritage sites in the Arctic that States Parties could take forward for nomination. The project has two central goals:

a. to help strengthen the balance and representation of the World Heritage List, and

b. to advance conservation of the Arctic marine environment by identifying outstanding and globally unique ecosystems that require protection, improved management and international recognition due to their vulnerability and their importance in maintaining the function and resilience of the Arctic marine environment.

Box 1.
the Prince Albert II of Monaco Foundation

H.S.H. Prince Albert II of Monaco, along with the Prince Albert II of Monaco Foundation and the Principality of Monaco have been outstanding leaders in supporting both Arctic conservation and the work of UNESCO, NRDC and IUCN in the Arctic region. Their support enabled the organization of the first "International Expert Meeting on World Heritage and the Arctic" in 2007 and an international meeting on "Climate Change and Arctic Sustainable Development" which took place in Monaco in 2009. In 2013, the Prince Albert II of Monaco Foundation decided to support a new project from IUCN, NRDC and UNESCO's World Heritage Marine Programme to identify candidate marine World Heritage sites in the Arctic that are potentially of OUV with respect to natural criteria. The results of this study will be presented in 2017.

A preliminary baseline assessment of possible marine sites of OUV was reviewed by scientific researchers and experts during a two-day working meeting at UNESCO's Headquarters in Paris, from 25 to 26 February 2016. Experts from the Russian Federation, Canada, Denmark, the United States of America and Norway discussed unique and exceptional Arctic marine features and areas that could potentially merit inscription on the UNESCO World Heritage List for their nature conservation values[3].

A key conclusion of the meeting centred on the intimate interaction between local communities, traditional cultures and the Arctic's natural environment, and agreed that the OUV of the Arctic region should be considered from both its cultural and natural perspectives. This article briefly describes the outline of the project and how it will advance management and conservation of exceptional places in the Arctic Ocean.

"A key conclusion of the 2016 Expert Meeting centred on the intimate interaction between local communities, traditional cultures and the Arctic's natural environment."

Marine scientists and other experts gather in Paris to explore potential World Heritage in the Arctic (February 2016, Paris, France).

3 http://whc.unesco.org/en/news/1453/

2. Globally unique features of the Arctic marine environment

The Arctic Ocean is the smallest and shallowest of the world's oceans, covering approximately 10 million square kilometres (Michel et al., 2013) with a mean depth of 1361 metres. Almost 50 percent of the Arctic Ocean consists of broad continental shelves (Michel et al., 2013) where most of the biological production takes place. The seas over the Chukchi, East Siberian, Laptev, Kara, Barents, White, Greenland, Lincoln, Beaufort shelves are generally considered to be part of the Arctic Ocean.

The Arctic marine environment is home to a spectacular array of habitats and animals found nowhere else on earth. Sea ice dominates the region's marine ecology, providing habitat for thousands of species, from tiny ice-associated amphipods to the largest whales and polar bears. Many species are completely dependent on sea ice for all of their basic life functions and live year round in the Arctic. The polar bear, the largest bear in the world, is one of those iconic species. Many other species depend on the Arctic during some stages of their life histories, and migrate thousands of kilometres to feed, breed and give birth there in the brief summer season. This gives rise to some of the most spectacular wildlife migrations in the world, several of which are connected with already existing marine World Heritage sites. Many of these migrations are timed to the spring surge of phytoplankton productivity that accompanies the annual ebb of sea ice in the Arctic.

The Arctic Ocean plays a crucial role in regulating and balancing the planet's climate, especially due to its influence on deep ocean currents and global circulation of the oceans (ACIA, 2005). The water in the Arctic Ocean gradually decreases in temperature and increases in salinity, making it heavier and slowly sinking to the bottom of the ocean. The sinking water is replaced by water that is pulled in from the Atlantic and Pacific Ocean, creating a global thermohaline circulation process. Temperature differences between the Arctic and southern latitudes are also fundamental in propelling weather systems in the Northern hemisphere.

A number of key features of the Arctic marine environment, however, are unique and could potentially be considered as having OUV.

Sea ice: Arctic sea ice is a globally significant marine feature. Sea ice dominates the region's marine ecology, providing habitat for thousands of species that live on, under or in the ice itself. It supports highly specialized biota found nowhere else on the planet. More broadly, Arctic sea ice plays a key role in regulating the global climate and exerts a strong influence on the Earth's ocean currents and weather patterns.

Many different forms and features of sea ice are expressed in the Arctic Ocean, several of which serve distinct ecological functions. For example, polynyas, or areas of open water surrounded by sea ice, are often areas of enhanced or early-season productivity, making them important biological hot spots. Multi-year ice (ice that has survived at least two summer melt seasons) supports unique species that do not occur in younger ice.

Saline stratification: Unlike most of the world's oceans, where stratification is driven by vertical differences in temperature, stratification in the Arctic is driven at least as much by vertical salinity differences. Relatively warm and saline Atlantic water enters the Arctic Ocean through the Fram Strait, circulating cyclonically and following the bathymetry of the Arctic Ocean (Carmack et al., 2006). Pacific waters, which enter the Arctic Ocean through the narrow Bering Strait, are less saline than Atlantic waters and, as a result, form a distinct layer on top of the Atlantic layer (Michel et al., 2013). Massive quantities of freshwater are added to the system by rivers draining the land surrounding the Arctic Ocean, and, along with melted sea ice, contribute significantly to stratification (Michel et al., 2013). This salinity-driven stratification has important implications for ice dynamics, productivity and nutrient availability (Carmack et al. 2015).

Major currents: There are several large-scale circulation systems within the Arctic Ocean. At a large scale, the Arctic Ocean is integrally connected to the global ocean system via the Northern Hemisphere Thermohaline Circulation (NHTC) (Bluhm et al., 2015). The Arctic Circumpolar Boundary Current (ACBC), an eddy-rich interior circulation system, is topographically guided by boundary currents along the

Parallel cloud bands converge at the horizon over a landscape of ice floes, melt pools, and a polynya to the right. August 19, 2009.

margins of the ocean basins (Aksenov et al., 2011), carrying Atlantic water cyclonically around the boundaries of the basins (Bluhm et al., 2015). In the southern Canada Basin, wind-driven circulation forces the cyclonic Trans-Polar Drift from Siberia to the Fram Strait and the anti-cyclonic Beaufort Gyre. Additionally, there is a very slow exchange of deep waters across the Arctic (Bluhm et al., 2015).

Temperature and seasonality: The episodic nature of sea ice ebb and flow and related primary production in the Arctic influences the annual cycling of nutrients. Levels of surface nutrients typically decline following the spring and summer phytoplankton bloom (Aguilera et al., 2002), and remain low until autumn unless there is resupply via upwelling (Williams et al., 2008). This seasonality determines potential growth and biomass accumulation at lower trophic levels (Tremblay et al., 2011).

Biodiversity and species: Species richness is generally lower in the Arctic than at lower latitudes, likely due to the extreme seasonality, short growing season, widespread persistent ice cover, and overall harsh climate characteristic of the Arctic region (Payer et al., 2013). Examples of biological diversity hotspots include contact zones between sea and land (the coastal zone), sea and freshwater (river mouths and estuaries), or sea and ice (polynyas or the marginal ice zone), as well as convergence points between different water masses (oceanographic fronts). The wide range of environmental conditions, including gradients in salinity, temperature, and nutrient concentrations, along with the presence of sea ice, are fundamental to Arctic biological diversity (Payer et al., 2013).

Thirty-five species of marine mammals, including unique and iconic species like polar bears, walrus, narwhal and pinnipeds, inhabit or seasonally use the Arctic marine environment. Seven of these are endemic to the Arctic and highly associated with sea ice. Feeding, resting, and reproduction are often closely linked to sea ice dynamics. With some exceptions these species range widely and undergo large seasonal migrations involving hundreds of thousands of animals.

At least one hundred and forty different bird species breed in the Arctic, mainly waterfowl, shorebirds and seabirds. Due to their migratory nature, most Arctic birds connect the Arctic to all other parts of the globe (Ganter et al., 2013) including various iconic marine sites already inscribed on UNESCO's World Heritage List. Some regions in the Arctic support staggering aggregations of birds; for example, an estimated 12 million seabirds migrate annually to nest and forage in the Bering Strait region.

Nearly 250 marine fish species have been documented in Arctic Ocean waters, sensu stricto (Mecklenburg et al., 2011). Two species of cod are endemic to the Arctic Ocean and are the only cryopelagic fishes in the northern hemisphere, utilizing sea ice for both habitat and spawning substrate.

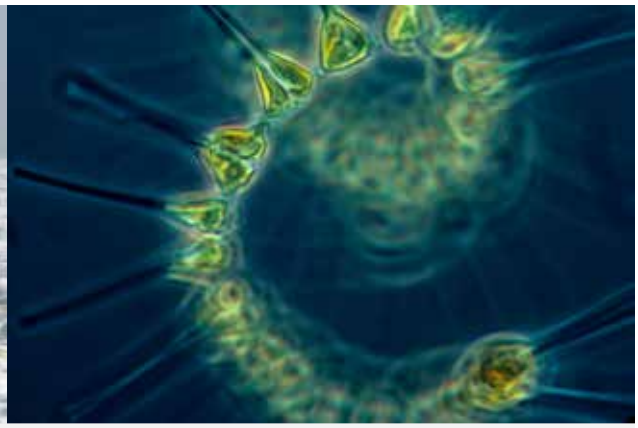
Marine phytoplankton are responsible for more than 45 percent of the annual net primary production of the Earth (Simon et al., 2014), and in the Arctic, marine phytoplankton and sympagic algae are at the base of the marine food web (Daniëls et al., 2013).

Nationally or internationally recognized threatened and endangered species found in the region include Bowhead, Blue, Fin, Humpback and Beluga whales, Spectacled and Steller's eiders, Ringed seals, Polar bears, Atlantic and Pacific walrus, Narwhal, Emperor goose, Kittlitz's murrelet, Ivory gull, Spoon-billed sandpiper, White-billed diver, and Long-tailed duck.

Several thousand species of marine invertebrates have been documented in the Arctic and many more are likely to be discovered as research advances (Gradinger et al., 2010a). The Arctic Register of Marine Species (ARMS)[4] currently identifies 11,739 taxa across all biological kingdoms. Despite the inhospitable climate and challenging logistics which often limit scientific research, new species are continuously being discovered. Earlier this year even a new species of beaked whale was discovered in the Arctic (Morin et al., 2016).

4 http://www.marinespecies.org/arms/index.php . Accessed 01/12/2016.

Pacific walrus bull, *Odobenus rosmarus*.
© Joel Garlich Miller, U.S. Fish and Wildlife Service



Phytoplankton - the foundation of the oceanic food chain.
© NOAA MESA Project

White Beluga Whale
© Cedric Weber/Shutterstock.com

Ivory Gull *(Pagophila eburnea)*, adult plumage.
© jomilo75

A pink fish encountered during the NOAA/OER Arctic Exploration 2002.
© Image courtesy of Arctic Exploration 2002, NOAA/OER

This copepod *(Family Aetideidae)*, laden with eggs, was captured in a net tow by the Pelagic Ecological Group.
© Image courtesy of Arctic Exploration 2002,
Russ Hopcroft, University of Alaska Fairbanks, NOAA/OER

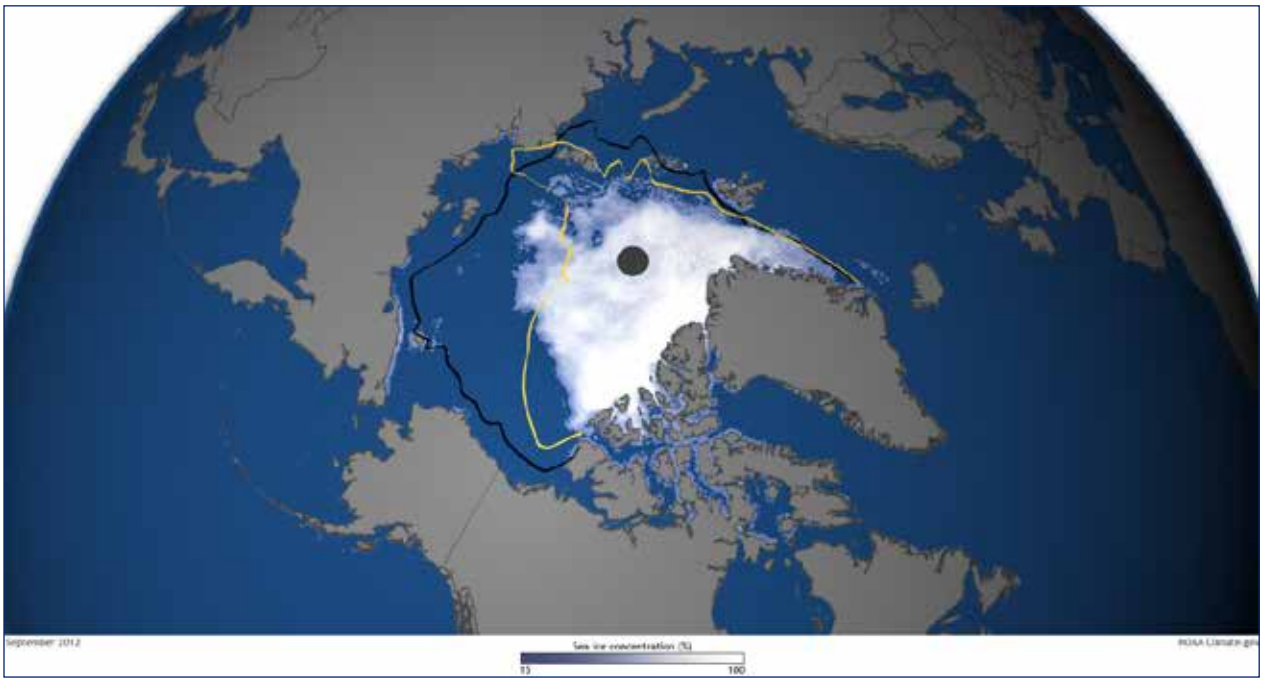
3. Threats to the Arctic marine environment

It is no secret that climate change is by far the most serious threat to the marine environment in the Arctic region. The shifts in timing and extent of summer sea ice retreat resulting from global warming (fig. 1) are disrupting patterns of migration, breeding, feeding and other life functions for many animals, unravelling ecological relationships that have developed over millennia. For many ice dependent species, the future looks bleak.

Disappearing sea ice also means that previously inaccessible areas are rapidly opening up to development, particularly oil and gas extraction, shipping and fishing. Accidents, oil spills, pollution, invasive species, underwater noise, bottom trawling and a host of other impacts related to industrial development pose major threats to a region already coping with profound change due to global warming.

"It is no secret that climate change is by far the most serious threat to the marine environment in the Arctic region."

Figure 1: Record minimum Arctic sea ice extent in September 2012. The black line represents the 1979-2000 median mid-September sea ice extent. The yellow line represents the 2007 mid-September sea ice extent.



Source: Dan Pisut - NOAA Environmental Visualization Lab.

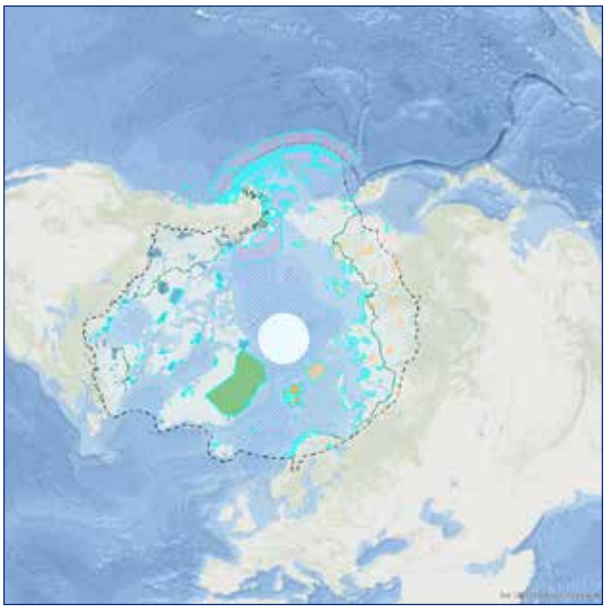
Figure 2: Towns and industrial activities in the Arctic.

Sources: Riccardo Pravettoni, UNEP/GRID-Arendal.

4. Current levels of protection for the Arctic marine environment

Only a tiny fraction of the Arctic marine environment has been protected to date, compared to roughly 8 percent of the Arctic terrestrial environment. Figure 3 presents a preliminary overview from the European marine Observation and Data Network[5] on all marine protected areas in the Arctic.

Figure 3. Preliminary overview of Marine Protected Areas (MPAs) in the Arctic (provisionary results, June 2016).



Source: EMODnet Arctic. http://www.emodnet-arctic.eu/mpa

MPAs are a critically important tool to help maintain biodiversity and resilience of Arctic marine ecosystems as they face the twin threats of climate change and new industrial development. A short window of opportunity exists to get out in front of accelerating industrial development and create an ecologically connected network of MPAs in the Arctic Ocean. Because many species of whales, fish, birds, seals, and other Arctic marine wildlife are highly migratory and do not stay within the waters of one country, it is not enough to pursue MPAs independently on a country-by-country basis. Coordinated international action is needed and the Arctic is a central component of this. Given that several migratory species that make up the OUV of marine World Heritage sites all over the world use the Arctic during at least one stage of their life, enhanced protection of the Arctic is key for the protection of humanity's common heritage.

The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States, Arctic indigenous communities and other Arctic inhabitants on common Arctic issues, in particular on issues of sustainable development and environmental protection in the Arctic[6]. The work of the Council is primarily carried out in six Working Groups that focus on issues such as monitoring of the Arctic environment, prevention of accidental release of pollutants, conservation of wildlife and flora, and improving the conditions of Arctic communities as a whole. The Protection of the Arctic Marine Environment Working Group (PAME) is the focal point of the Arctic Council's activities related to the protection and sustainable use of the Arctic marine environment[7]. A number of reports and analyses prepared by various Arctic Council working groups and expert committees have recommended the establishment of MPAs as a key tool to maintain the health and resilience of Arctic marine ecosystems. The concept of a pan- network of MPAs has been embraced by all eight Arctic Council States, and an expert group has been established to advance collaboration and cooperation in creating Arctic marine protected area networks.

"The conservation of several World Heritage marine sites is intimately connected with the Arctic Ocean."

5 http://www.emodnet-arctic.eu/mpa

6 http://www.arctic-council.org/index.php/en/about-us
7 http://www.pame.is/index.php/shortcode/about-us

5. World Heritage in the Arctic

5.1. Existing World Heritage sites in the Arctic region

As of 1 August 2016, the Arctic remains generally underrepresented on the World Heritage List with only four World Heritage sites including two natural, one mixed and one cultural property[8]: the Rock Art of Alta (Norway), Laponian Area (Sweden), the Natural System of Wrangel Island Reserve (Russian Federation) and Ilulissat Icefjord (Denmark) (See Box 2).

Only one of these sites – The Natural System of Wrangel Island Reserve – has a significant marine component. Since its designation in 2004, no new World Heritage sites have been inscribed in the Arctic region. In that time frame accelerating loss of sea ice and accompanying economic development have posed increasing risks to unique and globally significant Arctic marine features. It is critically important to enhance conservation and protection of these areas, while Arctic States, in consultation with local communities, consider potential nominations for consideration by the World Heritage Committee.

5.2. Connections between the Arctic and existing World Heritage marine sites

The Arctic Ocean has a profound impact on the wellbeing of marine ecosystems all over the world. Many birds that breed in the Arctic during summer season migrate south during winter to feed and rest. They go as far south as the Wadden Sea (Denmark, Germany, Netherlands) and the Banc d'Arguin National Park (Mauritania), two of the most critical points for migratory birds on the East Atlantic Flyway (fig. 4). The ecosystems of these two World Heritage marine sites are thus intimately connected with the Arctic Ocean.

The Whale Sanctuary of El Vizcaino (Mexico) is recognized as the World's most important place for the reproduction of the once endangered Eastern subpopulation of the North Pacific Grey Whale. Most of the subpopulation migrates between the lagoons and the summer feeding grounds in the Chukchi, Beaufort and Northwestern Bering Seas in the Arctic (fig. 5). There are even some indications that some whales migrate all the way from Mexico to the feeding grounds near the Natural System of Wrangel Island Reserve (Russian Federation) World Heritage site.[9]

Figure 4: Interconnectivity between the Arctic and the Wadden Sea and Banc d'Arguin National Park World Heritage marine sites.

Source: Wadden Sea Flyway Initiative

8 http://whc.unesco.org/en/list/1149http://whc.unesco.org/en/list/1023 http://whc.unesco.org/en/list/774http://whc.unesco.org/en/list/352

9 WHC-04/28.COM/14B.REV. Suzhou, 25 June 2004. http://whc.unesco.org/archive/2004/whc04-28com-14Breve.pdf

Figure 5: Interconnectivity between the Arctic and the Whale Sanctuary of El Vizcaino.

Source: Courtesy U.S. National Oceanic and Atmospheric Administration (NOAA).

"The Arctic Ocean has a profound impact on the wellbeing of marine ecosystems all over the world."

5.3. Potential new sites of Outstanding Universal Value in the Arctic marine environment

Recognizing that marine ecosystems almost always transcend national boundaries, the new project that is currently being undertaken to identify possible new World Heritage marine sites in the Arctic is using an ecosystem approach rather than a mere traditional country-by-country approach. An ecosystem approach for the identification of potential World Heritage sites focuses on identifying and describing ecologically significant features without regard to jurisdictional boundaries. It is more suitable to the dynamics of the marine environment and at scales more meaningful from an ecosystem perspective. This approach will likely result in the identification of potential candidate World Heritage sites that cross national boundaries. The scientific approach allows us to capture important areas of potential OUV that lie beyond the jurisdiction of any one State. But the protection, management and integrity of possible new World Heritage properties are also crucial to consider when preparing possible nominations. Finally, an ecosystem approach to World Heritage site designation is fully consistent with, and will help advance, the emerging focus on ecosystem-based management in the Arctic Council and in the individual Arctic coastal States.

Adult gray whale and calf, El Vizcaino.
© José Eugenio Gómez Rodríguez - Wikipedia

Box 2.
Existing World Heritage sites in the Arctic region[10]

The Rock Art of Alta (Norway): In 1985 the World Heritage Committee inscribed The Rock Art of Alta on the World Heritage List due to its exceptional illustrations of the life, the environment and the activities of hunter-gatherer societies in the Arctic in prehistoric times. Thousands of paintings and engravings of high artistic quality reflect a long tradition of hunter-gatherer societies and their interaction with landscape, as well as the evolution of their symbols and rituals from approximately 5000 B.C. to about the year 0.

Rock Art of Alta (Norway).
© UNESCO/Vesna Vujicic-Lugassy

Laponian Area (Sweden): Inscribed in 1996 and covering 940,000 ha in the county of Norrbotten, Sweden, the Laponian Area was inscribed by the World Heritage Committee for the area's outstanding examples of ongoing geological, biological and ecological processes. These include a great variety of natural phenomena of exceptional beauty and significant biological diversity including a population of brown bear and alpine flora. The site has been occupied continuously by the Saami people since prehistoric times and is one of the last and unquestionably largest and best preserved examples of an area of transhumance, involving summer grazing by large reindeer herds, a practice that was widespread at one time and which dates back to an early stage in human economic and social development.

Laponian Area (Sweden).
© Vincent Ko Hon Chiu

The Natural System of Wrangel Island Reserve (Russian Federation): At its 28th Session in 2004, the World Heritage Committee inscribed the Natural System of Wrangel Island Reserve on the World Heritage List. The Reserve includes the mountainous Wrangel Island (7,608 km^2), Herald Island (11 km^2) and surrounding waters. Wrangel was not glaciated during the Quaternary Ice Age, resulting in exceptionally high levels of biodiversity for this region. The island boasts the world's largest population of Pacific walrus and the highest density of ancestral polar bear dens. It is a major feeding ground for grey whales migrating from Mexico and the northernmost nesting ground for 100 migratory bird species, many endangered.

Natural System of Wrangel Island Reserve (Russian Federation).
© Alexander Gruzdev

Ilulissat Icefjord (Denmark), also inscribed in 2004, is one of the few glaciers through which the Greenland ice cap reaches the sea. It contains Sermeq Kujalleq, one of the fastest and most active glaciers in the world at the time of inscription. Studied for over 250 years, it has helped to develop our understanding of climate change and icecap glaciology. The combination of a huge ice-sheet and the dramatic sounds of a fast-moving glacial ice-stream calving into a fjord covered by icebergs presents an awe-inspiring natural phenomenon.

Ship in Ilulissat Icefjord, UNESCO World Heritage Greenland.
© Romantravel/Shutterstock.com*

10 Adapted from descriptions of Outstanding Universal Value. http://whc.unesco.org/en/list/

5.4. Marine World Heritage: its importance for the future of Arctic conservation

The scientific efforts currently being undertaken to identify possible new World Heritage marine sites in the Arctic will advance management and conservation of outstanding marine areas in the Arctic region in the following way:

Encouraging Arctic States to prepare new World Heritage site nominations: By providing a first scientific analysis of marine features in the Arctic Ocean that might be of OUV, this project paves the way for States Parties to identify possible new World Heritage sites and develop nomination dossiers. As the world's most visible and nearly universally ratified convention, the 1972 World Heritage Convention would bring attention to exceptional Arctic marine ecosystems and the need for their conservation. It would make protection of outstanding features of the Arctic Ocean an international priority.

Advancing the work of the Arctic Council to advance the development of an ecologically connected pan-Arctic network of Marine Protected Areas (MPAs): The Arctic Council and its working groups have recognized the importance of protected areas in enhancing resilience of the Arctic marine environment and the people who depend on it. In 2012 the Arctic Council established an expert group on the development of an ecologically connected, pan-Arctic network of MPAs, which is working to strengthen and integrate the efforts of individual Arctic States in this regard. Scientific data about possible MPAs that might be of OUV helps to inform this effort and set priorities for the future.

Meeting the Convention on Biological Diversity's Aichi Targets: Aichi Biodiversity Target 11 of the Strategic Plan for Biodiversity 2011-2020 calls for effectively and equitably managed conservation areas covering at least 17 percent of the world's terrestrial areas and 10 percent of marine areas—especially areas of particular importance for biodiversity and ecosystem services—by 2020. All of the Arctic nations have embraced the Aichi targets. New marine World Heritage sites will assist Arctic States in their consideration of options to achieve the 10 percent marine target.

Promoting coordination and cooperation between Arctic States in conserving shared marine ecosystems of global significance: Arctic marine ecosystems do not respect political boundaries and their sustainable conservation depend on international cooperation that takes this into account. In recognition of this, a number of initiatives to advance transboundary protection and management of shared marine ecosystems are underway. Most recently, President Obama (United States of America) and Prime Minister Trudeau (Canada) announced a joint initiative to achieve and surpass protection of 10 percent of the Arctic marine environment by 2020[11]. Designation of possible new World Heritage marine sites would help inform and bolster these efforts.

Informing the development of management measures, such as creation of shipping lanes, siting of oil and gas facilities, and managing fisheries: Efforts currently undertaken to identify new possible marine World Heritage sites will set out areas that potentially meet the natural OUV criteria, hereby highlighting the need for conservation and precautionary management of these areas as a first basis. The identification of such areas can further inform an ecosystem-based management of human industrial activities that could harm the globally unique values represented in the areas.

Providing the basis for more sustainable economic activities: Perhaps most importantly, the identification of areas that possibly meet the criteria for OUV can help provide the basis for more sustainable economic activities in the future, as for example sustainable tourism and in some cases recreation. The sense of local pride in residing near an area identified as globally significant and unique can create a strong incentive for stewardship and protection, even if the sites never formally make it onto the World Heritage List. In this way, the scientific efforts now being undertaken will have a far larger impact on Arctic marine conservation, well beyond just the possible inscription on the World Heritage List.

11 https://www.whitehouse.gov/the-press-office/2016/03/10/us-canada-joint-statement-climate-energy-and-arctic-leadership

8. Conclusion

The Arctic region includes a number of marine ecosystems that are of potential Outstanding Universal Value and could merit inscription on UNESCO's World Heritage List. But as sea ice retreats and these ecosystems become increasingly accessible to fishing, shipping and new economic development, the need for an increased understanding and protection of these priceless assets of potential OUV grows. A short window of opportunity exists to get out in front of accelerating economic development and inscribe marine ecosystems of potential OUV in the Arctic on the World Heritage List before these possible unique treasures are lost to humanity.

Any potential new marine World Heritage sites require protection improved management, as well as international recognition that these areas are not only vulnerable but globally exceptional, and of crucial importance in maintaining the function and resilience of the Arctic marine environment as well as marine places around the world to where Arctic species migrate. As the world's most visible and nearly universally ratified legal instrument for nature conservation, the 1972 UNESCO World Heritage Convention has the potential to tremendously increase the protection of the Arctic Ocean. Designation of new marine World Heritage sites in the Arctic would also bring international attention to exceptional Arctic marine ecosystems and the need for their conservation. Finally, awarding new sites in the Arctic Ocean the "Nobel Prize for Nature", as World Heritage is sometimes referred to[12], would finally address a long-identified and critical gap on the World Heritage List.

The final project report on which this article is largely built will present maps with a detailed description of potential sites of OUV in the Arctic marine environment. It is expected to be available online in 2017.

12 See also Thorsell, J. 1997. Nature's hall of fame: IUCN and the World Heritage Convention in Parks, Vol. 7, No. 2, IUCN, Gland.

Beautiful iceberg in Arctic.
© kongsak sumano/Shutterstock.com

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Part 9
World Heritage in the High Seas: An idea whose time has come

9

A dumbo octopus displays a body posture never before observed in cirrate octopods.

Dan Laffoley,
Vice-Chair Marine,
World Commission on Protected Areas (WCPA),
IUCN

David Freestone,
Executive Secretary,
Sargasso Sea Commission

1. Introduction[1]

Isaac Newton once wrote 'I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me'. Thus the great metaphorical ocean lay undiscovered before Isaac Newton back then, and regrettably, in an analogous way some 200 years later, the vast ocean still lies in a similar undiscovered state when it comes to World Heritage. To address this issue, in August 2016 UNESCO's World Heritage Centre and the International Union for Conservation of Nature (IUCN) launched a report[2] that explores how the 1972 World Heritage Convention could one day apply to the wonders of the open ocean. This article highlights some of the key findings of a two year research project on World Heritage in the High Seas.

2. Outstanding Universal Value in the High Seas: why does it matter?

Seventy percent of our planet is covered with ocean and nearly two-thirds of it lies beyond the jurisdiction of nations. This open ocean covers half our planet. It would seem amazing to many that the 1972 World Heritage Convention has yet to be applied to the other half of our world that we know as the open ocean – the so-called High Seas. This is the vast ocean which sets Earth aside from anywhere else in the universe as we know it: a marine area that falls outside the jurisdiction of any single nation. As the largest remaining area of global commons it seems strange that we have yet to consider how the Convention applies to such a large and critical part of our world. In many respects, it reflects the last major gap in the application of the 1972 World Heritage Convention.

The time has come to close this gap, so that recognition and celebration can be given to areas of Outstanding Universal Value (OUV) in this other half of planet Earth. Just as remarkable places on land, such as the Grand Canyon National Park and Serengeti National Park, have been acknowledged, so the deepest and remote ocean which harbours amazing places deserves recognition too. Imagine a world with sunken fossilized islands covered in a great diversity of corals and other marine life, giant volcanoes forming vast seamounts that can all but dwarf the tallest mountains on land, a floating golden rainforest on the ocean surface with its own unique creatures, or even a deep dark place with 60-metre-high white spires of rock just like you could imagine in a lost city beneath the waves. Some of these places are even powered not by the light of the sun like everything else on earth, but by chemistry, giving birth to some of the most unusual species – most of it still unknown to science. They are so extreme that space agencies are studying them to inform future missions to search for life on distant planets. All these exist and more in the High Seas and the deep seabed – which together are known as Marine Areas beyond National Jurisdiction (ABNJ).

In 1972 when the Convention concerning the Protection of the World Cultural and Natural Heritage was concluded, international environmental law was at a very early stage. The 1972 World Heritage Convention was then, and still is, highly innovative. Its unique and uncompromising vision is set out in the Preamble which states that "*parts of the cultural or natural heritage are of outstanding interest and therefore need to preserved as part of the world heritage*

1 This article is largely based on the report: Freestone, D., Laffoley, D., Douvere., F and Badman, T. 2016. World Heritage in the High Seas: An Idea Whose Time Has Come. World Heritage reports 44. http://whc.unesco.org/en/highseas/

2 http://whc.unesco.org/en/highseas

of mankind as a whole.[3]" It highlights the fact that existing international instruments "*demonstrate the importance, for all the peoples of the world, of safeguarding this unique and irreplaceable property, to whatever people it may belong*."

Nothing in this inspirational vision suggests that natural or cultural heritage of OUV that is located in areas outside national jurisdiction should be excluded from this protection. Indeed, under the 1982 United Nations Convention on the Law of the Sea (UNCLOS) the High Seas are waters that are open to all and that may not be subjected to the sovereignty of any state – they are the global commons. It is difficult to imagine that the Convention's founders' farsighted vision of protection captured in the preamble would have intentionally excluded half the surface of the earth.

Nevertheless, the practicalities of proposing, assessing and inscribing sites has put the primary obligation on the states within whose territories they are situated. The time has come to remedy this historical oversight. Research reveals that there are several sites of potential OUV in ABNJ and as knowledge becomes more available there will likely be many more. The original vision of the 1972 World Heritage Convention appears to encompass these sites, but they have been neglected in the development of the procedural means by which nomination, inscription and protection under the World Heritage Convention takes place.

Signature of the World Heritage Convention by René Maheu, UNESCO Director-General, 23/11/1972.
© UNESCO / DG

3 UNESCO (1972) Convention Concerning the Protection of the World Cultural and Natural Heritage adopted by the General Conference at its 17th session, Paris, 16 November 1972: http://whc.unesco.org/en/conventiontext/

A sea slug at the entrance of a sea cave at North Rona, St Kilda.
© SNH/George Stoyle

3. World Heritage in the High Seas: From inception of the idea to a shortlist of possible sites

Consideration of the possibility of applying the 1972 World Heritage Convention to the open ocean actually goes back many years. In 1994, the World Heritage Committee launched a Global Strategy for a representative, balanced and credible World Heritage List.[4] By "balanced" it refers to "representativity" among bio-geographical regions or events in the history of life and its "credibility" would depend not only on the number of sites inscribed, but on the representativeness of sites from the different regions of the world and stages of the Earth's history, and in addition the quality of management of designated World Heritage sites, including the ability to address threats and dangers to bring them back to their normal conditions, if needed. The Global Strategy aims to avoid an overrepresentation of a small selection of regions or categories and to ensure that the World Heritage List reflects the broad diversity of the world's cultural and natural areas of OUV. Efforts to encourage nomination of properties from categories and regions currently not represented or underrepresented on the World Heritage List are crucial to implementing the Global Strategy.

To support implementation of the Global Strategy and in recognition of the need to address ocean issues more comprehensively, in 2005, at the 29th session of the Committee held in South Africa, the World Heritage Committee established the UNESCO World Heritage Marine Programme. The objective of the World Heritage Marine Programme was to ensure that all marine sites with OUV are protected effectively and that they cover all major marine regions and marine ecosystems in a balanced, credible and representative manner. Successful global representation of exceptional marine features on the World Heritage List requires a thorough understanding of what is covered already and where other areas of OUV are that should be added. Essentially, all major marine regions and marine ecosystem types should be represented.

It was clear however by 2008 at the Marine Protected Areas Summit convened by the IUCN World Commission on Protected Areas in Washington DC (Laffoley, 2008), that such recognition of ocean issues needed a boost to scale up efforts concurrent with the marine challenges at hand. As a result, in 2010 IUCN collaborated with the World Heritage Centre and other partners in developing the Bahrain Action Plan for Marine World Heritage. The plan was specifically developed to ensure that marine areas did not become the "*poor relation*" to World Heritage action on land and to help ensure balance and proportional action under the Convention. Part of that Action Plan highlighted what it called the "*reality of application of the World Heritage Convention*" which is that it currently can be applied to just half the world's surface. The remaining 50 percent is covered by the High Seas, areas of ocean beyond the responsibility of any individual country, which remain unprotected. These marine areas have features of potential OUV that are found nowhere else on the planet.

The Bahrain Action Plan acknowledged that in the coming years mechanisms will be found to protect the wildlife, habitats and value of ABNJ and it recommended that:

"To 'future-proof' the 1972 World Heritage Convention it is therefore critical that actions now commence to consider what might be protected in the open ocean and deep sea beyond national jurisdiction so that when mechanisms are identified, there is information available of how the Convention can play a similar role to the one it has played for areas currently under its jurisdiction."[5]

4 http://whc.unesco.org/en/globalstrategy/

5 Laffoley, D. and Langley, J. 2010. Bahrain Action Plan for Marine World Heritage. Identifying Priorities and enhancing the role of the World Heritage Convention in the IUCN-WCPA Marine Global Plan of Action for MPAs in our Oceans and Seas. Switzerland, IUCN. http://whc.unesco.org/document/105357

This proposed approach was vindicated in 2013 by a major "gap analysis" by IUCN – whose special expert advisory role in relation to natural heritage is recognized in the text of the 1972 World Heritage Convention itself. That study concluded that:[6]

"The World Heritage Convention is currently not applied to Areas beyond National Jurisdiction (ABNJ), which constitute about 60–66 percent of the ocean's surface, i.e. most of this three-dimensional biome, and which contain a number of unique and exceptional natural heritage values that know no national boundaries. The high seas undoubtedly include areas that would be regarded as meeting the natural World Heritage criteria. This has resulted in a significant gap that States Parties may wish to fill and has the potential to be addressed by developing a specific process for the selection, nomination, evaluation, and management of such marine World Heritage sites, consistent with international law as reflected in the United Nations Convention on the Law of the Sea (UNCLOS). Ongoing discussions at the United Nations on a possible new instrument under UNCLOS for conservation and sustainable use of marine biodiversity in ABNJ could provide a possible vehicle to address this gap."

The High Seas were further highlighted as an important gap in the UNESCO World Heritage List in the study *Marine World Heritage: Toward a representative, balanced and credible World Heritage List* (Spalding, 2012). The study used methods such as the marine ecoregions of the world and pelagic provinces of the world classification as designed by UNESCO's Intergovernmental Oceanographic Commission (IOC) in view of applying a systematic approach toward identifying gaps in the ocean.

This gap analysis was further supported by the 2011 External Audit on the implementation of the Global Strategy which noted that despite the success of the Marine Programme in achieving the inscription of more than 40 marine sites by 2011, insufficient progress was made concerning the representation of natural heritage. In particular:

"There are zones, such as the High Seas (part of the Arctic) and the Antarctic, to which the World Heritage Convention does not apply, zones that escape the sovereignty of States Parties. As the action plan for marine World Heritage adopted in 2009 in Bahrain underlines, 50 percent of marine areas are located in the High Seas. If the Antarctic Treaty (1959) offers a collaborative workable mechanism focused on ocean conservation for that region, it is appropriate that States establish without delay workable provisions adapted for the High Seas, of which the natural heritage long preserved due to its isolation and the difficulty in exploiting its resources, is now threatened. The Bahrain expert workshop recommended establishing a list of sites of the High Seas that fulfilled the OUV criteria in order to give impetus to progress through the framework of the Convention on the Law of the Sea or the Convention on Migratory Species to better argue an eventual extension of the World Heritage Convention."[7]

The prediction in the 2009 Bahrain Action Plan that "*in the coming years mechanisms will be found to protect the wildlife, habitats and value of the High Seas*" has proven remarkably far sighted. In 2004, the United Nations General Assembly (UNGA) had agreed to the recommendation of the United Nations Informal Consultative Process on the Oceans and the Law of the Sea (UNICPOLOS) to establish an Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction (BBNJ).

On 19 June 2015, the UNGA, following a recommendation of the BBNJ working Group from January 2015, adopted a resolution providing for an intergovernmental conference to negotiate an "international legally binding instrument" (ILBI), under the 1982 United Nations Convention on the Law of the Sea (UNCLOS), on the Conservation and Sustainable Use of Marine Biological Diversity in Areas Beyond National Jurisdiction. The first two meetings of a Preparatory Commission established to identify elements for such an ILBI took place in March and August 2016. The process foreseen in 2009 has now begun.

It is therefore a highly appropriate point for the Parties to the World Heritage Convention to consider how its important work can form part of this global process at the UNGA.

> "It is appropriate that States Parties [to the World Heritage Convention] establish without delay workable provisions for the High Seas."
>
> 2011 External Audit on the implementation of the Global Strategy

6 Marine Natural Heritage and the World Heritage List interpretation of World Heritage criteria in marine systems, analysis of biogeographic representation of sites, and a roadmap for addressing gaps, IUCN 2013. https://cmsdata.iucn.org/downloads/marine_natural_heritage_and_the_world_heritage_list.pdf

7 WHC-11/35.COM/INF.9A. Paris, 27 May 2011, p. 24. http://whc.unesco.org/archive/2011/whc11-35com-9Ae1.pdf

4. Potential Outstanding Universal Value in the High Seas

4.1. Outstanding Universal Value: the concept that underpins World Heritage

Central to the Word Heritage Convention is the concept of Outstanding Universal Value (OUV). OUV defines why a place is considered so significant as to justify recognition and inscription on the UNESCO World Heritage List. OUV is what underpins the whole of the World Heritage Convention. Nomination of a site for consideration of its listing as World Heritage is decided by a determination of its OUV. The ultimate decision over whether or not a site is of OUV lies with the World Heritage Committee that meets annually.

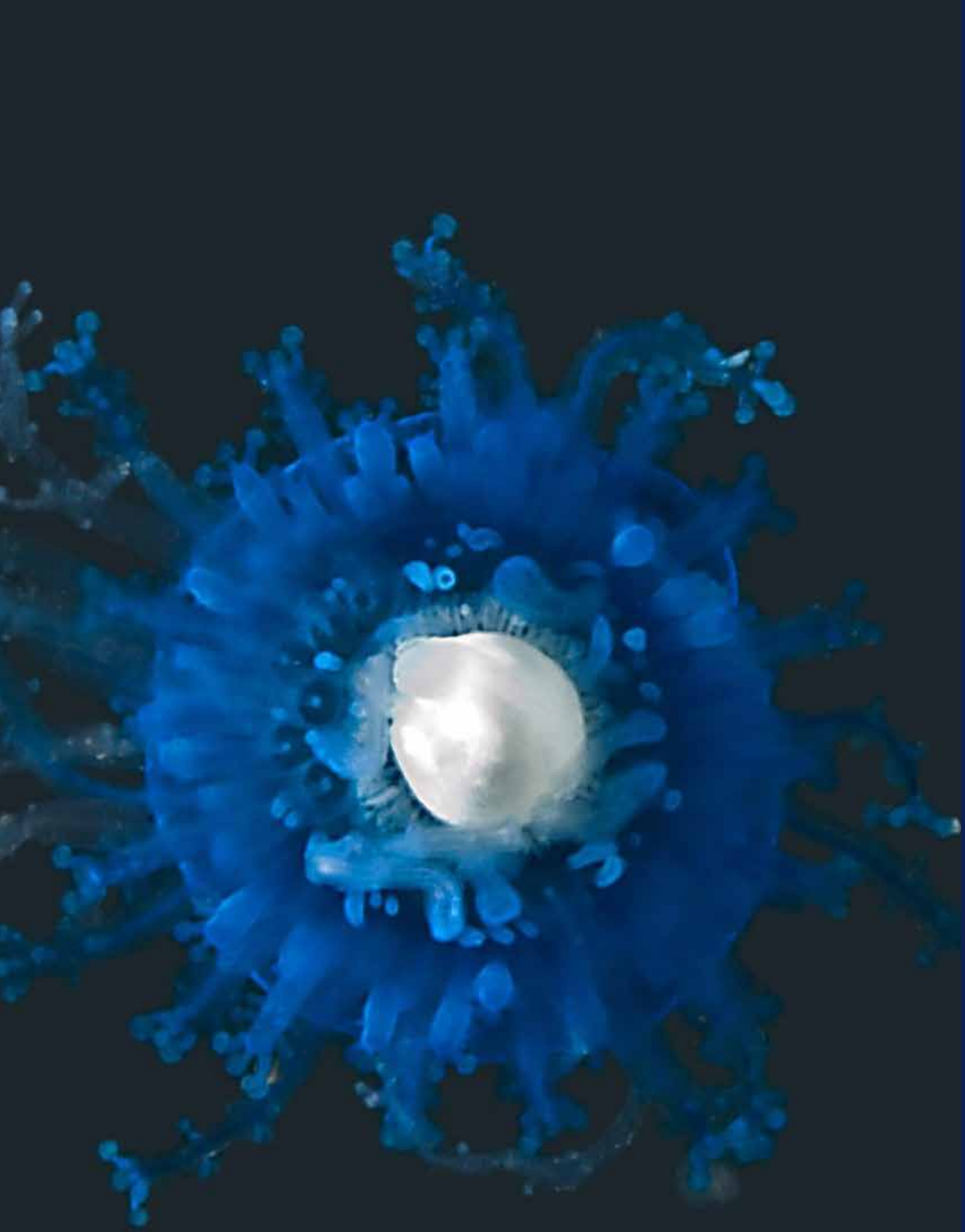
Firstly, this implies that the features of the proposed site are outstanding globally, and to do this effectively requires a global comparative analysis, assessing the features of the site against other sites on a global basis. Secondly, a screening of existing properties on the World Heritage List must be undertaken, to ensure that the site in question is not already addressed by a better example being included on the List, and includes features that are lacking from the existing portfolio of World Heritage sites. Both of these processes require significant investment in conducting the appropriate level of data collection – in situ and from the literature – both on the site in question, and its comparison with other sites around the world.

Nominating a site for inscription on the UNESCO World Heritage List requires a rigorous process of identifying the features of potential OUV at a site, and making a case for inscription. The concept of OUV itself is based on three foundations: 1) A property is required to meet one or more of the World Heritage selection criteria; 2) A property is required to meet the conditions of integrity (and authenticity if relevant); 3) Property needs to meet the requirements for protection and management. All three aspects must be in place for a property to be recognized as of OUV and as such become eligible for inscription on the UNESCO World Heritage List. Of the ten World Heritage selection criteria, only four relate to natural World Heritage. As set out in the introduction, only natural phenomena in the High Seas have been considered for the purpose of the report. There are four natural World Heritage criteria. Sites must:

- Criterion (vii): Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- Criterion (viii): Be outstanding examples representing major stages of Earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features;
- Criterion (ix): Be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
- Criterion (x): Contain the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of OUV from the point of view of science or conservation.

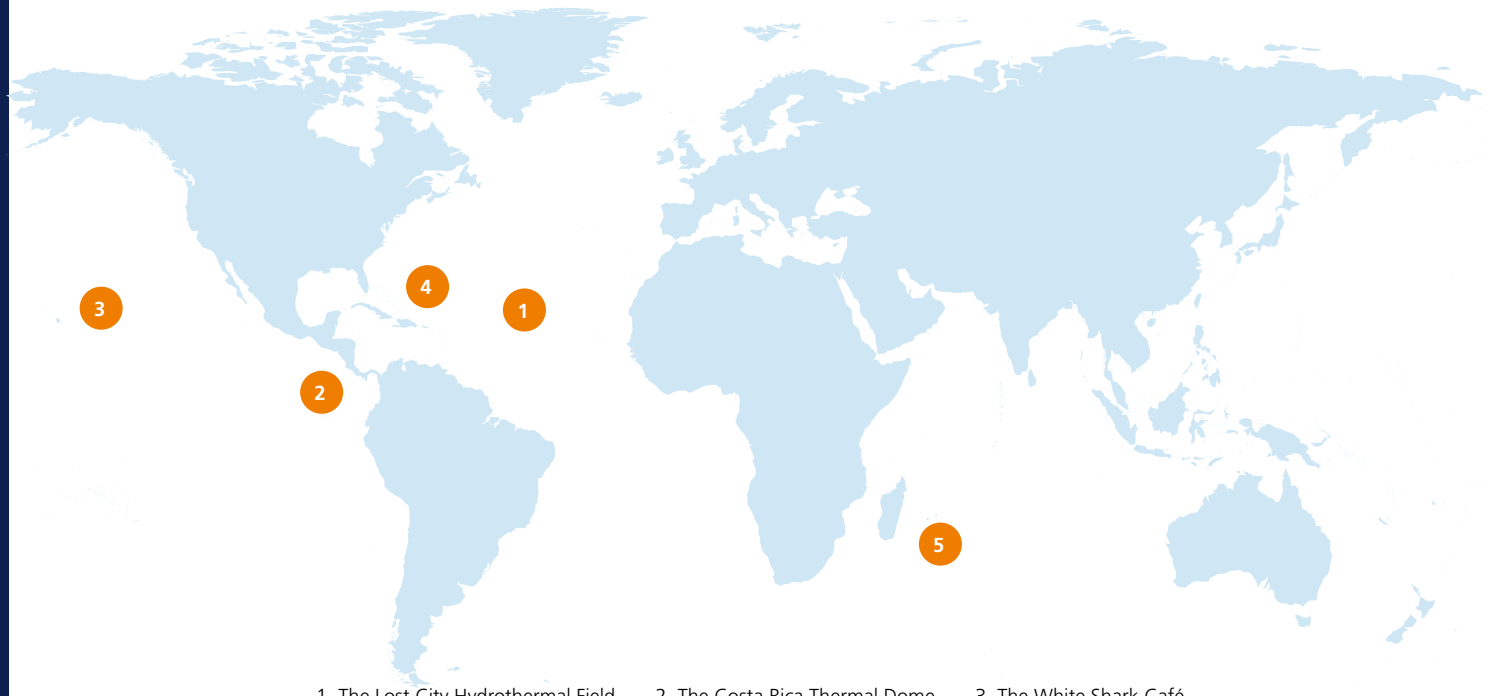
4.2. Illustrations of potential Outstanding Universal Value in the High Seas

While a systematic approach has been taken toward identifying this selection of potential sites, it is by no means a comprehensive tentative list of potential OUV in the High Seas. Many other unique features in the High Seas would likely also merit World Heritage recognition while overall still very little of the deep ocean is actually known to science. The sites identified by the UNESCO and IUCN report (Freestone et al., 2016), and described below, are thus but a sample of the truly iconic treasures our deep oceans harbour and are meant to inspire their possible future protection as part of our global heritage legacy of humankind.



A juvenile of the neustonic chondrophore *Porpita porpita*.

Illustrations of potential Outstanding Universal Value in the High Seas.



1. The Lost City Hydrothermal Field 2. The Costa Rica Thermal Dome 3. The White Shark Café
4. The Sargasso Sea 5. The Atlantis Bank

The report presents five illustrations of potential OUV in the High Seas, the Costa Rica Thermal Dome (Pacific Ocean), the White Shark Café (Pacific Ocean), the Sargasso Sea (Atlantic Ocean), the Lost City Hydrothermal Field (Atlantic Ocean), and the Atlantis Bank (Indian Ocean). All five illustrations contain traits that reflect the fundamental underpinnings of Outstanding Universal Value.

The Costa Rica Thermal Dome is a unique oceanic oasis, a wind-driven upwelling system, which forms a highly productive area and a critical habitat, which provides singular spawning sites, migration pathways and feeding grounds to multiple endangered and commercially important species. Source: NOAA - http://oceanexplorer.noaa.gov/explorations/04mountains/logs/summary/media/small_paragorgia.html

Balaenoptera musculus (blue whale).

The White Shark Café is a pristine open ocean region approximately halfway between the North American mainland and Hawaii that is the site for the only known offshore aggregation of north Pacific white sharks. The Café provides a unique offshore habitat where these irreplaceable marine predators congregate in cobalt blue pristine waters.

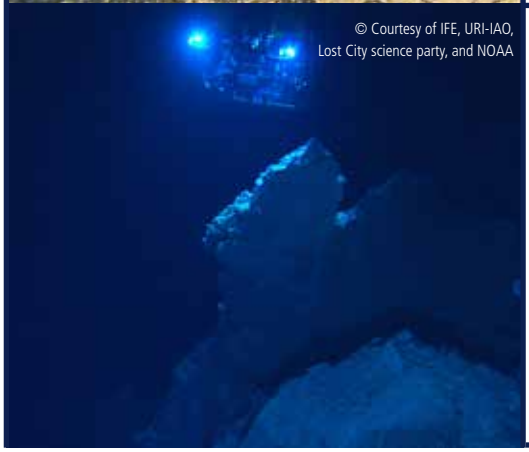
Great white shark at Isla Guadalupe, Mexico, August 2006. Shot with Nikon D70s in Ikelite housing, in natural light. Animal estimated at 11-12 feet (3.3 to 3.6 m) in length, age unknown.

The 'Golden Floating Rainforest of the Ocean', the Sargasso Sea, is home to an iconic pelagic ecosystem built around the floating Sargassum seaweeds, the world's only holopelagic algae. It was first viewed by Columbus on his first voyage in 1492 and has been a place of myth and legend ever since. Its global importance derives from a combination of physical and oceanographic structures, its complex pelagic ecosystems, and its role in global ocean and earth system processes.

Humpback whale.

The Atlantis Bank, located within sub-tropical waters of the Indian Ocean, was the first tectonic sunken fossil island ever studied. The complex geomorphology of old headlands, precipitous cliffs, stacks, beaches and lagoons harbours a very diverse deep-sea fauna at depths from 700 to 4,000 metre characterized by large anemones, large armchair-sized sponges, and octocorals. Large Paragorgia colonies are particularly notable. Source: NOAA- http://oceanexplorer.noaa.gov/explorations/04mountains/logs/summary/media/small_paragorgia.html

A Paragorgia forest site as seen from the ROV Hercules during the Mountains in the Sea 2004 expedition.



The Lost City Hydrothermal Field is a remarkable geobiological feature (biotope) in the deep sea (700-800 metre water depth) that is unlike any other ecosystem yet known on Earth. The site, dominated by the Poseidon carbonate monolith (a 60-metre high carbonate edifice), was discovered serendipitously in 2000 during an Alvin dive on the Mid-Atlantic Ridge, and it is still being explored. Source: Courtesy of IFE, URI-IAO, Lost City science party, and NOAA- http://oceanexplorer.noaa.gov/explorations/05lostcity/logs/summary/media/slideshow/slideshow.html

Space shot to our own planet: ROV Hercules approaches a ghostly, white, carbonate spire in the Lost City Hydrothermal Field, about 2500 feet below the surface of the Atlantic Ocean.

5. Protecting World Heritage in the High Seas through the World Heritage Convention: Legal and policy considerations

Allowing the World Heritage Convention to cover protection of unique marine areas beyond national jurisdiction does not require any change in the definitions of natural and cultural heritage. They would remain the same. The central question however is: how could the necessary procedural changes be made that would allow inscription and protection of World Heritage sites in areas beyond national jurisdiction? A series of possible scenarios with some of the key arguments for and against were considered as part of the recent study.

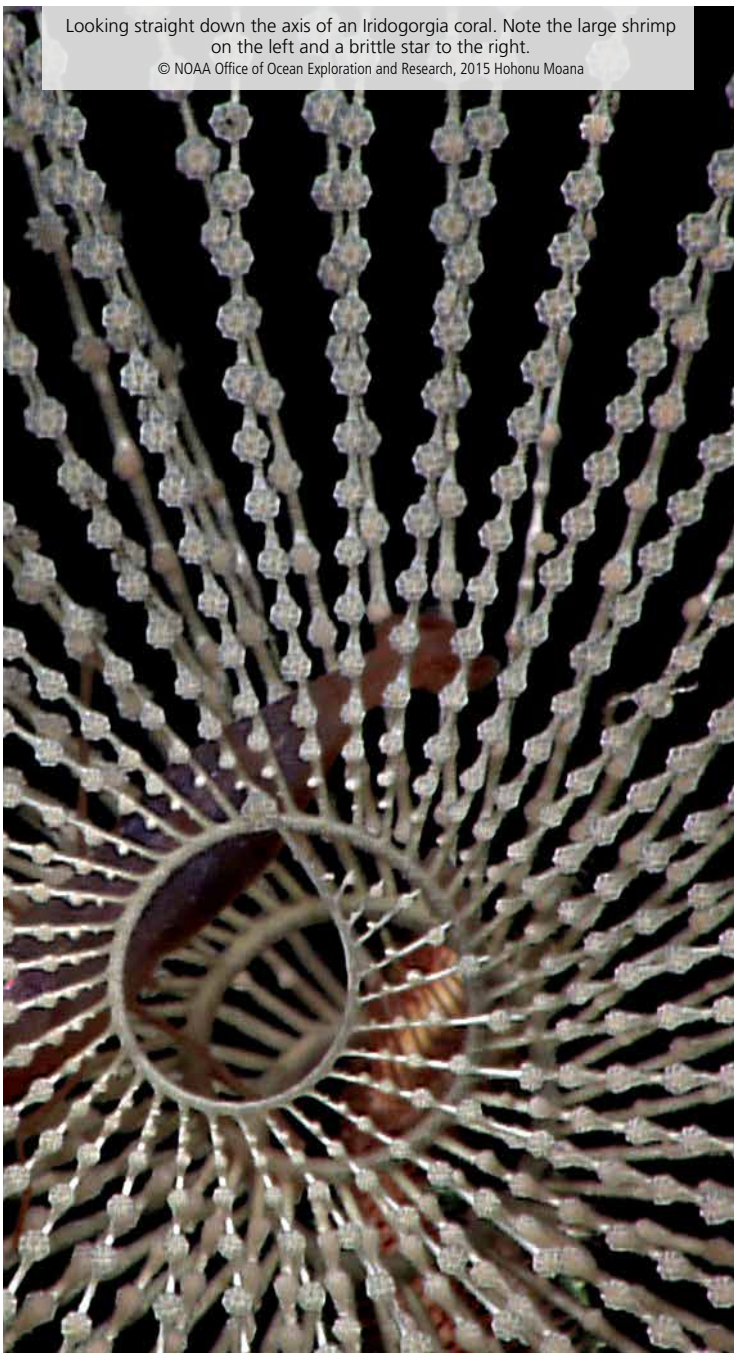
In summary, there are three potentially feasible scenarios for the application of the 1972 World Heritage Convention to include World Heritage sites in ABNJ:

1) Bold interpretation of the Convention, either through incremental change or a formal policy change;

2) Amendment outside the terms of the 1972 Agreement akin to the 1994 Part XI Implementing Agreement to UNCLOS; and

3) An optional protocol to the 1972 Convention developed through an international negotiation among States Parties, binding only on those States that choose to ratify any resulting protocol.

Under any scenario, a system for the protection of World Heritage sites in areas beyond national jurisdiction will need to be elaborated, both in conjunction with the relevant competent international organizations and their States Parties, and in coordination with potential procedures for marine protected areas developed for the conservation and sustainable use of marine biodiversity in ABNJ pursuant to any new international instrument under UNCLOS. The criteria for defining the OUV of potential World Heritage sites go beyond biodiversity to include, for example, 'geological and physiographical formations' and sites of historic, archaeological or cultural value. So the discussions within the United Nations in New York of a new agreement under UNCLOS would not supersede the need for discussions within the framework of the World Heritage Convention.



Looking straight down the axis of an Iridogorgia coral. Note the large shrimp on the left and a brittle star to the right.

6. How does World Heritage advance the global agenda for High Seas protection?

This new move to get application of the Convention and recognition of OUV in areas beyond national jurisdiction fits well with concurrent work now underway through the United Nations General Assembly (UNGA) which looks with renewed interest at the importance of the conservation and sustainable use of resources of areas beyond national jurisdiction, recognizing the importance of the open oceans and the seabed for a range of issues - including the exploitation of marine genetic resources. The 1972 World Heritage Convention protects the sites of OUV that are the *"best of the best"* and has the potential to play a key role in this agenda, protecting sites which are the equivalent of charismatic places on land – the Taj Mahal and the Iguazu National Park, for example, although by definition far from land and often deep beneath the ocean.

Inscription of a site on the World Heritage List is but a first step. Central to the Convention are its mechanisms to monitor the state of conservation of the OUV of sites and assisting countries to secure their long term protection. Therefore, apart from the issues related to nomination and inscription of World Heritage sites in marine ABNJ, an important issue relates to the protection of their OUV once they are recognized.

Current existing management measures in ABNJ are largely sectoral and can be fragmented, but these areas are not totally ungoverned (Freestone, 2016). There is a relatively large range of specialist organizations whose specific tasks include coordinating Member States' management of human activities in ABNJ over which they have jurisdiction. Although the organizations do not have specific mandates to protect natural or cultural heritage, under particular agreements states do have some obligations regarding the conservation and management of resources in ABNJ. For example, the International Seabed Authority (ISA) is the organization "*through which States Parties shall . . . organize and control activities in the Area, particularly with a view to administering resources . . .*"[8] in accordance with Part XI.

UNCLOS also provides that activities "*be carried out for the benefit of mankind as a whole, irrespective of the geographical location of states...*";[9] the International Maritime Organization (IMO) which coordinates Member States' regulation of international vessel traffic, safety and vessel source pollution in the marine environment including the ABNJ; the Food and Agriculture Organization of the United Nations (FAO) and the wide range of Regional Fisheries Management Organizations (RFMOs) are the organizations in which Member States coordinate the conservation and management of fisheries' resources in ABNJ. The effectiveness of these organizations largely depends on flag state and port state enforcement. Regulatory measures are developed by the organizations but compliance with these measures is the responsibility of the Member States themselves, either individually or jointly.

It is quite feasible for the Member States of the 1972 World Heritage Convention to agree among themselves a regime for the protection of sites with OUV in marine ABNJ. The chosen regime would focus on the protection of those flagship marine areas that are recognized for their OUV and as such are inscribed on the UNESCO World Heritage List. They could also agree to collaborate with existing international sectoral organizations with relevant competences. For example, the ISA in relation to a seabed site in the Area[10] or an RFMO in relation to a High Seas site recognized for its fish species aggregations of OUV. In this regard, the mechanisms developed by the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage are of particular interest and provide a useful precedent.[11]

8 Article 157 UNCLOS

9 Article 140(1) UNCLOS.

10 Article 1(1) UNCLOS reads: '"Area" means the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction.'

11 UNESCO (2001) Convention on the Protection of the Underwater Cultural Heritage adopted by the General Conference at its 31st session, Paris, 2 November 2001. 48 *Law of the Sea Bulletin* 29 (in force 2 January 2009). Text at http://unesdoc.unesco.org/images/0012/001246/124687e.pdf#page=56

7. Conclusion and looking ahead

Under any option, a system for the protection of World Heritage sites in areas beyond national jurisdiction will need to be elaborated, both in conjunction with the relevant competent international organizations and their States Parties, and in coordination with potential procedures for marine protected areas developed for the conservation and sustainable use of marine biodiversity in ABNJ pursuant to any new international instrument under UNCLOS. As the criteria for defining the OUV of potential World Heritage sites go beyond simply biodiversity to include, for example, 'geological and physiographical formations' and sites of historic, archaeological or cultural value, the UNCLOS discussions would not supersede the need for discussions within the World Heritage Convention membership itself.

The process has already started at the UN in New York to develop an international legally binding instrument under UNCLOS for the conservation and sustainable use of biodiversity in areas beyond national jurisdiction. If the Parties to the 1972 World Heritage Convention were to agree to develop a process to protect World Heritage sites in the High Seas, this could be an important parallel and complementary process. It is indeed an idea whose time has come...

Acknowledgments

This article is largely based on the UNESCO-IUCN report "World Heritage in the High Seas: An Idea Whose Time Has Come" (Freestone, D., Laffoley, D., Douvere., F and Badman, T. 2016. World Heritage in the High Seas: An Idea Whose Time Has Come. World Heritage reports 44. http://whc.unesco.org/en/highseas/) and an Expert Working Meeting that was held in Paris from 29 to 30 October 2015.

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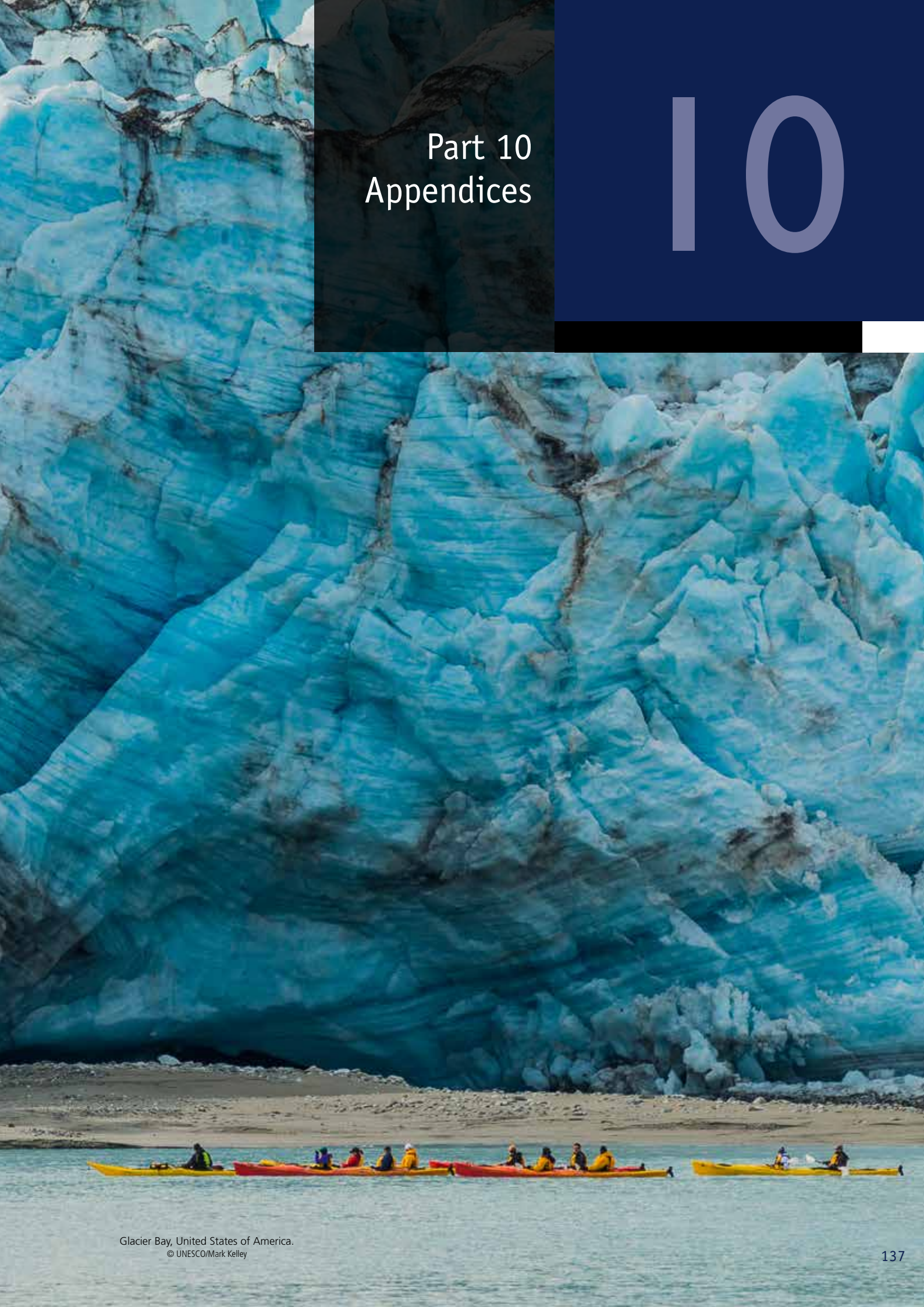
Part 10
Appendices

10

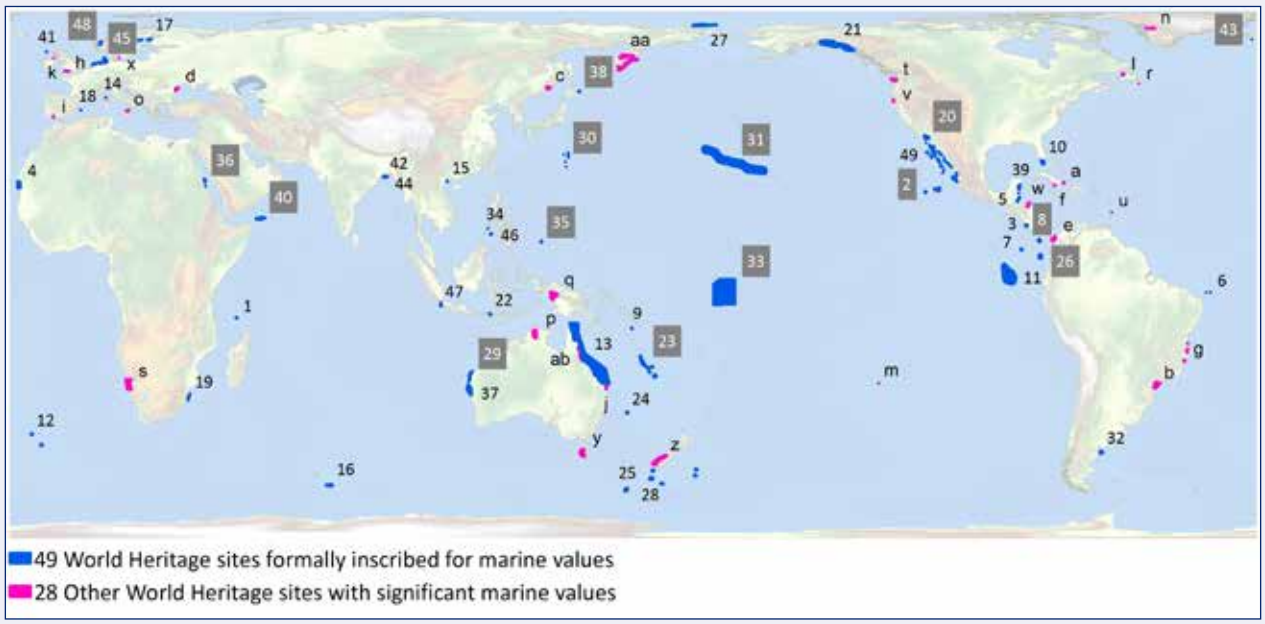


Glacier Bay, United States of America.
© UNESCO/Mark Kelley

Appendix 1. Marine World Heritage sites (as of 1 August 2016)

Label in fig. 1	Site Name	Country	Year	Area (km^2)	Criteria
1	Aldabra Atoll	Seychelles	1982	350	(vii)(ix)(x)
2	Archipiélago de Revillagigedo	Mexico	2016	6,367	(vii)(ix)(x)
3	Area de Conservación Guanacaste	Costa Rica	1999	1,470	(ix)(x)
4	Banc d'Arguin National Park	Mauritania	1989	12,000	(ix)(x)
5	Belize Barrier Reef Reserve System	Belize	1996	963	(vii)(ix)(x)
6	Brazilian Atlantic Islands: Fernando de Noronha and Atol das Rocas Reserves	Brazil	2001	433	(vii)(ix)(x)
7	Cocos Island National Park	Costa Rica	1997	1,998	(ix)(x)
8	Coiba National Park and its Special Zone of Marine Protection	Panama	2005	4,308	(ix)(x)
9	East Rennell	Solomon Islands	1998	370	(ix)
10	Everglades National Park	USA	1979	5,929	(viii)(ix)(x)
11	Galápagos Islands	Ecuador	1978	140,665	(vii)(viii)(ix)(x)
12	Gough and Inaccessible Islands	UK	1995	3,979	(vii)(x)
13	Great Barrier Reef	Australia	1981	348,700	(vii)(viii)(ix)(x)
14	Gulf of Porto: Calanche of Piana, Gulf of Girolata, Scandola Reserve	France	1983	118	(vii)(viii)(x)
15	Ha Long Bay	Viet Nam	1994	1,500	(vii)(viii)
16	Heard and McDonald Islands	Australia	1997	6,734	(viii)(ix)
17	High Coast / Kvarken Archipelago	Finland, Sweden	2000	3,369	(viii)
18	Ibiza, Biodiversity and Culture	Spain	1999	112	(ii)(iii)(iv)(ix)(x)
19	iSimangaliso Wetland Park	South Africa	1999	2,396	(vii)(ix)(x)
20	Islands and Protected Areas of the Gulf of California	Mexico	2005	18,990	(vii)(ix)(x)
21	Kluane / Wrangell-St Elias / Glacier Bay / Tatshenshini-Alsek	Canada, USA	1979	98,391	(vii)(viii)(ix)(x)
22	Komodo National Park	Indonesia	1991	2,193	(vii)(x)
23	Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems	France	2008	15,743	(vii)(ix)(x)
24	Lord Howe Island Group	Australia	1982	1,465	(vii)(x)
25	Macquarie Island	Australia	1997	5,400	(vii)(viii)
26	Malpelo Fauna and Flora Sanctuary	Colombia	2006	8,575	(vii)(ix)
27	Natural System of Wrangel Island Reserve	Russian Federation	2004	19,163	(ix)(x)
28	New Zealand Sub-Antarctic Islands	New Zealand	1998	13,868	(ix)(x)
29	Ningaloo Coast	Australia	2011	7,050	(vii)(x)
30	Ogasawara Islands	Japan	2011	79	(ix)
31	Papahānaumokuākea	USA	2010	362,075	(iii)(vi)(viii)(ix)(x)
32	Península Valdés	Argentina	1999	3,600	(x)
33	Phoenix Islands Protected Area	Kiribati	2010	408,250	(vii)(ix)
34	Puerto-Princesa Subterranean River National Park	Philippines	1999	58	(vii)(x)
35	Rock Islands Southern Lagoon	Palau	2012	1,002	(iii)(v)(vii)(ix)(x)
36	Sanganeb Marine National Park and Dungonab Bay – Mukkawar Island Marine National Park	Sudan	2016	1,995	(vii)(ix)(x)

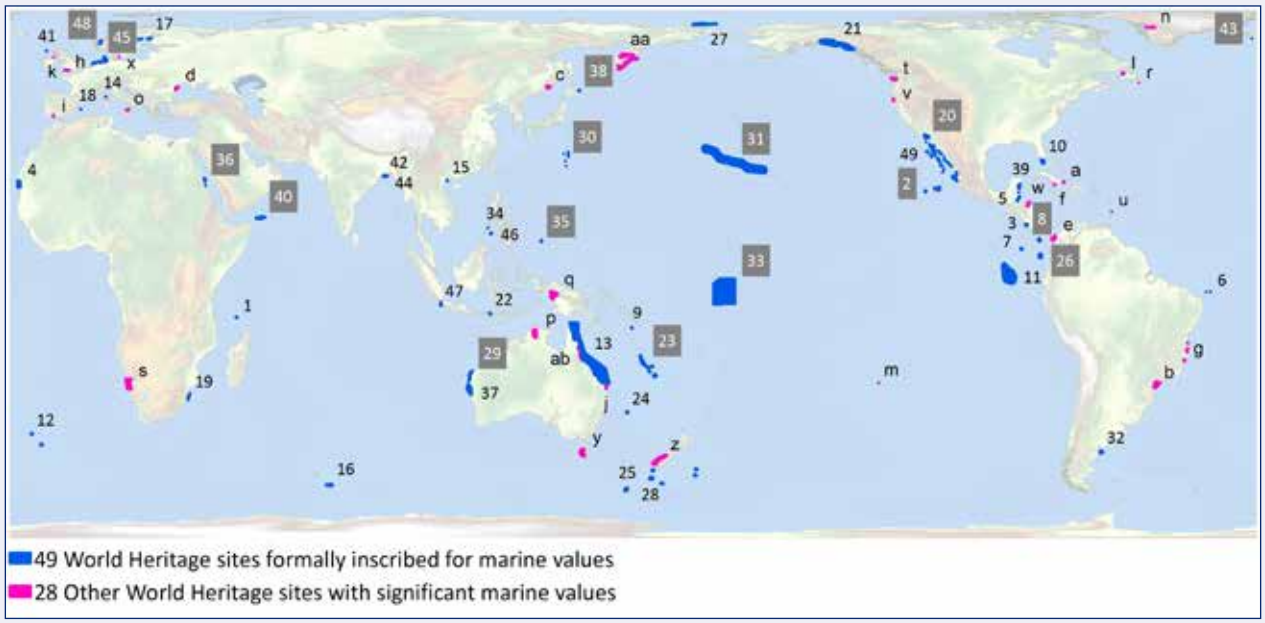
Label in fig. 1	Site Name	Country	Year	Area (km²)	Criteria
37	Shark Bay, Western Australia	Australia	1991	21,973	(vii)(viii)(ix)(x)
38	Shiretoko	Japan	2005	711	(ix)(x)
39	Sian Ka'an	Mexico	1987	5,280	(vii)(x)
40	Socotra Archipelago	Yemen	2008	4,105	(x)
41	St Kilda	UK	1986	242	(iii)(v)(vii)(ix)(x)
42	Sundarbans National Park	India	1987	1,330	(ix)(x)
43	Surtsey	Iceland	2008	34	(ix)
44	The Sundarbans	Bangladesh	1997	1,397	(ix)(x)
45	The Wadden Sea	Denmark, Germany, Netherlands	2009	11,434	(viii)(ix)(x)
46	Tubbataha Reefs Natural Park	Philippines	1993	968	(vii)(ix)(x)
47	Ujung Kulon National Park	Indonesia	1991	1,231	(vii)(x)
48	West Norwegian Fjords - Geirangerfjord and Nærøyfjord	Norway	2005	1,227	(vii)(viii)
49	Whale Sanctuary of El Vizcaino	Mexico	1993	3,710	(x)



Source: Abdulla et al., 2013

Appendix 2. Other World Heritage sites with a marine or coastal component (as of 1 August 2016)

Label in fig. 1	Site Name	Country	Year	Area (km^2)	Criteria
a	Alejandro de Humboldt National Park	Cuba	2001	693	(ix)(x)
b	Atlantic Forest Southeast Reserves	Brazil	1999	4,682	(vii)(ix)(x)
c	Central Sikhote-Alin	Russian Federation	2001	4,062	(x)
d	Danube Delta	Rumania	1991	3,124	(vii)(x)
e	Darien National Park	Panama	1981	5,970	(vii)(ix)(x)
f	Desembarco del Granma National Park	Cuba	1999	326	(vii)(viii)
g	Discovery Coast Atlantic Forest Reserves	Brazil	1999	1,119	(ix)(x)
h	Doñana National Park	Spain	1994	543	(vii)(ix)(x)
i	Dorset and East Devon Coast	UK	2001	26	(viii)
j	Fraser Island	Australia	1992	1,840	(vii)(viii)(ix)
k	Giant's Causeway and Causeway Coast	UK	1986	1	(vii)(viii)
l	Gros Morne National Park	Canada	1987	1,805	(vii)(viii)
m	Henderson Island	UK	1988	37	(vii)(x)
n	Ilulissat Icefjord	Denmark	2004	4,024	(vii)(viii)
o	Isole Eolie (Aeolian Islands)	Italy	2000	12	(viii)
p	Kakadu National Park	Australia	1981	19,810	(i)(vi)(vii)(ix)(x)
q	Lorentz National Park	Indonesia	1999	23,500	(viii)(ix)(x)
r	Mistaken Point	Canada	2016	1.5	(viii)
s	Namib Sand Sea	Namibia	2013	30,777	(vii)(viii)(ix)(x)
t	Olympic National Park	USA	1981	3,697	(vii)(ix)
u	Pitons Management Area	Saint Lucia	2004	29	(vii)(viii)
v	Redwood National and State Parks	USA	1980	569	(vii)(ix)
w	Río Plátano Biosphere Reserve	Honduras	1982	5,000	(vii)(viii)(ix)(x)
x	Stevns Klint	Denmark	2014	0.5	(viii)
y	Tasmanian Wilderness	Australia	1982	15,842	(iii)(iv)(vi)(vii)(viii)(ix)(x)
z	Te Wahipounamu - South West New Zealand	New Zealand	1990	26,000	(vii)(viii)(ix)(x)
aa	Volcanoes of Kamchatka	Russian Federation	1996	39,958	(vii)(viii)(ix)(x)
ab	Wet Tropics of Queensland	Australia	1988	8,944	(vii)(viii)(ix)(x)



Source: Abdulla et al., 2013

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