

- Selections -

White Paper on the Oceans and Ocean Policy in Japan

2022



**Ocean Policy Research Institute,
Sasakawa Peace Foundation**

This publication was produced under the patronage of The Nippon Foundation from the proceeds of motorboat racing.

2022 White Paper on the Oceans and Ocean Policy in Japan

August 2022

Ocean Policy Research Institute of the Sasakawa Peace Foundation

1-15-16, Toranomom, Minato-ku, Tokyo,

105-8524 Japan

TEL 03-5157-5210 FAX 03-5157-5230

<http://www.spf.org/en/>

©Ocean Policy Research Institute of the Sasakawa Peace Foundation and various contributors, August 2022

All rights are reserved

No part of this book may be used or reproduced in any manner without permission except in the case of brief quotations embodied in critical articles and reviews.

FOREWORD

The Ocean Policy Research Institute of The Sasakawa Peace Foundation presents its latest edition of *White Paper on the Oceans and Ocean Policy in Japan*, in an effort to support comprehensive and interdisciplinary initiatives on ocean issues at home and abroad. We herein summarize and discuss, in a cross-sectional way, various events and activities related to the oceans from the perspective of “comprehensive management and sustainable use of the oceans.” The *White Paper* was first published in 2004, with this being the 19th edition.

Another year has passed under the COVID-19 pandemic constraints, while discussions on ocean issues have resumed in international communities, though mostly around the US and Europe. The 2021 United Nations Climate Change Conference (COP26) convened in the UK in the fall of 2021, and was followed by important in-person conferences such as the One Ocean Summit (France) in February and March 2022, and the United Nations Environment Assembly meeting (UNEA5.2). The second United Nations Ocean Conference is set to be held in June 2022. At the beginning of this edition we feature an interview with Peter Thomson, the United Nations Secretary-General’s Special Envoy for the Ocean, who leads these international discussions. As is mentioned in the interview, we can’t lose any time in addressing ocean issues and initiatives, for “the next decade” will be very important. Therefore, in *White Paper 2022* we focus on countermeasures against climate change, biodiversity, and marine plastics, which are key for “the next decade”. In response to the Arctic Science Ministerial (ASM3) meeting held in Tokyo in May 2021, we also present issues concerning the Arctic.

More recently, as we take maritime security around Japan into consideration, we can’t simply regard the recent crisis in Ukraine as someone else’s problem. The conflict is casting a shadow over international discussion regarding oceans as Russia currently holds chairmanship of the Arctic Council, and the discussions there are stalled. Next year’s issue, *Ocean White Paper 2023*, will be its 20 year anniversary issue. We will look back over the developments of national and international ocean policies for the past 20 years and of course continue to discuss new issues as well.

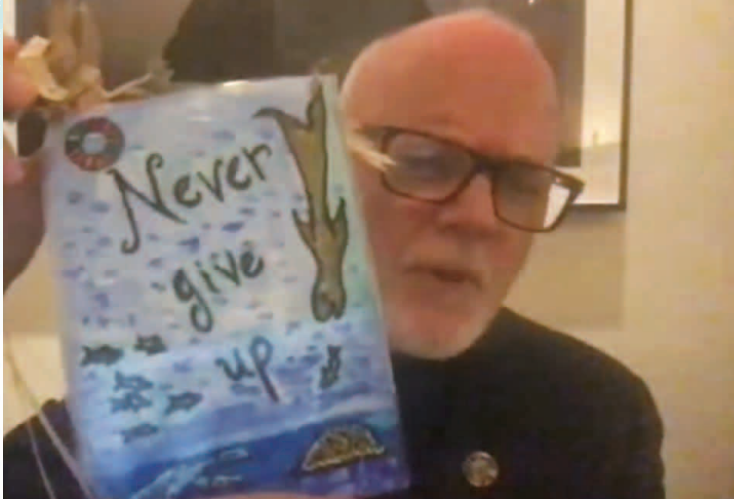
Lastly, nothing would please us more than to know that *White Paper 2022* is helping to raise awareness of the oceans as well as providing the latest information, knowledge, and ideas to those who cherish, think about, and work with the oceans.

August 2022

Atsushi Sunami
President, The Sasakawa Peace Foundation

Opening Interview

No Healthy Planet Without a Healthy Ocean



Ambassador Peter Thomson, Fijian diplomat and the United Nations Secretary-General's Special Envoy for the Ocean. He held the office of President of the General Assembly of the United Nations from September 2016 until September 2017.



Ms. Yuri Takeda, environmental journalist and Member of the Editorial Committee for the White Paper on the Oceans and Ocean Policy

Dr. Atsushi Sunami, President of the Sasakawa Peace Foundation

Yuri Takeda

Good morning, Ambassador Peter Thomson. I'm Yuri Takeda, an environmental journalist. I am also a member of the editorial committee of the White Paper on the Oceans and Ocean Policy. I produced a climate change TV program and reported on environmental refugees from around the world. Recently, I created the world's first wooden straws that are made from trees grown in Japan, which have been sliced into thin pieces.

Peter Thomson

Alright! Reusable?

Yuri Takeda

Yes. This is a completely new product we devel-

oped to address the modern problem of plastic straws. I'm very pleased to be able to interview you today with Dr. Atsushi Sunami, President of the Sasakawa Peace Foundation. I hope that you are doing well despite growing concerns over the surges of the Omicron variant.

To start off, I was informed that you traveled to Costa Rica last week. What brought you there?

Peter Thomson

Yes, so I was in Costa Rica last week. I was invited by the Costa Rican government to go there to witness two very important decrees which Costa Rican President Carlos Alvarado Quesada was signing: the first one on marine litter, which is of great interest to me because of SDG14.1, and the second was the signing of the decree for the Cocos Island marine protected area. By

signing that decree, Costa Rica's protected areas of its exclusive economic zone of the ocean came up to 30%. Thus, they've already reached the high target that countries are trying to set for 2030 by signing that decree last week. They're taking the necessary action. I could not say no to the invitation to go, and I'm very glad I went. I met a lot of fishermen there, as well as the president of the small-scale fisheries association. I think the world has a lot to learn from small-scale artisanal fisheries. So it was a very productive few days for me in Costa Rica.



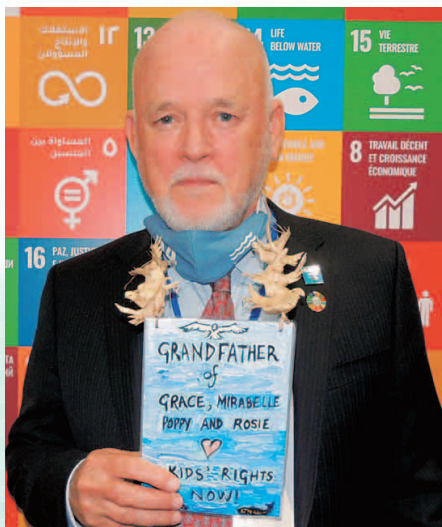
Ambassador Thomson with Costa Rican President Carlos Alvarado Quesada.

Yuri Takeda

Great, thank you. I've heard a lot about your involvement in advocating collective action to protect and sustainably use the ocean. One of the things that left an impression on me was a photo I happened to come across of you wearing a badge at COP26¹ in Glasgow. I heard your grandchild drew this badge. If you don't mind, could you share with us the story behind that badge?

Peter Thomson

Here is the badge that you're referring to. These are some pigeon birds made out of pandanas which were hanging on both sides. But the important message is here, introducing myself as the grandfather to my 4 granddaughters, and on the back side is the message of "Never Give Up." I had suggested to the United Nations Framework Convention on Climate Change (UNFCCC) that everybody who registered at the conference be given the option of some sort of badge identifying themselves as a parent, a grandparent, an uncle, and so on, to portray the fact that why we are working so hard on these climate change issues is not



Wearing a handmade supplementary badge. Its back side message is "Never give up".

¹ 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (31 October to 13 November 2021)

for ourselves. It's for those who are going to come after us - those whom we love and those we are condemning to a very uncertain future under the current track of global warming. Unfortunately, I wasn't able to sell the idea as a universal one, but a couple of my friends and I wore these badges, and as you know, they attracted a lot of attention. So, what we've decided for COP27, taking place in Egypt in November 2022, is that we're going to try and do a bit of a social media campaign to encourage people, of their own free will, to wear these badges, just to reinforce the fact that these COPs are not about us. They're about intergenerational justice. We're doing this for our kids and grandkids.

Yuri Takeda

It was a fantastic idea. Similarly, I also came upon a photo of you on a ship passing a baton. Could you share the background behind that as well?

Peter Thomson

That's the "Nature's Baton," which is a partnership between The Ocean Race^② and my office. The Ocean Race is described as the toughest team race, whereby yachts are sailed around the world in competition against each other. We arranged for an artist to build a beautiful baton out of driftwood. Inside it is a steel tube into which messages are put from the presidents of the various global conferences, the great environmental conferences that are happening in our time. The symbolism of this is to show that everything is connected. We have too often operated in silos at these conferences; but biodiversity loss, climate change, and declining ocean health are all related to the same basic problem, which is humankind's mistreatment of Nature. We are all connected and we have that one central global problem to work our way out of. So, we started the baton's journey to emphasize that connectedness. For sustainability reasons, I sailed with it in a yacht from Barcelona to Marseille for the IUCN World Conservation Congress a few months ago. From there, we took it up to Glasgow for COP26 by a bicycle relay. In 2022, it will be carried on a yacht to Brest, France for the One



Explaining over the ocean message baton to Prime Minister Frank Bainimarama of Fiji at COP26

Ocean Summit^③, and then to Nairobi for UNEA5, before going to Palau for the Our Ocean Conference^④ in April. Of course, it will arrive in Lisbon, Portugal, on 27 June in time for the UN Ocean Conference.

Yuri Takeda

It's just like an Olympic torch relay.

So for my next question about COP26, I would like to ask you about your observations on the outcomes like the documents known as the Glasgow Climate Pact. Are you satisfied with the results?

Peter Thomson

I think most of us shared the disappointment on the watering down of the language on coal towards the end of the conference. We are still in very, very dangerous territory for humanity. But if you look at the trajectories, I think there was improvement. Prior to Glasgow, we were on a trajectory for over 3 degrees, whereas

^② A yacht race that typically starts in Europe and circumnavigates the globe.

^③ International Conference in Brest, France, February 2022. The aim of the conference was to take concrete action against threats to the ocean.

^④ The annual international conference on the ocean launched by then-Secretary of State John Kerry in 2014. The Palauan government hosted the seventh conference in April 2022.



now I think we're on about 2.4. Don't hold me to that, but it's that level of improvement. The international community knows we need to go no higher than 1.5 degrees global warming, so there's still a huge amount of work to be done. We're starting to head in the right direction, but it's still a red alert for humanity that we're dealing with.

On the ocean side, this was a COP26 for us all to be proud of. I think the United Kingdom presidency holds a lasting legacy through the ocean being finally embedded within the UNFCCC process, after so many years of trying. Henceforth, the UNFCCC Secretariat is invited to include ocean issues in all of its work and to report accordingly, and the SBSTA⁶ chair is also invited to make this so. Rather than the one-off dialogue that was held at SBSTA in 2020, there is now an annual SBSTA undertaking to consider ocean-climate issues and report thereon to UNFCCC. I'm sure you agree this is as it should be on a planet on which climate is the result of interaction between the atmo-

sphere and the ocean. Now that we're inside the tent, we have much work to do.

Atsushi Sunami

Hello, Ambassador Thomson. It's good to see you. Thank you for coming and participating in this interview. We really appreciate your help towards the Sasakawa Peace Foundation. I actually wanted to come to COP26 myself and be with our ocean friends, but due to other issues I couldn't leave Japan. But I'm very happy to hear your positive assessment of the COP26 outcomes, as we have been working together for many years in actually putting the ocean on the climate agenda. I think you're also right that the U.K. and COP26 were very historic moments, now that the ocean is a big part of the climate dialogue. But are you really happy? I think we expected that to happen at COP26. However, in terms of the content of the dialogue and the com-

⁶ *Subsidiary Body for Scientific and Technological Advice. Meets twice a year under UNFCCC.*



Oceans Action Day at COP25

mitment for the COP process, is that what you really wanted? What is your assessment on the outcome of COP26, and what should we then do for the next target?

Peter Thomson

Like you, I've been to many COPs. One of the reasons that I feel reasonably good about the outcomes from Glasgow is that this was the first COP where all those people who were trying to deny that we've got a global crisis of climate change are now gone from our midst. Those that were present were committed to the fact that we've got a global problem and we need to put in place the solutions. So this was for me a very different kind of COP. Bear in mind that I don't go to the plenaries anymore; I must have made about 50 speeches at COP26 in the two weeks I was there. For me it was all about what was happening outside the plenary, which was hugely vibrant, hugely innovative, and hugely positive. Because we all acknowledge that we have a global problem, there was a very constructive mood. As I was saying earlier, for somebody who's principally concerned with intergenerational justice, it was heartening to feel we're finally on the right track.

Atsushi Sunami

That's great. Unfortunately, I've also heard some rather critical opinions on the outcomes of COP26. I think they were expecting more in terms of whether we can push the agenda of the ocean further. Of course, I think we have more work to do, but I agree with you that COP26 has been one of the most vibrant events and there is something very positive that came out of it.

Yuri Takeda

It was unfortunate that COP26 was just a day after Japan's national election, which may have limited Japan's presence. I hope that Japan will demonstrate leadership when it comes to these types of global issues. So, Dr. Sunami, may I ask about your expectations towards Prime Minister Kishida and his administration?

Atsushi Sunami

I was in Washington three weeks ago, and I had a meeting at the U.S. State Department and with people in the wider government. One thing I was very struck by was that they were saying there are many issues relating to U.S.-Japan relations and other things. And, that the Biden govern-

ment is “at war.” This is something that's very different from other types of diplomacy, but when it comes to climate change issues, the whole government is “at war.” Moreover, they have to win this “war.” That sense of urgency that I felt in Washington is not here in Japan. While I think the Japanese government sees zero emissions by 2050 as a big commitment, that sense of crisis that the people in Washington and in the government were talking about, that the government is really facing a “war” crisis, may not be felt as much here. President Macron of France is now starting an initiative called One Ocean. Everyone is taking action. However, I don't feel that happening in Japan. I think one of the reasons is because we have basically shut down and people are not going abroad. They are not engaged in international dialogue in person. It is very unfortunate that the Prime Minister, ministers, and all people are stuck in Japan because of the very strict restrictions on overseas travel. I think it's due to this that the sense of urgency was not shared much inside of Japanese policy-making. I hope in the coming months that the Prime Minister and his staff would really share this global sense of crisis. We have all these issues with U.S.-Japan and U.S.-China. We hear of Russia's issues in Ukraine. All these things are happening, but what about when it comes to climate crisis? This, I believe, is the issue.

Peter Thomson

That's a very interesting observation. It echoes what the Secretary General of the United Nations, António Guterres, said some time ago, that we have been “at war” with Nature and it's time to make

peace. We have to remember that it's all of us who have been at war with Nature. Nature is like our mother; we're in its embrace. But somehow, we imagined that humankind is bigger than Nature, and we're still doing that. Every time anybody gets into a motorcar emitting CO2, they're adding to the hurt of Mother Nature. And so, we've got so much to do to make peace, and it's all of us that have to do that.

Yuri Takeda

I agree. I think that difference between Japan and other countries could be a very big issue. The year 2022 will be a very important one for the ocean. Palau is hosting the Our Ocean Conference. Ambassador Thomson is spearheading the preparation for the second UN Ocean Conference to be held in Lisbon in June. There are many other important international meetings as well. Could you tell us about some of those key events related to the ocean on the agenda for the year 2022?

Peter Thomson

Well, I can tell you that the level of activity over the next six months is completely unprecedented. Sometimes, I wonder how we're going to fit it all in. In sum-



Ambassador Thomson was President of the 71st session of the UN General Assembly. <https://www.un.org/counterterrorism/fr/node/12455>

mary, in February, President Macron will host the One Ocean Summit at Brest in north-west France. I'm involved in the organization of that summit - in fact, I had meetings on it yesterday and have meetings again today. This will be the beginning of a great ocean action wave, which will sweep all the way through to Lisbon at the UN Ocean Conference in June. In April we will be attending the Our Ocean Conference in Palau, which is cohosted by the U.S. government and the Palauan government. I know that the Sasakawa Peace Foundation and the Nippon Foundation have been a huge help in this as well. Like President Sunami, I keep in close contact with the U.S. State Department on this conference. I have been performing a synergy role between the Brest and Palau conferences. One of my roles is to make sure that conversations that begin in Brest get carried through to Palau, and from there forth to deliver solutions at the UN Ocean Conference in June. Examples of such subjects include the curtailing of IUU fishing, and the better governance and funding of marine protected areas. I should also mention Nairobi, Kenya, and the UN Environmental Assembly (UNEA5.2) taking place at the end of February. It is at the UN Environmental Assembly that we hope to get mandated the international treaty for control of marine pollution. Well, actually, all plastic pol-

lution. We're aiming to get a negotiating committee started at UNEA5.2 to make a start on an internationally binding treaty, so Nairobi becomes very important to the ocean action community. Ending plastic pollution is critical to stopping the decline of the ocean's health, so thanks again to Japan for its action in support of ending the travesty of pollution.

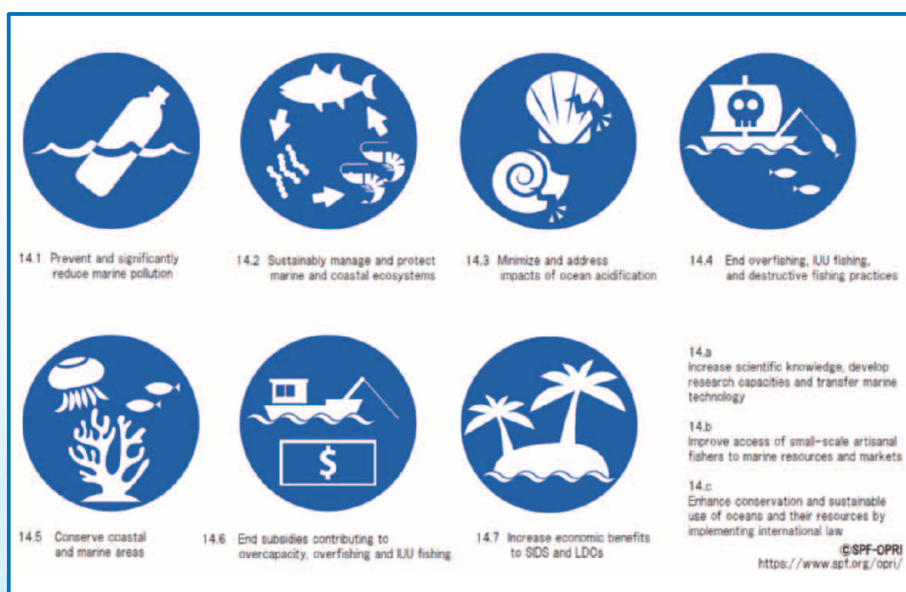
In March, we will have the Intergovernmental Conference on Biodiversity Beyond National Jurisdiction (BBNJ). I'm not sure whether that will be the last session of the BBNJ conference, but it will obviously be very important for the governance of the high seas that a robust treaty emerges from the process. Around the same time, The Economist is holding its virtual World Ocean Summit, and there's a plethora of private sector meetings, regional meetings, and national meetings on ocean subjects happening as well, but I guess we don't have time for me to go into all these now. Let me just mention that in the middle of June is the SBSTA meeting that will resume the ocean-climate nexus dialogue. Then, of course, we will have the UN Ocean Conference itself, cohosted by the governments of Portugal and Kenya in Lisbon from June 27th to July 1st.

Yuri Takeda

One of the biggest challenges of ocean policies would be how to secure a global agreement on the suggested target of '30 by 30,' protecting 30% of the global ocean by the year 2030. What are some expectations and potential issues related to this?

Peter Thomson

There were two very important meetings that I didn't mention in the summary I just gave you, one of which is the Convention on Biodiversity COP15 in Kunming, China, which was scheduled



Infographic of Sustainable Development Goal 14 (SDG 14)

for April, but is now postponed to dates to be confirmed later in 2022. This is a very important international meeting for the ocean, considering the high proportion of the planet's biodiversity dwelling in and on the ocean, but especially because of the proposed '30 by 30.' Protecting 30% of the planet by 2030 is key to stopping the decline in the ocean's health. I deeply appreciate the work of the biodiversity community in pursuit of the 30 by 30 target for inclusion in the CBD's new framework. I also thank them for the way that they have welcomed the ocean community throughout this whole process.

The other meeting that I didn't mention is the World Trade Organization (WTO) ministerial meeting, which was originally scheduled for 2021. This is also hugely important for the ocean, because after over 20 years of negotiation, we're finally getting close to the removal of harmful fishery subsidies, which have been described as the most damaging thing humanity does to marine ecosystems. Between \$20 billion to \$30 billion of public funds are spent this way per year - basically subsidizing industrial fleets to go out and chase diminishing stocks of fish in the high seas. So, this WTO ministerial meeting is a very important one as it can stop harmful fisheries subsidies for good. We're just waiting for the dates for that gathering. The ocean community will need to follow these two meetings closely.

Yuri Takeda

Thank you. Since you mentioned fishery subsidies, could you tell us about your thoughts and challenges you foresee on the subjects of over-fishing and IUU fishing?



Our Ocean Conference Venue

Peter Thomson

Yes. Well, I expect that to be a very important part of the One Ocean Summit in France and the Our Ocean Conference in Palau. As far as the UN Ocean Conference is concerned, this is central to our work because it's the main content of target SDG14.4. We have to hold our feet to the fire when we get to Lisbon. How are we doing on this? Not particularly well. We have plenty of evidence that illegal fishing is continuing and has even flourished during the COVID pandemic in some cases.

Atsushi Sunami

I have a follow-up question for Ambassador Thomson. You mentioned IUU fishing as one of the key topics to be addressed in the Our Ocean Conference, but is it going to be the same for the One Ocean Summit in France? Or, will something else be discussed there?

Peter Thomson

The One Ocean Summit at Brest is being built on ten workshops, followed by a half-day summit of the invited heads of government. One of these workshops will address the resources we take from the sea, including fish, so IUU fishing will certainly be covered. Many are keen to be part of these IUU fishing discussions, so we will be able to take the findings from Brest and expand

on them in Palau, and as I've said, by the time we get to Lisbon we must be ready to hold ourselves to account as a world community on this and other marine issues. We've set the target within SDG14, so the Food and Agriculture Organization (FAO) will be reporting to us on the latest findings, and if we're not doing well, we'll have to work out how to improve.

That particular target, SDG14.4 matured in 2020. But I think we've always realized this would be a long, hard fight and the target will always be there until we've reached it. But the great thing about the UN Ocean Conferences is they give us a universal chance to take stock of our progress.

Atsushi Sunami

Great. The Sasakawa Peace Foundation would also like to do its part in support of the UN Ocean Conferences. Thank you.

Yuri Takeda

Speaking of the SDGs, the UN Decade of Ocean Science for Sustainable Development was launched this year. What do you see as an important element for advancing ocean science?

Peter Thomson

Again, let me say thank you to Japan, because Japan has been particularly active in the preparations for and delivery of the goals of the UN Decade of Ocean Science. The UN General Assembly mandated the Ocean Science Decade because there is so much we have to learn about the scientific make-up of the ocean. It's estimated we know only about 20% of the scientific properties of the ocean. This is an incredible situation to find ourselves in; we know more about the face of Mars and the Moon than we do about the surface of the deep sea. You have

probably heard the mantra of "the science we need for the ocean we want." That's really what we're doing here.

The Intergovernmental Oceanographic Commission (IOC) of UNESCO, which is based in Paris, did a fantastic job in preparing for this Ocean Science Decade and putting together the various tools to deliver us the ocean that we want. They've held regional meetings all around the world to make sure we were doing what the scientific, academic, and political community want to derive out of the Decade activities. If current global warming trends continue, the world will have some very difficult decisions to make by the time we get to 2030. Part of our armory to facilitate those difficult decisions will be what is known by then about the ocean's properties. You don't want to make big decisions without knowing the full scientific picture of that which covers over 70% of the planet – namely the ocean.

Yuri Takeda

I agree with you. In fact, President Sunami is co-chairing the Japanese National Committee for the UN Decade of Ocean Science. Would you like to add or elaborate on some of the important aspects of advancing ocean science in this context?



Venue for the 2025 Osaka-Kansai World Expo

Atsushi Sunami

One thing we are trying to do is promote the Decade within Japan first. Unfortunately, it's still relatively unknown to not only the general public, but also the scientific community, what we are trying to achieve through this world effort of advancing social science and its significance. By creating a national committee, we are trying to promote this campaign or this global effort of advancing ocean science within Japan first. Also, we wanted to actually create a community and reach out to other communities in Asia. There's a lot of networking and a lot of collaboration that we can do in terms of bringing about ocean science efforts. For example, bringing in the Korean science community, the Chinese science community, or even the Southeast Asian science communities, to create a kind of regional platform to talk about what we can do in terms of advancing ocean science in our part of the world. And we are also looking for some of the good practices within Asia to share with the global community in the near future.

Peter Thomson

It's wonderful to hear those words, because I think the UN Decade of Ocean Science is meant to be all about partnerships. We've just heard a very good exposition there of regional partnerships. It's about sharing our observations, putting it all into a universal data bank which we can all have access to.

Yuri Takeda

Great. As you may know, Japan is hosting the World Expo in Osaka in 2025. The Sasakawa Peace Foundation had the privilege of airing a video message from Ambassador Thomson for the Ocean Expo Seminar they hosted in October

2021. Can you please share with us your predictions on the 2025 Expo?

Peter Thomson

I expect the 2025 Expo to be a great one. I think the main expectation from the ocean community would be that the sustainable blue economy will have a really good showing in Osaka. Even though the sustainable blue economy is not specifically mentioned in SDG14, if you analyze the target, it basically comes down to the blue economy being at the heart of conserving and sustainably using the ocean's resources. So, I'm very hopeful that this will be a strong theme in Osaka in 2025.

Why? Because going forward we'll be turning to the ocean for our new medicines - as we did during this pandemic. We will be eating new foods, and the foods will come from the ocean. It's just logical; 90% of the living space of the planet is in the ocean. But it won't be the food that we are currently eating. Just as our grandparents ate very different food from us, our grandchildren will eat very different food. They will be eating more sustainably and less wastefully than us, because they will have to. Instead of eating big fish, they will be eating more seaweed and algae. They'll be eating what I call "marine tofu," which hasn't really been invented yet, but I envisage farming of the sea



based on the resilience and proliferation of phytoplankton. This will provide nutritious food for generations to come and I expect to see in Osaka many innovative ideas in that regard. Then, of course, I'm sure the challenging area of the decarbonization of shipping, the whole area of offshore energy - including wave, tidal and offshore wind - will feature prominently in Osaka.

Yuri Takeda

Thank you very much. Next, I would like to ask President Sunami about ways to make the ocean mainstream as a key theme for the Osaka Expo, demonstrating social collaboration, science, and innovation for a sustainable ocean. Can you give us your perspective on how to prepare for the Osaka Expo?

Atsushi Sunami

Thank you, Ambassador Thomson, for highlighting what the Osaka Expo should be aiming at. These are precisely the ideas that the Osaka Expo would feature. Future sustainable food, nutrition, and the whole idea of bringing innovation to solve global challenges, the climate challenge, and food crisis. We have been communicating with leadership in various levels of organizations, including the Japanese government and the local government of Osaka, to alert them that the global community has to truly come together on the ocean issue. As we host this Expo in 2025, one of the main issues should be about how we coexist with the ocean and nature. The Expo will be hosted at a venue in the middle of Osaka Bay, so we'd like to present all this, for this Expo facing the ocean. So I think the message that Ambassador Thomson highlighted is well-suited for the physical location. And I think the people in Osaka agree, and so we're trying to work with them to bring the Ocean Expo.

Yuri Takeda

We are now approaching the end of the inter-

view. Before we close, do you have a message you would like to leave for the readers of the White Paper on the Oceans? And can you touch upon "The importance of the upcoming decade for the ocean," the theme of this year's White Paper?

Peter Thomson

Thank you for providing me with the English version of the White Paper on the Oceans 2021 at COP26. I read the White Paper with great interest, with all that was covered on the UN Decade of Ocean Science and the Blue Recovery, from the pandemic and fisheries reform, to maritime security. I urge you to continue with those high standards.

As we approach the Osaka Expo, I would like to see a further push for Japan's marine initiatives towards the implementation of the Osaka Blue Ocean Vision. I think there's such an important message and ocean action content that was agreed to by the G20 there in Osaka. You know, these things can drift out of the forefront of the mind unless you really keep ramming home what was agreed to. The Osaka Blue Ocean Vision is an extremely important part of the struggle to free the ocean of plastic pollution, and I'm very keen that you keep pushing its message.

With regards to the upcoming decade, you've heard my mantra: No healthy planet without a healthy ocean, and the ocean's health is measurably in decline. What do we have ahead of us in the 8 years between now and 2030? Essentially, a lot more hard work and acceptance of transformation for the common good. Everybody's in on this, from the big problem to the solutions. It's not like a few people are delegated to try and fix the problem. No, everybody is part of the problem, so everybody's got to be part of the solutions. Of course, we should always be full of hope and determination. Humanity came from the Stone Age to the Space Age on the back of our incredible powers of innovation. We can think and work our way out of the problem we've created, or as President Sunami said, out of the war which we have imposed on Nature. In finding the

peaceful solutions, rest assured we'll use the incredible powers of innovation that Homo sapiens possesses. Thank you very much for your time. It has been such a pleasure talking to you and President Sunami, and I hope we'll meet again very soon.

Atsushi Sunami

Yes, I also look forward to meeting again soon. Thank you very much for today.

Yuri Takeda

Thank you very much, Ambassador Thomson and President Sunami, for sharing your views and wisdom on ocean policy. I look forward to further developments, and also seeing you hopefully face to face next time. Thank you once again.

2022 CONTENTS



FOREWORD

Opening Interview

The Next 10 years Will Decide the Ocean's Future



2
3
3
4
5
8
8
10
12
13
14

Japan and the World's Ocean Initiative

1 Toward Achieving Ocean-based Carbon Neutrality

1 A Need for Ocean Based Climate Change Countermeasures

1 IPCC Sixth Assessment Report Working Group I Report

2 Assessments for the Oceans and Coastal Areas

3 The 26th United Nations Climate Change Conference (COP26) and the Oceans

2 Decarbonizing Shipping

1 Background of Shipping Decarbonization

2 Discussion toward the Decarbonization of Shipping

3 Current Status of Decarbonization of Shipping

4 Current Status of Technology Development

5 Challenges for the Future

2 The Fully Autonomous Ship Program MEGURI2040

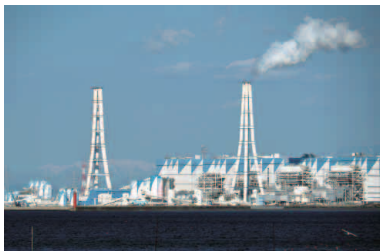
1 Fully autonomous navigation at Sarushima, Yokosuka

2 Smart Coastal Ferry

3 Verification Testing of Fully autonomous Technologies Using Coastal Container Vessels and Car Ferries

4 Designing the Future of Full Autonomous Ship

5 Development of Fully Autonomous Amphibious Driving Technology



16
17
17
18
19
19

3 Conservation of the Marine Ecosystem

1 International Efforts for Conservation of the Marine Ecosystem

1 Introduction

2 What Should We Achieve by 2030?

3 The United Nations Decade on Ecosystem Restoration

4 G7 Summit and Nature Compact

2 New National and International Developments Surrounding Marine Plastics

1 International Developments

2 National Developments



21
21
21
22
23
23
24
24
24
28

32	3	International and National Developments in and Around the Arctic Region
33	1	Developments at the Arctic Council
34	2	Japan's Recent Initiatives regarding the Arctic
37		Reference Materials
38	1	Articles from the "Ocean Newsletter"
38		The Natural World Heritage Site Amami Trail
38		A New Approach for a Fertile Seto Inland Sea
42	2	CARBIS BAY G7 SUMMIT COMMUNIQUÉ Our Shared Agenda for Global Action to Build Back Better
44	3	G7 2030 Nature Compact
46	4	IPCC Sixth Assessment Report -Working Group I Headline Statements from the Summary for Policymakers
48	5	IPCC Sixth Assessment Report -Working Group II Headline Statements from the Summary for Policymakers
51	6	IPCC Sixth Assessment Report -Working Group III Headline Statements from the Summary for Policymakers
57		Contributors

A decorative graphic consisting of three overlapping squares of different shades of blue. The top square is a bright cyan, the middle one is a medium blue, and the bottom one is a light blue. They are arranged in a descending staircase pattern from the top left towards the bottom right.

Japan and the World's Ocean Initiative

1 Toward Achieving Ocean-based Carbon Neutrality

Following Prime Minister Yoshihide Suga's declaration of Japan's goal to achieve carbon neutrality by 2050 in his policy speech to the Diet in October 2020, policies to implement ocean-based mitigation measures were introduced in 2021. For example, the *Growth Strategy Action Plan*, setting forth economic policy to be implemented, included initiatives to promote ocean industry, such as promoting new industries related to offshore wind and accelerating commercial operation of zero emission vessels utilizing alternative fuels such as hydrogen and ammonia. These policies were carried over by the current Kishida administration, and on October 2, 2021, the *Plan for Global Warming Counter Measures and Long-Term Strategy under the Paris Agreement as Growth Strategy* were approved by the cabinet, and the Global Warming Prevention Headquarters set forth Japan's Nationally Determined Contribution (NDC).

Momentum toward carbon neutral was carried forward to the 2021 United Nations Climate Change Conference (COP26) of the United Nations Framework Convention on Climate Change (UNFCCC), held for the first time in two years¹. At the World Leaders Summit held on November 1st and 2nd, Prime Minister Fumio

¹ It was held from October 31st to November 14th, 2021.

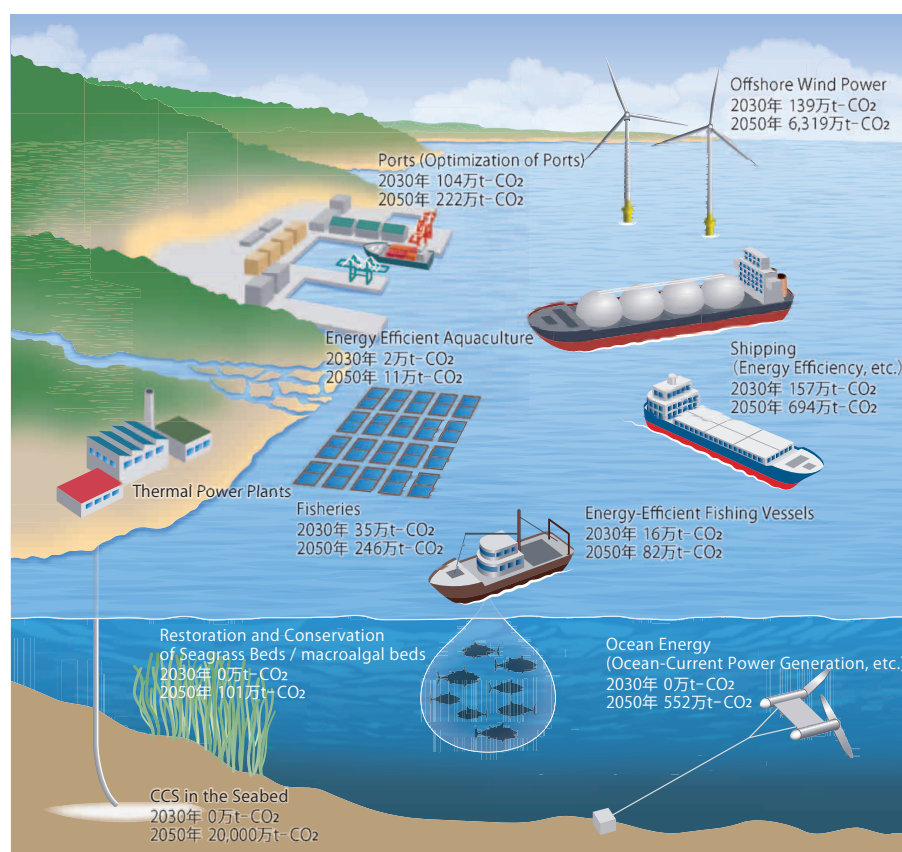


Figure 1-1-1 Ocean-based Climate Change Mitigation Measures in Japan (Official goal by 2030 and ambitious goal by 2050)

Kishida acknowledged the coming decade to 2030 as a critical decade and set forth Japan's new goal to reduce its greenhouse gas emissions by 46% in 2030 from its 2013 levels and committed to make an additional contribution of up to 10 billion USD and to double its assistance for disaster risk reduction in the next five years.

In this chapter, we highlight Japan's efforts regarding carbon neutrality, while reflecting on international developments such as the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) published in August 2021 and COP26.

(Tomohiko Tsunoda)

1 A Need for Ocean Based Climate Change Countermeasures

In this section, the report of the United Nations Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR 6) Working Group I (WG 1) and the developments at COP26 are discussed as part of the international context of Japan's effort to achieve Carbon Neutrality by 2050. The AR 6 WG 1 report is summarized, introducing assessments from observations made thus far and future prospects for the oceans. The need of ocean-based climate change countermeasures is also outlined in the context of developments at COP26.

1 IPCC Sixth Assessment Report Working Group I Report

In August 2021, the IPCC released the Sixth Assessment Report (AR 6) Working Group I (WG 1) report for the first time in seven years. The report, which was one of the AR6 reports to be published in series from 2021 to 2022, compiled the current understanding of the physical science basis of climate change².

Just as other IPCC reports, the WG 1 report was prepared thoroughly and rigorously, with 234 contributing authors from 65 countries, more than 14,000 references cited, and more than 78,000 peer review comments from experts and governments.

The report states that it is undeniable that human influence has rapidly warmed the atmosphere, ocean and land and that unless deep reductions in greenhouse gas emissions occur, global warming of 1.5°C and even 2°C will be exceeded by the end of the 21st century. Limiting cumulative CO₂ emissions, i.e. achieving net zero CO₂ emissions, is required. Though these points resemble those stated in the previous AR5 report, the assessments of the new report are further refined.

The report (AR 6/WG I) utilizes the latest global climate models participating in the Coupled Model Intercomparison Project Phase 6 (CMIP 6)³. The climate models are simulated in Shared Socio-economic Pathways (SSPs). The previous report,

² The IPCC Sixth Assessment Report comprises four reports: Working Group I (WG 1) report: *Climate Change: the Physical Science Basis*; Working Group II (WG 2) report: *Climate Change: Impacts, Adaptation and Vulnerability*; Working Group III (WG 3) report: *Mitigation Measures such as Reduction of GHG Emission*; and Synthesis Report, which integrates the three Working Group reports.

³ An international collaborative framework designed to improve climate change prediction and reduce uncertainty, in which the latest climate models from various parts of the world including Japan participate.

AR 5, used Representative Concentration Pathways (RCPs), while AR 6 adopted scenarios that combine socio-economic factors, such as future population and economic growth and pace of technology developments and RCPs. Table 1–1–1 shows five scenarios adopted in AR 6. A scenario equivalent to the 1.5°C goal set out by the Paris Agreement (SSP1–1.9) is added in AR 6. SSP1–1.9 Scenario assumes net zero CO₂ emission by the mid 21st century.

Table 1–1–1 Scenarios adopted in IPCC Assessment Report (comparison of AR 6 and AR 5)

SSP Scenario (AR6)	GHG Emissions	Equivalent RCP Scenario (AR 5)
SSP1–1.9	Very low (equivalent to 1.5°C goal)	N.A.
SSP1–2.6	Low (equivalent to 2°C goal)	RCP2.6
SSP2–4.5	Intermediate	RCP4.5
SSP3–7.0	High	Between RCP6.0 and RCP8.5
SSP5–8.5	Very high (maximum emissions)	RCP8.5

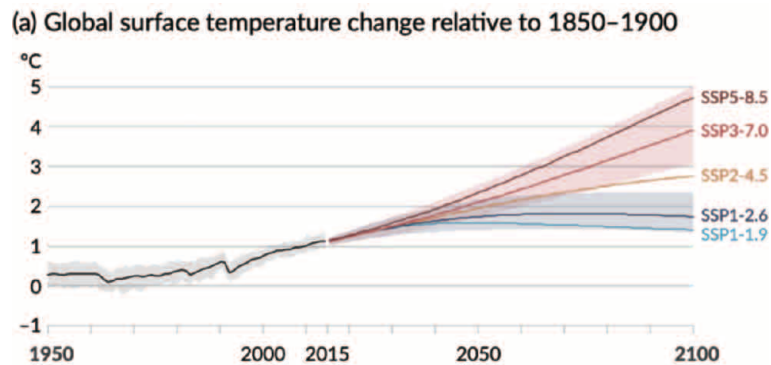


Figure 1–1–2 Global Surface Temperature relative to 1850–1900 (°C)

Source: IPCC (2021) Figure SPM8 (a)

Under all the five scenarios, the increase in global average surface temperature is likely to reach 1.5°C by 2040 (Figure 1–1–2). In order to limit human-induced global warming to a certain level, it is necessary to limit cumulative CO₂ emissions, at least achieve CO₂ net zero emission, and significantly reduce other greenhouse gases (GHG) as well. Current national reduction targets are not enough and unless decarbonization is accelerated, neither the 1.5°C nor 2°C goals can be achieved.

2 Assessments for the Oceans and Coastal Areas

Following the *Special Report on the Ocean and Cryosphere in a Changing Climate* released by the IPCC in 2019, the AR6 WG1 report discusses a wide range of current and future changes in the oceans. Ocean warming, higher frequency of marine heatwaves, ocean acidification, deoxygenation, and rapid loss of arctic sea ice mass are being observed in the oceans around the world. Global average sea level rose about 20cm from 1901 to 2018 and it is still accelerating. Such changes are irreversible on a multi-century to millennial time scale. It is now unavoidable that the sea level will continue to rise over hundreds and thousands of years due

to continuing deep-ocean heat uptake and mass loss of ice sheets.

A new finding was presented that should the Antarctic Ice Sheets be destabilized and collapse under the SSP5–8.5 scenario, sea-level could rise as much as 15m (Figure 1–1–3).

As already indicated in many publications, changes in the state of the oceans have seriously affected the ocean, coastal ecosystems and the livelihood of people living in coastal areas. Implementation and furtherance of adaptive measures are becoming a pressing issue. Meanwhile, the ocean and coastal areas could provide significant opportunities for mitigation measures, such as renewable energy and conservation and regeneration of the blue carbon ecosystem. Consequently, ocean-based global warming countermeasures are attracting increasing attention.

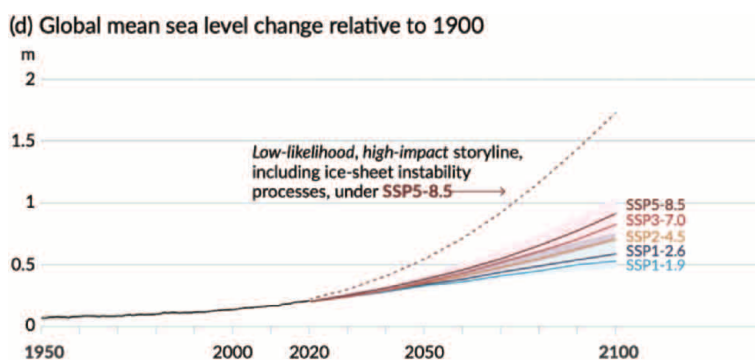


Figure 1–1–3 Global mean sea level change
Source: IPCC (2021) Figure SPM 8 (d)

3 The 26th United Nations Climate Change Conference (COP26) and the Oceans

The 26th United Nations Climate Change Conference (COP26) of the United Nations Framework Convention on Climate Change (UNFCCC) was held for the first time in two years in the fall of 2021 in Glasgow, UK. The WG1 report of IPCC/AR6 was welcomed and the findings were received with serious concern. At COP 26, nations reached agreements on important issues such as guiding implementation principles of market mechanisms. At COP27, to be held in fall of 2022 in Egypt, UNFCCC will undertake the Technical Assessment for Global Stocktake for the first time. The Global Stocktake is a mechanism of the Paris Agreement which is used to assess the collective progress towards achievement of the agreed goals and is a fundamental component for the enhancement of climate change countermeasures. The result of the technical assessment at COP27 will be reviewed at COP28 in 2023. The sixth Assessment Report of the IPCC will be made available in stages; four reports will be released by October 2022 and scientific findings regarding climate change will be updated⁴.

Since their inceptions, the IPCC and the UNFCCC have complemented each other's activities. For example, the Fifth Assessment Report (2013–2014) was released immediately before the adoption of the Paris Agreement in 2015 and the COP Decision (1/CP.21), to which the text of the Paris Agreement was annexed,

⁴ WG II Report will be published in February 2022, WG III Report in March 2022, and the Synthesis Report in October 2022.

Table 1-1-2 Main assessment in IPCC AR6/WG 1 and AR5/WG 1

	Assessment in AR6/WG1 Report	Assessment in AR5/WG 1 Report (2012)
Arctic Sea Ice	<ul style="list-style-type: none"> ●September Arctic Sea ice extent decreased by 40% between 1979–1988 and 2010–2019. March Arctic Sea ice extent decreased by 10% between the same period. ○Under the five scenarios considered in this report, the Arctic zone will become practically sea ice-free in September more than once by 2050. 	<ul style="list-style-type: none"> ●The annual mean Arctic Sea ice extent decreased by 3.5–4.1% (450,000–510,000 km²) per decade between 1979 and 2012. ○Under the RCP8.5 scenario, the Arctic Sea will become practically sea ice-free in September by the mid 21st century.
Sea Surface Level (GMSL)	<ul style="list-style-type: none"> ●Global mean sea level has risen about 0.20m between 1901 and 2018. ●Global mean sea level rise: <ul style="list-style-type: none"> 1901–1971: ca 1.3mm/year 1971–2006: ca 1.9mm/year 2006–2018: ca 3.7mm/year ●Human activity is the main driver of global mean sea level rise since at least 1971, according to observations. ○Relative to the period 1995–2014, global mean sea level will rise by 2100: <ul style="list-style-type: none"> SSP 1–1.9: 0.28 to 0.55m SSP 1–2.6: 0.32 to 0.62m SSP 2–4.5: 0.44 to 0.76m SSP 5–8.5: 0.63 to 1.01m ○Global mean sea level will continue to rise for centuries due to continuing deep-ocean heat uptake and mass loss of the ice sheets, and will remain elevated for thousands of years. 	<ul style="list-style-type: none"> ●Global mean sea level has risen about 0.19m over the period 1901–2010. ●Global mean sea level rise: <ul style="list-style-type: none"> 1901–2010: ca 1.7mm/year 1971–2010: ca 2.0mm/year 1993–2010: ca 3.2mm/year ○Relative to the period 1986–2005, global mean sea level will rise between 2081 to 2100: <ul style="list-style-type: none"> RCP2.6: 0.26 to 0.55m RCP4.5: 0.32 to 0.63m RCP6.0: 0.33 to 0.63m RCP8.5: 0.45 to 0.82m ○As sea level rise caused by thermal expansion will continue for centuries, global mean sea level will continue to rise even after 2100.
Extreme sea level (ESL)	<ul style="list-style-type: none"> ○Extreme sea level events that were recently expected once every 100 years will occur annually at more than half the locations where tide gauges are installed. 	<ul style="list-style-type: none"> ●Extreme sea level events have increased since the 1970s. ○The frequency of extreme sea level events will increase by the end of the 21st century.
Sea surface temperature (SST)	<ul style="list-style-type: none"> ●Global sea surface (0 to 700m) temperature has increased since the 1970s. Human influence is the main driver. Sea temperature rise is irreversible on a multi-century to millennial time scale. 	<ul style="list-style-type: none"> ●Ocean warming dominates the global energy change inventory. Warming of the ocean accounts for more than 90% of the increase in the earth's energy inventory between 1971 and 2010.
Extreme sea temperature (Marine heatwaves) (MHW)	<ul style="list-style-type: none"> ●The frequency of marine heatwaves has doubled since the 1980s. ●Human influence was the main driver of most of the marine heatwaves observed since 2006. 	<ul style="list-style-type: none"> No assessment regarding marine heatwaves
Ocean acidification and deoxygenation	<ul style="list-style-type: none"> ●Anthropogenic CO₂ emissions are main drivers of ocean acidification in the global surface ocean. ●The ocean surface water has undergone deoxygenation since the mid–20th century. Human influence has contributed to deoxygenation. ○Ocean stratification, acidification and deoxygenation of the surface ocean continue to increase through the 21st century at the pace of the future emission scenario. 	<ul style="list-style-type: none"> ●The oceans store about 30% of anthropogenic CO₂ emissions, causing ocean acidification. ●pH of surface waters decreased by 0.1 since the preindustrial era. ○pH of surface waters will decrease by the end of 21st century: <ul style="list-style-type: none"> RCP2.6: 0.06 to 0.07 RCP4.5: 0.14 to 0.15 RCP6.0: 0.20 to 0.21 RCP8.5: 0.30 to 0/32

Note: (●) indicates changes observed; (○) indicates predicted changes

Source: Ministry of the Environment, Japan edited by the author

required the IPCC to prepare a special report on global warming of 1.5°C. Among others the *Special Report on the Ocean and Cryosphere in a Changing Climate* (SROCC), (2019), released one year after the publication of the *Special Report of Global Warming of 1.5°C* (2018), provided scientific evidence regarding the importance of the oceans in global warming mitigation, and has accelerated mainstreaming of the oceans in the UNFCCC.

At COP25 (2019), held immediately after the release of SROCC, Chile, the host country, referred to it as the “Blue COP” to emphasize its focus on the ocean and cryosphere. This prompted the COP25 decision to include language referring to the importance of the ocean as an integral part of the Earth’s climate system and request the Subsidiary Body for Scientific and Technological Advice (SBSTA) to convene “a dialogue on the ocean and climate change”⁵.

The Ocean Dialogue, convened online in December 2020 due to the COVID-19 pandemic, provided a space for various stakeholders such as government negotiators, scientists, businesses, and non-profit organizations to discuss the current status and challenges of ocean-based mitigation and adaptation measures, bringing together the latest information⁶. An unofficial summary report on the discussion at the Ocean Dialogue was prepared by the Chair of SBSTA and released in April 2021⁷.

At an informal meeting on the ocean held during the June 2021 session of the SBSTA, countries exchanged views based on the summary report and several countries proposed continuation of the Ocean Dialogue. At COP26 the usefulness of the Ocean Dialogue was recognized, according to the previous discussion and the summary report. In the COP26 Decision, *the Glasgow Climate Pact* (1/CP.26), it was decided to hold an annual dialogue, starting at the fifty-sixth session of SBSTA (June 2022) and to request the relevant work programmes and constituted bodies under the UNFCCC consider how to integrate and strengthen ocean-based action into their existing mandates and to report⁸. The resolution reaffirmed the global goal to pursue efforts to limit the temperature increase to 1.5°C. The parties were called upon to update and strengthen 2030 national emission goals in 2022.⁹ It was agreed to enhance adaptation measures and to achieve the goal of mobilization of climate financing of USD 100 billion per year for developing country Parties by developed country Parties, which had not been met, by 2025. It was also decided to accelerate “efforts towards the phasedown of unabated coal power and phase-out of inefficient fossil fuel subsidies.” To facilitate and support those efforts, the holding of an annual Ocean Dialogue which provides a place for various stakeholders to continue the discussion is highly significant.

The Synthesis report on Nationally Determined Contributions, released by the UNFCCC secretariat in advance of COP26, estimated that even with implementation of the latest NDCs, 89% (1.5°C) and 39% (2°C) of the global carbon budget¹⁰ would be expended by 2030. To achieve goals under the Paris Agreement, strengthening climate actions by multi-stakeholders, including non-state parties such as local governments and businesses as well as state governments, is imperative.

As mentioned at the beginning of this chapter, Prime Minister Kishida, at the World Leaders Summit, acknowledged the coming decade, to 2030, as the “critical

5 1/CP. 25

6 See *White Paper on the Oceans and Ocean Policy in Japan 2021*

7 https://unfccc.int/sites/default/files/resource/SBSTA_Ocean_Dialogue_SummaryReport.pdf

8 1/CP. 26 paras, 58, 60–61

9 NDCs : Nationally Determined Contributions

10 Residual carbon budget: the maximum amount of cumulative CO₂ emissions from the present time that would result in target temperature rise. By setting a limit of temperature rise, allowable CO₂ emissions could be estimated.



Figure 1-1-4 MPGCA Ocean and Coastal Zones Action Event held on November 5 at COP26 (top) and the presentation on Japanese Blue Carbon initiatives at the event (bottom)¹¹.

¹¹ MPGCA Ocean and Coastal Zone Action Event “A healthy and productive ocean for a resilient, nature-positive and net-zero future” (Ocean Action Day)

¹² See Ocean Newsletter 490 (https://www.spf.org/o/pri/newsletter/490_1.html)

decade,” and declared Japan’s new reduction goal by 2030 and additional commitment of financial support for the next 5 years. Furthermore, Japan co-hosted the Asia-Pacific Seminar on Climate Change in March 2021 with Australia and hosted the Asia-Pacific Climate Week 2021, leading discussions in the Asia-Pacific region.

What can the oceans contribute towards achieving Japan’s as well as the world’s goals? The potentials of ocean-based solutions are recognized in various media including the report of the High-Level Panel for Establishment of Sustainable Ocean Economy¹². It is increasingly expected that ocean-based climate change mitigation measures will be promoted.

(Mai Fujii)

2 Decarbonizing Shipping

1 Background of Shipping Decarbonization

1 The Significance of Maritime Industry in Japan

As an island nation, 99.6% of the trade volume, import and export, of Japan is seaborne. Seaborne trade accounts for about 40% of domestic trade volume and for about 80% of domestic transportation of industrial commodities such as steel, petroleum products, and cement in freight ton kilometers. Maritime transportation

is indispensable for movement of local residents and everyday commodities in Japan. The social and economic development of Japan, surrounded by the sea, depends on secure and stable maritime transportation and it is important from the viewpoint of economic security. Japan's maritime industry has built up one of the world's leading maritime clusters¹³ centered on shipbuilding and shipping industries, supporting seaborne trades.

However, in recent years Japan's shipbuilding industry has been forced to cut prices in order to remain competitive against Chinese and Korean shipbuilders receiving public assistance. Further market downturn due to the Covid-19 pandemic has intensified the hardship of the industry. Although the current market condition is showing recovery both in volume of new-building demand and prices, the soaring price of steel is threatening the profitability. World shipbuilding capacity remains in oversupply. It is expected that the industry will continue to face intense international competition. To ensure conditions in which Japan's shipbuilding industry continues to contribute to local economies, employment and Japan's economic security and to provide a stable supply of vessels, it is necessary to strengthen the industry base through improvements in productivity and/or business restructuring. In an increasingly competitive international shipping sector, Japan needs to keep pace with the growth of the world and ensure stable and reliable international ocean shipping. It is necessary to further strengthen Japan's international competitiveness by encouraging introduction of high-quality vessels as well as to create an encouraging environment for new-build orders.

The Act Revising a Part of the Maritime Transportation Act, etc. (commonly known as Act to Strengthen Maritime Industry), intended to strengthen the maritime industry base, was published in the official gazette on May 21, 2021. To create a positive cycle between the supply side (shipbuilding industry) and the demand side (shipping industry) through comprehensive policy measures, the Plan Recognition System in shipbuilding and shipping areas was established under the Act to Strengthen Maritime Industry. On the shipbuilding side, productivity improvement plans and/or business reorganization plans recognized by the Minister of Land, Infrastructure and Transportation can take advantage of government support such as preferential finance, special tax treatments, and grants. On the shipping side, officially recognized plans to introduce "special vessels," featuring high

¹³ Japan's maritime clusters as a whole has sales of 11.3 trillion yen, employs 340,000, and accounts for about 1% of GDP in added value, of which the cumulative total value of waterborne transportation, shipbuilding, and ship machinery industry sales are 8.7 trillion yen and employment is 309,000.



Figure 1-2-1 Japan's Maritime Industry: Shipping and Shipbuilding

environmental, safety, and laborsaving capabilities, can also take advantage of government support.

On December 24, 2021, a cabinet decision was made that provisions of the Act regarding mariners and domestic shipping would be put into force on April 1, 2022. With the Act coming into force, reform of mariners' working practices, measures to improve transaction conditions, and the productivity of domestic shipping will be implemented.

2 As the World Economy Grows, Greenhouse Gas Emissions from International Shipping Increase

The total volume of international seaborne trade is expected to continue to increase in the medium- to long-term as the world economy grows. Some estimate that CO₂ emissions from vessels operating in international ocean shipping will account for 7.0% of the world's emissions by 2050 without any mitigating measures.¹⁴ Therefore, efforts to reduce CO₂ emissions from ships are necessary to achieve the global long-term goal of "pursuing efforts to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels" set in Article 2 of the Paris Agreement. It is an important challenge to contribute to the decarbonization of the world.

¹⁴ As of 2018, it accounted for 2% of the world CO₂ emissions.

2 Discussion toward the Decarbonization of Shipping

1 Discussion and Agreement at the International Maritime Organization (IMO)

As international shipping involves a wide variety of stakeholder countries, greenhouse gas (GHG) emissions reduction measures can't be implemented within the framework of nationally determined contributions. For this reason, it is being discussed and developed under the International Maritime Organization (IMO), one of the United Nations Specialized Agencies.¹⁵

The IMO adopted its GHG emissions reduction measures in 2011. The Energy Efficiency Design Index (EEDI) regulations came into force in 2013.¹⁶ The regulations require new ships built in and after 2013 to comply with minimum mandatory energy efficiency levels.

In 2016, the IMO adopted amendments making mandatory the requirement for ships to collect and submit fuel oil consumption data. The mandatory fuel consumption reporting regulation began in 2019. With the implementation of the regulation, fuel oil consumption data are aggregated in an IMO database. In 2018, the IMO adopted the Initial IMO Strategy on reduction of GHG emissions from ships. It identified the following objectives: 1) to reduce average CO₂ emissions by at least 40% compared to 2008 by 2030; 2) to reduce average CO₂ emissions by at least 50% compared to 2008 by 2050; and 3) to pursue efforts towards phasing them out by the end of the 21st century. The IMO Strategy is scheduled to be revised in 2023 and discussions have been under way at the IMO. Most recently, the IMO adopted new regulations to require existing ships to have the same fuel

¹⁵ The Kyoto Protocol does not apply to international shipping and Article 2 Section 2 of the Protocol provides that the reduction measures of GHG emissions from international shipping shall be discussed by IMO.

¹⁶ Energy Efficiency Design Index (EEDI) is a common index used to evaluate the energy efficiency of new ships.

economy performance (EEXI¹⁷) as new-buildings are required under the EEXI and the carbon intensity indicator (CII) rating system in June 2021 to achieve objective 1 of the Strategy.

All the above mentioned GHG emissions reduction measures of the IMO were spearheaded by Japan. For example, Japan negotiated with member states, holding at least 50 on-line conferences before the adoption of the EEXI and the CII. Japan also drafted the revision of MARPOL (The International Convention for the Prevention of Pollution from Ships) in coordination with concerned member states, which was ultimately adopted.

The Marine Environment Protection Committee (MEPC) of the IMO, which addresses GHG emissions reduction measures, is chaired by Mr. Hideaki Saito, Advisor to the Ministry of Land, Infrastructure and Transport of Japan.¹⁸ It is important that measures adopted at the IMO should contribute to mitigation of climate change in such a way as to improve the international competitiveness of the maritime industry of Japan. Japan's taking the initiative in rule-making and having a Japanese person as a chair of the rule-making committee is significant.

Domestically, Japan launched its International Shipping GHG Zero Emission Project in 2018 in cooperation with industry, academia and the public sector, where climate change countermeasures to be proposed to the IMO are discussed among national stakeholders.¹⁹ In March 2020, the Project released the *Roadmap to Zero Emission from International Shipping*, which outlined the technology developments and international rules necessary to implement its GHG reduction strategy.²⁰

2 Japan's Efforts to Decarbonize Domestic Shipping

As the global movement toward decarbonization accelerates, in October 2020 Prime Minister Yoshihide Suga declared Japan's ambition to achieve carbon neutrality by 2050. Japan is being called upon to further strengthen and accelerate its efforts to reduce CO₂ emissions in all industry and consumer sectors. Against such a background, taking into consideration developments in the government as a whole and other industries, Japan revised the reduction goal for domestic shipping, set in the Global Warming Countermeasures Plan, from 1,570,000 t-CO₂ compared to 2013 by Fiscal Year 2030 to 1,810,000 t-CO₂. It is necessary to strategically advance efforts toward CO₂ emissions reduction to contribute to achieving the goal of carbon neutrality by 2050.

The Maritime Bureau of Ministry of Land, Infrastructure and Transportation set up the Committee to Promote Carbon Neutrality of Domestic Shipping in April 2021. The Committee summarized the situation surrounding domestic shipping, discussed possible measures to lower the carbon intensity of domestic shipping toward the ultimate goal of decarbonization, and drew up a roadmap for decarbonization. Its report was released in December 2021.

¹⁷ Energy Efficiency Existing Ship Index (EEXI) is a common index used to evaluate the energy efficiency of existing ships.

¹⁸ Mr. Saito was first elected in 2018 for a one-year term. Currently he is serving his fifth term.

¹⁹ https://www.mlit.go.jp/maritime/maritime_tk7_000026.html

²⁰ https://www.mlit.go.jp/maritime/GHG_roadmap.html

3 Current Status of Decarbonization of Shipping

1 Current State and Strength of Private Business in Japan and Efforts of Overseas Companies

Japan's maritime industry enjoys advantages in building and operating environmentally friendly vessels. In recent years, international interest in global warming countermeasures has been growing. One area is the transition to alternative marine fuels, such as hydrogen and ammonia. The international maritime industry is at a key juncture. It is a great opportunity for the Japanese maritime industry to show its strength and make further strides.

Not to lose out on this opportunity, Japanese shipbuilders are accelerating their efforts. Japan's largest shipbuilders, such as Imabari Shipbuilding Co. Ltd. and Japan Marine United Corporation as well as Kawasaki Heavy Industries, Ltd., which is undertaking construction of liquified hydrogen carriers, are developing plans for environmental compliance. As for shipping companies, the Japanese Shipowners' Association announced that the Japanese shipping industry would take on the challenge of net zero GHG emissions from international shipping by 2050.²¹ Three major Japanese shipping companies, NYK Line, Mitsui O.S.K. Lines, and K Line, also announced their ambition to achieve net zero by 2050, taking on the challenge of carbon neutrality.

Outside of Japan, MAN, a major German engine manufacturer/licensor has been developing two-stroke dual fuel engines using ammonia as fuel since 2019 and they expect that they will be able to supply engines operating on ammonia in the first half of 2024. Chinese and Korean companies have acquired Approval in Principle (AIP) for designs of ammonia fueled engines from classification societies in collaboration with European companies. The world is moving forward to develop ammonia fueled vessels. In Korea, universities are conducting preliminary studies and research on hydrogen fueled vessels. Currently the world stands at the same starting line to develop ammonia/hydrogen fueled vessels. If Japan's maritime industry could lead the world in technology development, they could respond to global decarbonization demand before other countries. Endeavors from now on are crucial.

2 International Development outside of the IMO

Efforts toward GHG emission reduction from international shipping are being actively pursued outside of the IMO. Major efforts are :

(1) National Governments' Initiatives

At the 2021 United Nations Climate Change Conference (COP26), an event related to decarbonization of international shipping was held and 22 countries including Japan, the United States and UK signed the Clydebank Declaration to create green shipping corridors, where zero emission vessels operate to reduce GHG emissions from international shipping.²²

²¹ https://www.jsanet.or.jp/e/pressrelease_e/2021/pdf/20211026e.pdf

²² <https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors/cop-26-clydebank-declaration-for-green-shipping-corridors>

(2) Private Sector Initiatives

The Getting to Zero Coalition, which is an international alliance committed to accelerate decarbonization of international shipping, took the initiative and released a Call to Action for Shipping Decarbonization in September 2019. The signatories for the Call to Action urge governments to: 1) commit to decarbonizing international shipping by 2050: 2) support industrial scale zero emission shipping projects through national action: and 3) deliver policy measures that will make zero emission shipping the default choice by 2030.

In October 2021, nine companies, including Amazon (US), IKEA (Sweden), Unilever (UK), and Michelin (France), established Cargo Owners for Zero Emission Vessels (coZEV)²³, a cargo owner-led platform for maritime decarbonization, and announced its vision to decarbonize their maritime freight by 2040.

²³ <https://www.cozev.org/>

4 Current Status of Technology Development

Formulation of Green Growth Strategy and Technology Development Green Innovation Fund

In October 2020, Prime minister Suga declared Japan's ambition to achieve a carbon neutral, decarbonized society by 2050. Following this, the Ministry of Economy, Trade and Industry, in collaboration with other ministries, formulated the "Green Growth Strategy through Achieving Carbon Neutrality by 2050."²⁴ The strategy identifies 14 priority sectors and sets ambitious goals for each. It specifies current challenges and future actions, and stipulates policy measures, including government funding, tax breaks, regulation reform and standardization, and international collaboration. Shipping is among the priority sectors.

²⁴ https://www.meti.go.jp/english/policy/energy_environment/global_warming/ggs2050/index.html

In the shipping sector, it is envisioned to develop vessels powered by alternative fuels such as hydrogen and ammonia, which are essential to achieve carbon neutrality by 2050, to start commercial operation of zero-emission vessels by 2028, and to expand use of such vessels in 2030 and beyond.

The third supplementary budget of fiscal year 2020 authorized establishment of the Green Innovation Fund administered by the New Energy and Industrial Technology Development Organization (NEDO). Projects in the 14 priority sectors receive financial support from the Fund for ten years through the stages of R&D, demonstration, and commercial application. In the shipping sector, projects to develop next generation vessels—hydrogen fueled vessels and ammonia fueled vessels, among others—were eligible for the grant. In October 2021, project themes and responsible companies were selected as awardees.²⁵

²⁵ https://www.mlit.go.jp/maritime/maritime_tk7_000041.html

As for development of hydrogen fueled ships, mid- and high-speed 4 stroke hydrogen engines, low-speed 2 stroke hydrogen engines, and carriers installed with hydrogen fuel tanks and systems to supply hydrogen to engines from storage tanks are being developed. As for development of ammonia fueled ships, tugboats with 4 stroke engines and ammonia transport ship with 2 stroke engine are being developed.



Figur 1-2-2 Large liquified hydrogen carrier (left) and ammonia powered ammonia carrier (right)
Photos courtesy of Kawasaki Heavy Industries (left) and NYK Line (right)

Japan will advance efforts toward carbon neutrality in the maritime sector by promoting introduction of such zero-emission ships.

5 Challenges for the Future

1 Toward Low Carbon and Decarbonized Domestic Shipping

As discussed earlier, CO₂ emission reduction measures should be strategically advanced in the domestic shipping sector. The Japanese government's Committee to Promote Carbon Neutrality of Domestic Shipping released a report in December 2021.

The report concluded that it was necessary to phase in measures toward carbon neutrality in domestic shipping. To achieve Japan's 2030 goal, energy saving measures such as development of comprehensive energy conservation vessels, reduction of CO₂ emissions through usage of biofuels, and development of a fuel consumption/energy saving efficiency index to make it easier for shippers to choose low carbon vessels are important. To contribute to Japan's goal of carbon neutrality by 2050, it is also important to support advanced efforts such as development and introduction of LNG fueled vessels, hydrogen fuel cell vessels, and battery powered vessels. Specific policy measures will be developed in the near future.

2 Discussion on Zero-Emission Vessels at the IMO

The Maritime Safety Committee (MSC) of the IMO deals with all matters related to maritime safety, and the Marine Environment Protection Committee (MEPC) addresses environmental issues. As a maritime nation, it is important that Japan, in close collaboration with relevant countries, not only fulfill its international responsibilities, but also take the initiative in international discussions at the IMO.

In regard to maritime safety, the IMO is drafting safety guidelines for maritime autonomous surface ships (MASS). MASS contributes to the reduction of human errors and workload of seafarers. Efforts are being made to support technology development and verification projects using prototype ships, with a target commercialization year of 2025. To ensure renewed competitiveness of the Japanese mari-

time industry, Japan will continue to pursue efforts for commercialization of MASS and lead the discussion on international rules at IMO, where the discussion will get into full gear in April of 2022.

In regard to environmental measures, as previously noted, IMO has been showing steady progress toward GHG emissions reduction from international shipping. As efforts toward climate change mitigation accelerate across the world, it is necessary to advance GHG emissions reductions in international shipping.

On October 26, 2021, Tetsuo Saito, Minister of Land, Infrastructure and Transportation, announced Japan's ambition to achieve zero GHG emissions from international shipping by 2050.²⁶ Then Japan proposed the goal of 2050 carbon neutrality at the IMO's Maritime Environment Protection Committee's 77th meeting (MEPC77), along with the United States, UK and other member countries.

At MEPC77, an in-depth discussion was held on Japan's proposal, and it was agreed to initiate the revision of the Initial IMO Strategy, recognizing the need to strengthen the ambition during the revision process.²⁷

Japan will continue to take the lead in discussions at the IMO regarding the GHG emissions reduction goal as well as economic measures and regulatory measures to achieve the goal. In addition to GHG emissions reduction measures, for the successful commercialization of zero-emission vessels, whose development will be necessary to achieve carbon neutrality by 2050, it is imperative to implement safety regulations, especially those related to mariners. Japan will actively facilitate the discussion.

(Akihiro Tamura and Atsuki Ito)

²⁶ https://www.mlit.go.jp/report/press/kaiji07_hh_000216.html

²⁷ https://www.mlit.go.jp/report/press/kaiji07_hh_000221.html

2 The Fully Autonomous Ship Program MEGURI2040

With more than 50% of mariners in Japan now over the age of 50, the aging of seafarers is a social challenge, as human error is said to account for 80% of marine accidents. Efforts made to reduce accidents so far haven't resulted in a significant decrease. As artificial intelligence (AI) and information and communication technology (ICT) advance, on-land developments of driverless automobile systems have been making rapid progress. With fully autonomous vessel operations on the horizon, in April 2019 The Nippon Foundation made quantitative and qualitative analyses of the projected effects of fully autonomous vessels on social and economic conditions for the Japan of 2040, then summarized the issues and provided recommendations. It estimated that Japan could expect an annual economic effect equivalent to 1 trillion yen if fully autonomous ships come to account for 50% of coastal navigation by 2040.

Based on the analyses, The Nippon Foundation launched the MEGURI2040 Fully Autonomous Ship Program in February 2020 with the following objectives:

1. Realization of the world's first fully autonomous operation on existing routes by fiscal year 2021
2. Full commercialization of fully autonomous operations in 2025
3. Shifting 50% of coastal vessels to fully autonomous operation by 2040.

MEGURI means "cycle" in Japanese. It is believed that fully autonomous operations will improve the "circulation" of logistics, people, cost, and transportation, thus improving the "circulation of Japan."

The Nippon Foundation announced the launching of the "joint technology development program on verification testing of fully autonomous ships" in June 2020 to achieve the first objective.



Figure 2-1 Routes for verification testing of 6 vessels (left) and the logo of MEGURI2040 (right)

The verification testing was conducted in five projects using 6 vessels on various routes until March 2022. Each verification testing included a “world’s first” factor. As verification of fully autonomous vessels cannot be conducted by a single company, marine industry and technology companies and organizations were asked to apply to participate. A total of about 50 companies and organizations participated in the program.

1 Fully autonomous navigation at Sarushima, Yokosuka

Under the leadership of Marubeni Corporation, the small tourism boat *Seafriend Zero*, operating between Shin-Mikasa Pier and Sarushima island, Yokosuka, was used as a test vessel to develop technology to convert existing small vessels inexpensively and easily for autonomous navigation. As Japan has many remote island routes, development of the autonomous navigation technology for small vessels could have a multiplier effect. On January 11, 2022, the world’s first fully autonomous navigation of a small tourism vessel was demonstrated. An obstacle detection system with cameras using AI worked in place of human



Figure 2-2 Small tourism boat *Seafriend Zero* and the navigation levers in the control room

crew visual detection and coordinated with the automatic collision avoidance system to automatically manipulate the navigation levers in the control room. The vessel successfully navigated autonomously from departure to docking.

2 Smart Coastal Ferry

Mitsubishi Shipbuilding Co., Ltd. led a consortium to develop a fully autonomous ferry, using *the Soleil*, a car ferry operating between Yokosuka and Shin-joji. It promoted technology development and verification of autonomous navigation, including autonomous departure and docking and enhanced remote monitoring for future application of machinery failure prediction. An autonomous berthing

and unberthing system, using reversing and turning movements, as well as a sensor to detect other ships using cameras were developed. On January 17, 2022, the *Soleil*, a 222-meter ferry, successfully sailed autonomously from Shin-moji to Iyonada and back to Shin-moji, a distance of 240km, at high-speeds of up to 50 km/h. It was the world's first autonomous navigation of a large vessel at high speeds.



Figure 2-3 The Soleil ferry and automated berthing/unberthing system monitor

3 Verification Testing of Fully autonomous Technologies Using Coastal Container Vessels and Car Ferries

The Mitsui O.S.K. Lines, Ltd. led consortium used a container vessel, the *Mikage*, operating between the ports of Tsuruga and Sakaiminato, and a car ferry, the *Sunflower Shiretoko*, operating between ports of Tomakomai and Oarai, to demonstrate technologies such as camera detection of other ships and a detailed distance measurement system for berthing and unberthing. Drone-assisted mooring operations were also demonstrated. The world's first sea trial for fully autonomous navigation with a containership was conducted on January 24 and 25, 2022. With the severe winter sea conditions in the Japan Sea, the container ship lurched as much as 35 degrees. Nevertheless, it successfully sailed as planned, while avoiding other ships. Upon arrival at Sakaiminato, an unmanned drone autonomously carried a heaving line (a line used to secure the vessel to a wharf) to the quay side. The demonstration with the *Sunflower Shiretoko* was conducted on February



Figure 2-4 An unmanned drone carrying a heaving line upon docking of the *Mikage* and the *Sunflower Shiretoko* autonomously docking at Oarai

6 and 7, 2022. It successfully sailed the 750 km from Tomakomai to Oarai, setting a world record of autonomous navigation for the furthest distance and longest time (18 hours). It autonomously departed, navigated, avoided collisions, and docked at Oarai.

4 Designing the Future of Full Autonomous Ship

The Designing the Future of Full Autonomous Ship (DFFAS) Consortium, led by Japan Marine Science, Inc., used a container ship, *Suzaku*, operating between Tokyo Bay and Ise Bay for a demonstration project. Envisioning the realization of a new era of domestic logistics, the consortium involved a wide variety of expert groups with extensive international experience in autonomous navigation and was made up of about 30 companies using an open innovation framework. A land-side system that monitors and supports the ship in case of autonomous navigation system failure was developed as well as technologies for autonomous berthing and unberthing and autonomous avoidance of obstacles by detecting other ships. The container ship left the Tokyo International Cruise Terminal on February 26, 2022, sailed to Ise Bay, then returned to Tokyo Bay on March 1, 2022. It was the world's first autonomous navigation in a congested sea area (Tokyo Bay) and it was the most difficult of all the projects. The collaboration of 30 Japanese companies contributed to the successful demonstration.



Figure 2-5 Suzaku, operating in Tokyo Bay and the land-based remote operation support center

5 Development of Fully Autonomous Amphibious Driving Technology

An ITbook Holdings-led consortium used an amphibious car-vessel, *Yanba Nyagaten Go*, in Yanba Agatsuma lake as a test vessel for an autonomous navigation program that was developed by extending an open-source autonomous driving program for automobiles. A technology was developed for communication for on-land monitoring using local 5G networks and simultaneously transmitting and receiving two 4K moving images. The demonstration was conducted on March 14, 2022, when it entered the lake, navigated the planned route, automatically detected and

avoided obstacles, and returned to land. It was the world's first demonstration of autonomous navigation by an amphibious vessel.

(Yasuyuki Niwa)



Figure 2-6 The amphibious car-vessel avoiding obstacles.



3 Conservation of the Marine Ecosystem

1 International Efforts for Conservation of the Marine Ecosystem

1 Introduction

Biodiversity is a concept used to describe the variety of life in the world and consists of three levels — genetic diversity, species diversity and ecosystem diversity. Biodiversity is essential to maintain a stable environment including ecosystems. It is said that the more diverse the ecosystem is, including humans and other living organisms, the more resilient against future change of environment (such as global warming), it could be. We benefit widely from biodiversity in terms of food supply, purification of air and water, and genetic resources for research and development of pharmaceutical compounds. However, biodiversity is being lost as a result of human activities, as seen in the extinction of species due to habitat loss, at unprecedented speed. The Convention on Biological Diversity (CBD), an international framework for the conservation of biological diversity and the sustainable and equitable use of its components, is currently ratified by 196 countries.

The situation concerning the CBD framework is reaching a critical milestone. The international targets to conserve biodiversity to 2020 (the Aichi Target) adopted at the tenth meeting of the Conference of the Parties (CBD-COP10), held in Nagoya, Aichi Prefecture, Japan in 2010, have expired. Currently, new international targets to 2030 to replace the Aichi Target are being discussed. The first draft of the new international targets, the post-2020 global biodiversity framework (post-2020GBF), is released on the website of the CBD Secretariat.¹ The post-2020GBF was supposed to be adopted at COP15, to be held at Kunming, China. However, due to the Covid-19 pandemic it has been postponed and the negotiation process has been delayed. During the time allowed by the postponement, the Working Group has held on-line meetings, and numerous discussions and conversations have been held to develop better targets. It seems many Parties share the same recognition that our ability to set an ambitious target for the next decade and achieve it will determine the future of the earth.

While the Covid-19 pandemic has slowed discussion on conservation of biodiversity, it has made us aware of the importance of the proper protection and use of wild animals, the control of poaching, and the illegal trade of wildlife in order to prevent zoonotic infections. The concept of One Health, which is an approach to consider human health, animal health and environmental health as an integral whole, has become a key word in biodiversity discussion.

¹ <https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf>

² Updated the zero draft was released to the public in August 2020, the first draft in July 2021.

2 What Should We Achieve by 2030?

The first draft of post-2020GBF was released in January 2020 and has been revised twice since, reflecting comments and opinions from governments and observers.² The vision of the post-2020GBF is a world where “by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.” It is the same vision as in the Aichi Target. The mission for us to accomplish by 2030 for this purpose is “to take urgent action across society to conserve and sustainably use biodiversity and ensure the fair and equitable sharing of benefits from the use of genetics resources, to put biodiversity on a path to recovery for the benefit of planet and people.” The framework specifies four goals. Goal A is to conserve ecosystem, species, and genetic diversity. Goal B is the sustainable use of nature’s contributions. Goal C is the fair and equitable utilization of genetic resources. Goal D is to secure financial and other means of implementation to achieve the vision. While the Aichi Target had 20 action-oriented targets, post-2020GBF has 21 action-oriented targets and it differs widely in content from its predecessor. See table 3-1-1 for the 21 targets.

Regarding conservation of marine biodiversity, the first draft includes the targets to designate at least 30 percent of land and sea as protected areas (10% in Aichi Targets) and to eliminate the discharge of plastic waste. It should be recognized that the first draft incorporates more ambitious numerical targets than the zero draft. However, the post-2020GBF does not set any ocean specific targets, while Aichi Targets had Target 6: sustainable management of marine living resources and Target 10: maintain integrity of coral reefs, and other vulnerable ecosystems

Table 3-1-1 21 action-oriented targets listed in post-2020GBF (first draft)

1. Biodiversity-inclusive spatial planning
2. Restoration of degraded ecosystems
3. Expansion of marine and terrestrial protected areas
4. Conservation of genetic resources
5. Sustainable use of wild species
6. Control of invasive alien species
7. Reduction of environmental pollutions that are harmful for ecosystem (nutrients, pesticides, plastics)
8. Mitigation of the impact of climate change
9. Sharing benefits from ecosystems
10. Sustainable agriculture, aquaculture, and forestry
11. Maintaining ecosystems’ regulative and protective functions
12. Creation of green and blue spaces in urban areas
13. Fair and equitable use of genetic resources
14. Mainstreaming of biodiversity values
15. Reporting of business activities taking biodiversity into account
16. Promotion of consumer activities taking biodiversity into account
17. Preventing potential adverse impacts of biotechnology on biodiversity
18. Elimination of grants and financial incentives harmful for biodiversity
19. Securing financial resources
20. Promoting education and research
21. Participation by indigenous peoples, women, and youth.

impacted by climate change or ocean acidification. Some signatory countries argue that it is a step back. Important subjects not fully discussed are conservation of coastal ecosystems including coral reefs, which are declining worldwide, improvement of marine protected areas management, and conservation and restoration of blue carbon ecosystems.

The post-2020GBF has a framework for monitoring, setting a number of corresponding indicators to assess progress towards the goals as well. As Aichi Targets didn't set indicators, it was difficult to assess the progress toward achieving the targets. The discussion of post-2020GBF focuses on two important criteria: (1) Specific, Measurable, Achievable, Realistic, and Timely (SMART) and (2) Communicable targets. There are a considerable number of indicators, as multiple indicators are set for each target. Once post-2020GBF is adopted, each signatory country is required to monitor these indicators and to report on a regular basis.

3 The United Nations Decade on Ecosystem Restoration

Restoration of lost or degraded ecosystems is included as a target in post-2020 GBF. The decade from 2021 through 2030 is also designated as the United Nations Decade on Ecosystem Restoration as well as the United Nations Decade of Ocean Science for Sustainable Development. The UN Decade on Ecosystem Restoration is aiming to regenerate and restore degraded ecosystems as well as conserve existing ones. It is being implemented by the United Nations Environment Programme (UNEP) and Food and Agriculture Organization of the United Nations (FAO). On its website, relevant resources and information on events are posted and a database on ecosystem restoration projects across the globe is also available.³

In Japan, not many activities regarding the UN Decade on Ecosystem Restoration have been seen yet. The United Nations University in Tokyo serves as a focal point for activities in Japan. In February 2022, the Sasakawa Peace Foundation Ocean Policy Research Institute co-hosted an international symposium on the Decade with the United Nations University (Japan) and the Ministry of the Environment of Japan.

In November 2021, the Japan Conference for 2030 Global Biodiversity Framework (J-GBF) was established to promote the cooperation among industry and the public and private sectors. The conference aims to contribute to achievement of international goals such as the post-2020 Biodiversity Framework and the UN Decade on Ecosystem Restoration as well as national goals.

4 G7 Summit and Nature Compact

The G7 Summit, a summit of leaders of seven major countries (Canada, France, Germany, Italy, Japan, United Kingdom, United States, European Union), was held

³ <https://www.decadeonrestoration.org/>

in June 2021 in Cornwall, UK. As one of the outcomes of the summit, G7 leaders adopted the 2030 Nature Compact, through which they commit to cooperate in conservation of earth's environment. Preservation of biodiversity is especially emphasized at the beginning, where they state clearly their commitment to "halt and reverse biodiversity loss by 2030."

The Compact refers to multiple important issues, recognizing the close relation between climate change and biodiversity and that climate change is a key driver of biodiversity loss, and that conserving and restoring biodiversity is crucial to addressing climate change. It also introduced the concept of "nature positive." It represents the idea of rather than simply doing less harm, reform of economic and social systems should impact nature and ecosystems positively.

The compact also addresses conservation of marine biodiversity to a great extent. Included are strengthening the policy measures to reduce marine plastic litter pollution under the G20 Osaka Blue Ocean Vision, solving the problem of lost and abandoned fishing gear, eliminating illegal unreported and unregulated (IUU) fishing, prohibiting certain harmful fisheries subsidies, protecting at least 30% of the global ocean, restoring biodiversity including the Blue Carbon ecosystem, concluding the negotiation of an ambitious international legally binding treaty to conserve ocean biodiversity outside of national jurisdiction, and supporting the efforts of the UN Decade of Ocean Science for Sustainable Development.

Such a show of commitment from G7 countries will hopefully create momentum for the discussion of post-2020GBF. There are also increased calls for a new international treaty to address the issue of marine plastic pollution, and specific details are to be negotiated at the United Nations Environment Assembly (UNEA) in 2022. These developments are worthy of attention.

(Junko Toyoshima)

2 New National and International Developments Surrounding Marine Plastics

1 International Developments

Vast amounts of plastic products such as plastic shopping bags, PET bottles, straws, and plastic components of consumer electronics have become indispensable elements in our everyday living. However, these plastic products, disposed improperly after use, eventually end up in the oceans and cause serious problems, having a wide variety of adverse effects on the marine environment, ship navigation, coastal habitats, tourism, and fisheries. Microplastics, fragments of plastic less than 5mm in length, absorb harmful chemicals in the oceans, including polychlo-

rinated biphenyl (PCB). There is concern that it could have serious consequences on human health as well as marine life and marine ecosystems through the food chain.⁴



Figure 3-2-1 Compressed PET bottles for recycling and plastic debris washed ashore

Each year, approximately 8 million tons of plastic flow into the ocean worldwide.⁵ According to the World Economic Forum Report released in 2016, the ocean is expected to contain more plastic than fish by weight by 2050.⁶ Marine plastic pollution is observed in the Arctic and the Antarctic and even on the abyssal seafloor, presenting a serious global problem.⁷ As a result, international discussions and initiatives addressing the marine plastic issue have accelerated. Marine plastic issues have been discussed at various international conferences, including the United Nations Conference on Sustainable Development (UNCSD), the UN General Assembly, G7 Summit, G20 Summit, and the UN Environment Assembly (UNEA). Development of a legally binding international agreement on marine plastic issues was discussed at UNEA in February 2022. In this section, current and future developments of international discussions are summarized, focusing on the UNEA. Japan's new national efforts are also showcased.

1 Developments at the United Nations Environment Assembly (UNEA)

The UNEA is the decision-making body of the United Nations Environment Programme (UNEP) and in principle is held biennially. Figure 3-2-2 shows the timeline of the Assembly sessions to date.

The first session of the UNEA was held in June 2014 and seventeen resolutions were adopted, including a resolution on “Marine Plastic Litter and Microplastics.” In this resolution, the UNEA recognized the significant risks arising from inadequate management and disposal of plastic, encouraged information exchange through the marine litter network, requested studies be undertaken to identify the sources of marine plastic debris and consider possible measures to prevent or minimize the level of microplastics in the marine environment, and to investigate the impacts plastics have on biodiversity, marine ecosystems, and human health.⁸

At the second session of the UNEA (UNEA-2), held in May 2016, another resolution on “Marine Plastic Litter and Microplastics” was adopted. It encouraged the establishment of harmonized international standards and methodologies for the measurement and monitoring of marine plastic debris and microplastics, called for more research on microplastics, urged the phasing out of the use of microbeads

⁴ Yamashita, R., Hiki, N., Kashiwada, F., et al., Plastic additives and legacy persistent organic pollutants in the preen gland oil of seabirds sampled across the globe, *Environmental Monitoring and Contaminants Research*, 1, 97-112, 2021

⁵ Jambeck, Jenna R. et al. “Plastic Waste Inputs from Land into the Ocean.” *Science* VOL 347 ISSUE 6223, 2015

⁶ World Economic Forum, *The New Plastics Economy Rethinking the future of plastics*, 2016

⁷ Isobe, A., Uchiyama-Matsumoto, K., Uchida, K., Tokai, T., *Microplastics in the Southern Ocean*, *Mar. Pollut. Bull.* 114, 6230626, 2017

⁸ <https://wedocs.unep.org/bitstream/handle/20.500.11822/17285/K1402364.pdf>

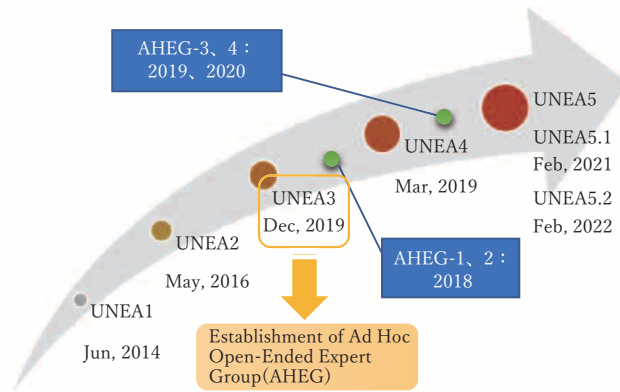


Figure 3-2-2 Timeline of the UNEA sessions

and other microplastic material in products, recognized the need to develop environmentally sound systems and methods for the removal and disposal of plastic wastes, and encouraged consideration of the environmental impacts of products containing microbeads and compostable polymers throughout their life-cycle.⁹

The third session of the UNEA (UNEA-3) was held in December 2017 and a third resolution on “Marine Plastic Litter and Microplastics” was adopted. It called for further examination of the barriers to and options for combating marine plastic litter and microplastics.¹⁰

It is noteworthy that the Ad Hoc Open-Ended Expert Group (AHEG) on marine litter and microplastics was established at the third session. The first and second meetings of the expert group was held in 2018, the third in November 2019, and the fourth in November 2020.

The fourth session of the UNEA (UNEA-4) was held in March 2019. A resolution on “Addressing Single-use Plastic Products Pollution” was adopted as well as a resolution on “Marine Plastic Litter and Microplastics,” which Japan, Norway, and Sri Lanka co-sponsored. It requested the strengthening of knowledge through a new scientific and technological advisory mechanism leveraging existing initiatives and the establishment of a multi-stakeholder platform on marine litter and microplastics for strengthening coordination and cooperation among various stakeholders. It also requested AHEG to report on the progress achieved by international initiatives and analyses of options for solutions at the fifth session, to be held in two years.¹¹

The resolution on “Addressing Single-use Plastic Products Pollution” encouraged promotion of the development of environmentally friendly alternatives to single-use plastic products, more resource efficient design, production, use and sound management of plastics considering the full life-cycle implications, and acknowledgment of the necessity of legislation and international agreements to address management of single-use plastic wastes and improvement of waste management practices.¹²

Due to the COVID-19 pandemic, the fifth session of the UNEA (UNEA-5) was convened in two phases. The first meeting of the UNEA-5 was held on-line in February 2021, where mainly pressing procedural issues were discussed. Issues requiring substantive negotiations were discussed at the second meeting (UNEA-5.2) held in February 2022.¹³ At UNEA-5.2, a historical resolution titled “End plastic pollution: Towards an international legally binding instrument” was adopted.¹⁴

⁹ <https://www.unep.org/environmentassembly/unea2>

¹⁰ <https://www.unep.org/environmentassembly/unea3>

¹¹ <https://www.unep.org/environmentassembly/unea4>

¹² <https://wedocs.unep.org/bitstream/handle/20.500.11822/28473/English.pdf>

¹³ <https://wedocs.unep.org/bitstream/handle/20.500.11822/28471/English.pdf>

¹⁴ The resolution recognized the necessity to address the full life cycle of plastic, called for establishment of an intergovernmental negotiating committee to develop legally binding international agreements regarding plastic pollution. <https://www.env.go.jp/press/files/jp/117593.pdf>

2 Developments at the G7 Summits

The issues of marine plastic have been discussed at the G7 Summits almost every year. Table 3-2-1 summarizes the discussions at the G7 Summits.

Table 3-2-1 Discussions on the issue of marine plastic at the G7 Summits

Host City	Date	Discussion
Elmau	June 2015	"G7 Action Plan to Combat Marine Litter" was adopted
Ise Shima	May 2016	Declaration on Resource Efficiency and the 3Rs Development
Charlevoix	June 2018	"G7 Ocean Plastics Charter" was adopted
Cornwall	July 2021	Establishment of a new international agreement on marine plastic was mentioned

The "Nature Compact," adopted at the G7 Cornwall Summit held in England in July 2021, clearly states, "building on the 'Osaka Blue Ocean Vision,' we will accelerate action to tackle the increasing levels of plastic pollution in the ocean from all sources — land and marine — including by working through the UN Environment Assembly on options including strengthening existing instruments and a potential new global agreement or other instruments to address marine plastic litter, including UNEA-5."¹⁵

3 Developments at the G20 Summits

Just as at the G20 Osaka Summit in 2019, where the "Osaka Blue Ocean Vision" was agreed upon, discussions have been held on issues of marine plastic at the G20 Summits. Table 3-2-2 summarizes the discussions.

Table 3-2-2 Discussions on the issue of marine plastic at the G20 Summits

Host City	Date	Discussion
Hamburg	July 2017	"G20 Action Plan on Marine Litter" was adopted
Osaka	June 2019	The "Osaka Blue Ocean Vision" was agreed upon The "Marine Initiative" was launched in Japan
Rome	October 2021	In line with the "Osaka Blue Ocean Vision", the commitment to address plastic litter was reaffirmed

The G20 Rome Summit carried on the discussion held at the G20 Osaka Summit. The G20 Rome Leaders' declaration states, "In line with the "Osaka Blue Ocean Vision", we reaffirm our commitment to address marine plastic litter, building on the initiatives conducted, inter alia, by the UNEA."¹⁶ At the Summit, Japan expressed its commitment to take the initiative in implementing the "Osaka Blue Ocean Vision."

4 Vision for Future Developments

Marine plastic litter is a global pollution issue, and it is imperative for countries across the world to take a collaborative approach to address it. As mentioned at the G7 Cornwall Summit held in July 2021, establishing legally binding international instruments such as conventions, agreements, and/or arrangements, is an important option. The European Commission (EC) finds that with the current measures only a 7% reduction in marine plastic pollution could be achieved.¹⁷ Currently, more than 100 countries call for establishment of international instruments

¹⁵ <http://www.g7.utoronto.ca/summit/2021/cornwall/210613-nature-compact.html>

¹⁶ <https://www.consilium.europa.eu/media/52730/g20-leaders-declaration-final.pdf>

¹⁷ https://ec.europa.eu/environment/topics/plastics/global-action-plastics_en

¹⁸ https://www.spf.org/global=data/opri/perspectives/prsp_024_2021_zhu.pdf

on plastic pollution. There are several international conventions concerning plastics: The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal; The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter; The Bonn Convention on the Conservation of Migratory Species of Wild Animals; The Convention on Biological Diversity; and the MARPOL Convention for the Prevention of Pollution from Ships.¹⁸ However, these conventions do not directly address marine plastic pollution. Instead, each refers to plastics in the context of its own objectives, such as wildlife and biodiversity conservation. Building on the historical resolution at UNEA-5.2, development of an international convention specifically on plastic pollution is expected.

International conventions should be drafted based on scientific knowledge of marine plastics. However, there are currently not enough scientific data on the distribution of marine plastic debris, including microplastics, the sources and leaching pathways, and the effects on the environment, ecosystems, and human beings. Moreover, there is no internationally unified methodology to monitor marine plastics (especially microplastics), and efforts to harmonize methodologies are called for. Field surveys of microplastics require sampling, pretreatment, and quantification analysis, with the pretreatment and quantification methodologies relying mainly on the subjective judgements of the researchers. In addition, identification methods for plastic according to size have also not been standardized. In future, it is important for researchers from various countries to build a solid scientific foundation for developing and standardizing international monitoring methodology.¹⁹

(Mengyao Zhu)

¹⁹ The Ministry of the Environment of Japan released "Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods," which was revised in 2020. The Ministry held the "G20 Workshop on harmonized monitoring and data compilation of marine plastic litter." <https://g20mpl.org/archives/893>

2 National Developments

1 Field Survey

In 2019, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) conducted a field survey and found an area offshore the Boso Peninsula where a large amount of plastic debris had accumulated.²⁰ The density of plastic debris found on the abyssal seafloor at the depth of approximately 6,000m — 4561 items/km² on average — was two orders of magnitude higher than previously recorded values for plastic debris on abyssal seafloors. Among a variety of items, the most prevalent were disposable plastics. Food packaging that was manufactured in 1984 was found in an almost intact state. The photo taken illustrates that the deterioration of plastic is extremely slow in the deep-sea where the water temperature is low, and that plastic manufactured even 35 years ago can remain almost intact. JAMSTEC anticipates the existence of another accumulation offshore of Shikoku Island, due to the pattern of the Japan Current. This would contribute to a further understanding of marine plastics distribution.

Progress has been made in understanding the pathways of household waste flowing into the ocean. The effect of measures to prevent diffidence of land-based

²⁰ https://www.jamstec.go.jp/e/about/press_release/20210330/

wastes is readily seen in the Seto Inland Sea, where there is little inflow of marine debris from the outer sea. The Seto Inland Sea Environmental Conservation Special Measures Act, revised in June 2021, stipulates that the national and local governments are obligated to cooperate in efforts to reduce generation of marine debris as well as carry out its removal. Furthermore, the Act stipulates that in addition to drifting debris and debris found on the seafloor, the obligation to remove and control generation of debris should also apply to that washed ashore and litter scattered on beaches. Okayama, Hiroshima, Kagawa, and Ehime Prefectures, which encircle the Seto Inland Sea, initiated the Setouchi Oceans X Project in partnership with The Nippon Foundation to develop comprehensive marine debris countermeasures. The project conducted a half-year large-scale survey of the origins of marine debris from December 2020. 280 rivers in the four prefectures running through densely inhabited areas and their tributaries and canals, for a total of 1,200 km, were divided into 50-meter sections. Researchers on foot identified the spots where the greatest accumulation of litter were observed in each section and counted pieces of litter larger than 2.5 cm. Items of litter were classified as 1) disposable shopping bags, 2) PET bottles, 3) plastic pieces, 4) bag litter, and 5) cans, bottles, and/or paper scraps; the number of top 2 litter types were reported for each. About 85 kg of plastic litter were found per every kilometer. It was estimated that more than 200 tons of plastic debris flow into the Seto Inland Sea every year (See Figure 3-2-3).



Figure 3-2-3 Data Aggregation Dashboard

Figure Details of the survey result are released on the website, Setouchi Oceans X Data Platform. <https://naigai-map.maps.arcgis.com/apps/dashboards/203aa87cece4f5eb5fb63c4c11971e1>

In the report of the survey, countermeasures are recommended for each area according to the characteristics of litter types. Regarding countermeasures, the Ministry of the Environment released “A Collection of Cases on Measures to Reduce Marine Litter Generation” in June 2021. The Ministry also released a Guide-

line for Survey of Scattered Litter, a Guideline for Research of Microplastics in Rivers, a Guideline for Research of Composition of Garbage Washed Ashore, and A Guide for Regional Planning under the Act on Promoting the Treatment of Marine Debris.²¹

²¹ <https://www.env.go.jp/press/109731.html>

2 Enhancing the Cycle of Recovery and Recycling

The Plastic Resource Circulation Act was approved by the Cabinet on March 9, 2021, and came into force in April 2022.²² The act requires the national government to develop guidelines for environmentally friendly product design and to establish a mechanism to certify products designed in accordance with the guidelines. On the twelve single-use plastic items specified, recommendations and orders are given to suppliers to reduce the number of products to be provided, to charge for products, and to reevaluate material.²³ To allow municipalities to collect plastic waste in general in addition to containers and packaging waste, and to allow manufacturers and retailers to collect and recycle their used plastic products, the existing laws and regulations such as the Containers and Packaging Recycling Law and the Waste Disposal Act will be liberalized. To encourage the shift to a Sound Material-Cycle Society, administrative directions, orders, and penalties may be issued to waste generators who generate large amounts of plastics. Also the names of violators may be made public.

²² See the Ministry of the Environment's special site for Circulation of Plastic Resources. <https://plastic-circulation.env.go.jp>

²³ Forks, spoons, knives, stirrer sticks, straws, hairbrushes, combs, shaving razors, shower caps, toothbrushes, hangers, and garment bags.

In preparation for implementation of the Plastic Resources Circulation Act, many entities started initiatives to collect and recycle plastic products.²⁴ Efforts to implement horizontal recycling stand out. Horizontal recycling refers to the process of resource circulation to recover used plastic products, convert them back into source material, and then use it to manufacture the same products. Many municipalities collaborated with various beverage manufacturers in the horizontal recycling of PET bottles (Bottle-to-Bottle recycling).

²⁴ Aside from PET bottles, collaborative demonstration projects, in which multiple manufacturers collected used detergent bottles and shampoo refill pouches together using shared collection boxes, were conducted to promote the implementation of horizontal recycling, including Collaborative Plastic Recycling Program of Tokyo, Kobe Plastic Next Program: Refill Pack Recycle of Kobe City, Hyogo prefecture, and MEGURU BOX Project of Kitakyushu City, Fukuoka prefecture.

There are new cases of upcycling efforts, too. Some local governments on remote islands and coastal regions have been plagued with massive amount of litter washed ashore. In 2021, Tsushima City in Nagasaki prefecture, Munakata City in Fukuoka prefecture, Ishigaki City in Okinawa prefecture and others announced upcycling initiatives to produce objects of value from marine litter in collaboration with beverage manufacturers. As for collaboration between corporations, the Alliance for the Blue produced a new series of Toyooka Bag Brand, utilizing recycled fiber made from discarded fishing nets.²⁵

²⁵ <https://www.nippon-foundation.or.jp/journal/2021/60161>

²⁶ Plastic pipes used for oyster farming are typical marine litter in the Seto Inland Sea. Pieces of plastic synthetic turf are common in the sea and rivers in Japan and they accounted for 20% of the total number of plastic litter items in the microplastic survey conducted by Pirika, a litter cleaning venture business, in fiscal year 2020.

The Project Ikkaku is a collaborative project of The Nippon Foundation, Japan Advanced Science and Technology Organization for Education, Human Development and Research (JASTO) and Leave a Nest Co., Ltd. The project aims to realize social implementation by businesses to reduce ocean debris. One of the interdisciplinary teams of the project, Team Material Circulator, made prototypes of traffic cones and shopping baskets from plastic pipes used for oyster farming and synthetic turf recovered from the oceans.^{26, 27} Another interdisciplinary team of Project Ikkaku, Team Eco Trinity, successfully converted microplastics, collected from seawater using a collection device installed on a Mitsui O.S.K. Lines operated ves-

²⁷ <https://prtimes.jp/main/html/rd/p/000000023.000015952.html>

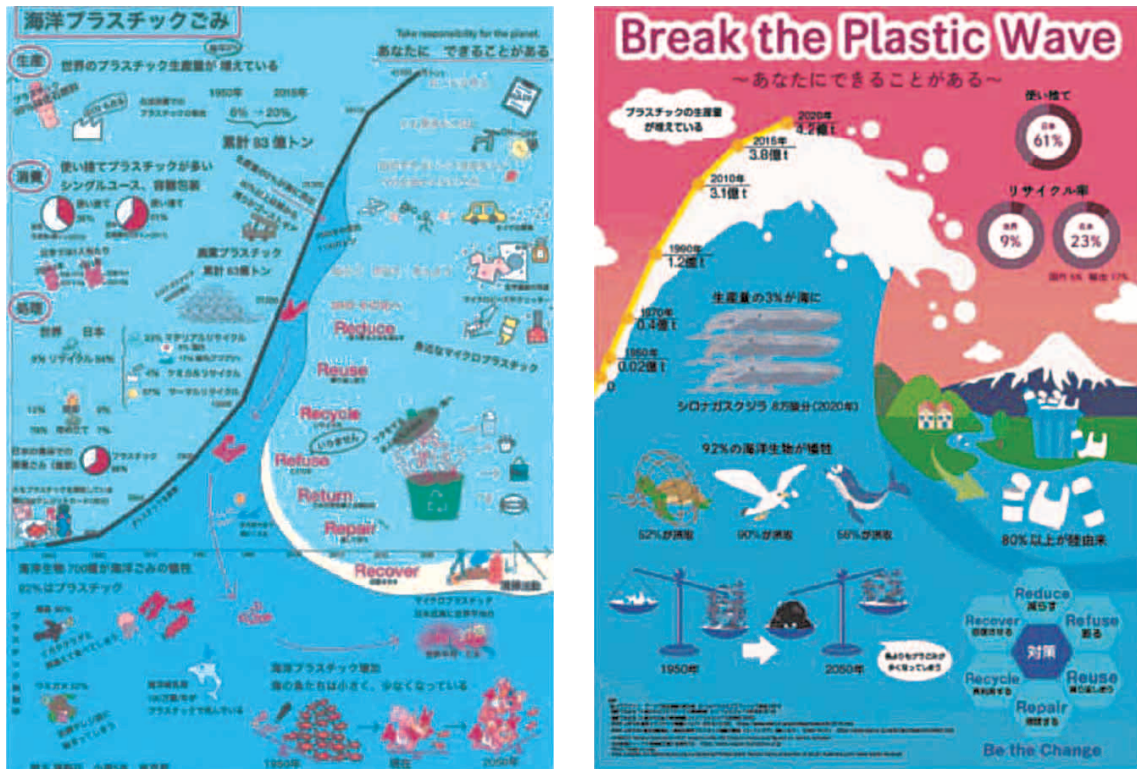


Figure 3-2-4 Ocean Infographic Contest first-place award winner. Marine Plastic Issues : There is Something You Can Do. (Erika Suzuki in fifth grade, Designer : Yuki Hamada)

sel, into carbon products by mixing them with microalgae and heating. This could be used as an energy resource.²⁸

Against a backdrop of growing interest in plastics recycling, Mitsui Chemical and IBM Japan have announced a partnership to establish a resource circulation platform using blockchain technology.²⁹ To ensure the safety of recycled products and prevent greenwashed products from entering the market, a mechanism to enhance material traceability is needed.

School children have also been involved. The Nippon Foundation and the Ministry of the Environment co-sponsored the third Zero Marine Debris Award. There were 276 submissions. The Blue Earth Project, in which female high-school students spread the word about marine debris issues through curbside events and through restaurants, won the first-place award. The project implementing body, Blue Earth High School, is an operation which has supported a network for learning for more than 1,000 female high-school students in 19 locations at home and abroad for fifteen years. Currently, more than 200 female students come together to organize and manage ecology awareness building projects, among other activities.

In the summer, the Ocean Infographic Contest of the Ocean and Japan Project was held for elementary school children nationwide.³⁰ A submission illustrating the marine plastic issue with a large wave was awarded first prize. Even though they could freely choose their theme, multiple children chose the marine plastic issue. It is encouraging to see the younger generation's high interest in the marine debris issue.

(Chiyo Setouchi)

²⁸ <https://www.mol.co.jp/en/pr/2021/21105.html>

²⁹ https://jp.mitsuichemicals.com/en/release/2021/2021_0426.htm

³⁰ In this contest, children participated an ocean seminar in June and wrote a report on free research projects. Selected 20 students collaborated with designers (in partnership with Ochanomizu Art Collage) in pairs to create infographics in August. <https://unipro.tokyo/Infographic/>

3 International and National Developments in and Around the Arctic Region

In the Arctic, temperatures are rising three times faster than the global average. Global warming has been causing rapid and widespread changes in sea and land ice (glaciers and ice sheets), permafrost, snow cover, and other physical aspects and characteristics. Warmer Atlantic and Pacific waters flowing in the Arctic Sea and reduced sea-ice cover are resulting in northward range expansions of sub-arctic fish and marine mammal species.³¹ These rapid changes in the Arctic environment led to practical use of the Northern Sea Route and resource development in the Arctic Sea, and international interest in the Arctic has been rapidly growing. The Arctic Council (AC) is a high-level forum promoting coordination and interaction among the Arctic States on common Arctic issues.³² Japan has had Observer status in the AC since 2013, and has been participating and contributing to discussions at the AC.

In 2021, important meetings such as the 12th Arctic Council Ministerial Meeting and the third Arctic Science Ministerial Meeting were held. In this section, recent international developments concerning the Arctic are reviewed, with a focus on these meetings and Japan's contributions.

31 Arctic Monitoring and Assessment Programme (AMAP), Arctic Climate Change Update 2021 Key Trends and Impacts, Summary for Policy-makers, 2021. <https://www.amap.no/documents/download/6759/inline>

32 <https://arctic-council.org/>



Figure 3–3–1 Map of the Arctic

The Arctic is a region north of latitude 66°30' N. The five Arctic Coastal States—Canada, the United States, Denmark, Norway, and Russia—have coastal frontage on the Arctic Ocean. Together with Finland, Iceland, and Sweden these constitute the eight Arctic States.

Source : <https://www.state.gov/key-topics-office-of-ocean-and-polar-affairs/arctic/>

1 Developments at the Arctic Council

The Arctic Council was established in 1996 by the non-legally binding Ottawa Declaration as a high-level forum to provide a means for promoting discussion and cooperation on common Arctic issues.^{33, 34} The eight Arctic States—Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States—constitute the member states of the Arctic Council. Among the functions of the AC are to provide a means for promoting cooperation, coordination, and interaction on common Arctic issues and to adopt terms of reference for, and oversee and coordinate, a sustainable development program (Article 1). It is noteworthy that the Declaration gives Arctic organizations of indigenous people the status of Permanent Participants in the AC and ensures their active participation and full consultation (Article 2 paragraph 4).³⁵ Non-Arctic States and inter-governmental and non-governmental organizations that the Council determines can contribute to its work are allowed to participate in the meetings as Observers (Article 3).

The ministerial meeting is normally held biennially, while meetings of Senior Arctic Officials take place more frequently (Article 4).³⁶ The Declaration stipulates that decisions of the AC are to be made by consensus of the members (Article 7). Article 5 of the Declaration stipulates “responsibility for hosting meetings of the Arctic Council, including provision of secretariat functions, should rotate sequentially among the Arctic States.” The Rules of Procedure prescribe that the Host Country shall act as chair of the AC from the conclusion of a biennial Ministerial meeting to the conclusion of the next biennial Ministerial meeting. The Senior Arctic Officials (SAO) meetings during the period are held in the chair State in principle, and the host country serves as the secretariat of the meetings for the two years.

Iceland held the chairmanship of the twelfth Ministerial meeting of the AC, which was held in Reykjavik, Iceland on May 20, 2021. Ministers of the member states and representatives of Arctic organizations of indigenous people got together and adopted the Reykjavik Declaration. After the preamble, the text of the declaration is divided into five parts: 1) People and Communities of the Arctic, 2) Sustainable Economic Development, 3) Climate, Green Energy Solutions, Environment, and Biodiversity, 4) Arctic Marine Environment, and 5) Stronger Arctic Council. The declaration reaffirmed the AC’s commitment to maintain peace, stability, and constructive cooperation in the Arctic region.

The Declaration also emphasized the Arctic States’ unique position to promote responsible governance in the region and asserted the importance of immediately addressing climate change in the Arctic.³⁷ At the previous Ministerial meeting held in Finland in 2019 a joint declaration was not adopted, but the Biden Administration’s emphasis on international cooperation seems to have made the unanimous decision possible.

At the 12th Ministerial meeting, the first ever Arctic Council Strategic Plan (2021–2030) was adopted in the 25 years since the establishment of the AC. The Plan

³³ Ottawa Declaration (1996) https://oaarchive.arctic-council.org/bitstream/handle/11374/85/EDOCS-1752-v2-AC-MMCA00_Ottawa_1996_Founding_Declaration.PDF?sequence=5&isAllowed=y

³⁴ The Ottawa Declaration stipulates that the Arctic Council should not deal with matters related to military security.

³⁵ Aleut International Association, Arctic Athabaskan Council, Gwich’in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North, and Saami Council.

³⁶ At the first ministerial meeting held in 1998 in Iqaluit, Canada, the Arctic Council Rules of Procedure were adopted. The biennial meeting of the AC is named “Ministerial Meetings” and more frequent meetings are named Senior Arctic Officials (SAO) meetings.

³⁷ <https://www.arctic-council.org/news/arctic-council-foreign-ministers-sign-the-reykjavik-declaration-adopt-councils-first-strategic-plan/>

38 During its Chairmanship, Iceland emphasized work on the Arctic marine environment, climate and green energy solutions, people and communities in the Arctic, and strengthening the Arctic Council.

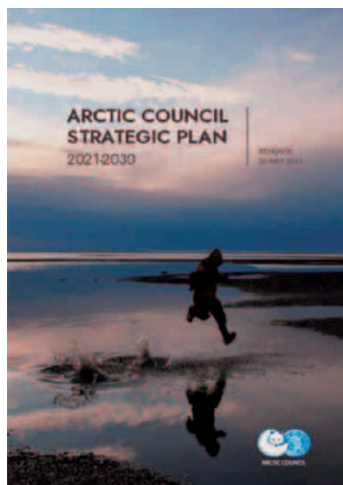


Figure 3-3-2 Arctic Council Strategic Plan (2021–2030)

Source : <https://oaarchive.arctic-council.org/handle/11374/2601>

set seven goals for the Council to work towards 1) Arctic Climate, 2) Healthy and Resilient Arctic Ecosystems, 3) Healthy Arctic Marine Environment, 4) Sustainable Social Development, 5) Sustainable Economic Development, 6) Knowledge and Communications, 7) Stronger Arctic Council.

At the meeting, the two-year Chairmanship was passed from Iceland to the Russian Federation for the next two years.³⁸ Responsible Arctic governance for sustainable development will be the main priority of the Russian Chairmanship. During its Chairmanship, Russia plans to focus on “Responsible Governance for a Sustainable Arctic” through promoting collective approaches to the sustainable development of the Arctic in a balanced way — environmentally, socially, and economically — enhancing synergy and cooperation and coordination with other regional structures, as well as the implementation of the Arctic Council’s Strategic Plan (2021–2030), while respecting international law.

The Russian Chairmanship sets the following priority areas: Peoples of the Arctic, including Indigenous Peoples; Environment protection, including Climate Change; Socio-Economic Development; and Strengthening of the Arctic Council.

To improve the work of the AC, the Russian Chairmanship intends to increase the effectiveness of the AC’s Working and Expert groups, the Secretariat, to develop a mechanism for financing the Council’s activities, to implement decisions and recommendations, to encourage dialogue and interaction with the Observers, as well as to further intensify collaboration of the Arctic council with the Arctic Economic Council, the Arctic Coast Guard Forum, and the University of the Arctic.^{39, 40}

To improve the work of the AC, the Russian Chairmanship intends to increase the effectiveness of the AC’s Working and Expert groups, the Secretariat, to develop a mechanism for financing the Council’s activities, to implement decisions and recommendations, to encourage dialogue and interaction with the Observers, as well as to further intensify collaboration of the Arctic council with the Arctic Economic Council, the Arctic Coast Guard Forum, and the University of the Arctic.^{39, 40}

2 Japan’s Recent Initiatives regarding the Arctic

Japan is in a geographical area susceptible to the effects of climate change in the Arctic. It also is the closest country in Asia to the Arctic Sea and could exploit economic and commercial opportunities such as utilization of the Arctic Sea Route and natural resources development. Considering its Arctic policy an important national issue, the government of Japan formulated its first comprehensive Arctic Policy in October 2015.^{41, 42} The Third Basic Plan on Ocean Policy, formulated in May 2018, positioned the Arctic Policy as a priority policy for the first time.⁴³

The 3rd Arctic Science Ministerial (ASM3) was held in Tokyo on May 8–9, 2021, co-hosted by Japan and Iceland. Delegates from thirty-five countries, regions, and indigenous peoples’ organizations participated. It was the largest number ever. The Arctic Science Ministerial is a meeting intended to promote research and observation and countermeasures for major social problems in the Arctic, and to further

39 Arctic Council, Senior Arctic Officials’ Report to Ministers 2021. 12th Arctic Council Ministerial meeting, Reykjavik, Iceland 20 Many 2021.

40 On March 3, 2022, after the beginning of the crisis in Ukraine, the Member States except for Russia issued the following joint statement: “Our representatives will not travel to Russia for meetings of the Arctic Council. Additionally, our states are temporarily pausing participation in all meetings of the Council and its subsidiary bodies, pending consideration of the necessary modalities that can allow us to continue the Council’s important work in view of the current circumstances.” <https://www.state.gov/joint-statement-on-arctic-council-cooperation-following-russias-invasion-of-ukraine/>

41 <https://www8.cao.go.jp/ocean/policies/arcticpolicy/arcticpolicy.html>

42 https://www8.cao.go.jp/ocean/english/arctic/pdf/japans_ap_e.pdf

43 https://www8.cao.go.jp/ocean/english/plan/pdf/plan03_gaiyou_e.pdf



Figure 3-3-3 A Scene from the 3rd Arctic Science Ministerial (ASM3)

Source : MEXT

scientific cooperation among concerned states and with indigenous peoples' organizations. The ASM3 was co-hosted by the Ministry of Education, Culture, Sport, Science and Technology (MEXT) of Japan and the Ministry of Education, Science and Culture of Iceland. Koichi Hagiuda, Minister of MEXT of Japan and Lilja Alfreðsdóttir, Minister of Education, Science and Culture of Iceland co-chaired the meeting. *Knowledge for a Sustainable Arctic* was the overarching theme for ASM3 and included four sub-themes under the titles : *Observe, Understand, Respond, Strengthen*.⁴⁴ It was agreed to promote international cooperation in scientific fields concerning the Arctic, enhance understanding, and to support science, which is the basis of policymaking in the Arctic.⁴⁵

At the Arctic Circle Assembly convened in October 2021, in Reykjavik, Iceland, a handover ceremony from ASM3 to ASM4 was held.⁴⁶ At the ceremony Ryotaro Suzuki, Japanese Ambassador to Iceland, stated that it was essential to further strengthen international cooperation—Arctic and non-Arctic states together—in science, and that the Arctic research vessel, which Japan has started to construct, would be used as an embodiment of international collaboration in the Arctic.⁴⁷ Mikhail Noskov, Russian Ambassador to Iceland, stated that the quality of life and well-being of the Arctic inhabitants is a priority within the ASM4 framework, and that they would concentrate on 1) Development of scientific cooperation in the Arctic, 2) The Arctic Seas, 3) Sustaining the Biodiversity, 4) Indigenous peoples and their traditional environment, 5) Education, and 6) Climate Change.

A final decision was made to construct a new Arctic research vessel with ice-breaking capability. The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) currently owns and operates an oceanographic research vessel, *Mirai*, which has performed observational operations many times in the Arctic and Antarctic, but since it does not have icebreaking capability can't enter sea-ice areas. The new Arctic research vessel is designed to have continuous icebreaking capacity of floe (flat ice) of up to 1.2 meters in thickness, which would make many new observations including sea-ice observation possible.

⁴⁴ *Observe* : Implementing Observing Networks ; Data-Sharing, *Understand* : Enhancing Understanding and Prediction Capability for Arctic Environmental and Social Systems, for the Global Impact of These Changes, *Respond* : Operationalizing Sustainable Development, Evaluating Vulnerability and Resilience, and Applying Knowledge, *Strengthen* : Preparing the Next Generation through Capacity Building, Education, Networking ; and Resilience.

⁴⁵ https://www.mext.go.jp/b_menu/activity/detail/2021/20210508.html

⁴⁶ Beside Ambassador Suzuki, Lilja Alfreðsdóttir, Minister of Education, Science and Culture of Iceland, Mikhail Noskov, Russian Ambassador to Iceland, and Sophie Laszlo, French ambassador to Iceland were among attendees.

⁴⁷ <https://www.youtube.com/watch?v=TIS0ZmymAak&list=PLI0a77tmNMvSz9UV6iIPzMfAnu8qiY7vj&index=46>

The importance of capacity building of young Arctic researchers has been recognized in Japan as well as in Arctic and non-Arctic countries. JAMSTEC intends to operate the new research vessel as a “platform of international research.” To reduce environmental load, the research vessel will feature a dual-fuel (diesel and LNG) engine and new equipment such as an advanced fishfinder.

Currently, there is an urgent need for capacity building of the next generation of Arctic researchers in Arctic States and non-Arctic States as well. At ASM3, Koichi Hagiuda, Minister of MEXT of Japan, proposed utilizing the new Arctic research vessel as an international platform and promoting capacity building. It is expected that capacity building among researchers who can contribute to problem solving in the Arctic will accelerate through use of the research vessel.

(Sakiko Hataya)



Reference Materials

The Natural World Heritage Site Amami Trail

IWAMOTO Chizuru

Councilor, Amami World Natural Heritage Office, Nature Conservation Division, Environment and Forestry Affairs Department, Kagoshima Prefectural Government (Ocean Newsletter No. 511, 20 November 2021)

In July 2021, Amami-Oshima Island and Tokunoshima Island were at last designated as Natural World Heritage sites. In the Amami Island group where these two islands are located, there is a long-distance nature walking trail called the Amami Natural World Heritage Trail where one can stroll through and enjoy the nature and culture of eight inhabited islands.

Amami Trail is aiming for conservation of the natural environment, the preservation and the passing on of environmental culture, and revitalization of the community, while also going forward with plans for sustainable tourism.

Inscription as a World Natural Heritage Site

On July 26, 2021, the 44th session of the World Heritage Committee declared the inscription of four regions that are part of the Nansei Islands, namely Amami-Oshima Island, Tokunoshima Island, the Northern part of Okinawa Island, and Iriomote Island, as World Natural Heritage sites. It has been about 18 years since work began to achieve World Natural Heritage status, and finally the efforts and thoughts of many people have come to fruition.

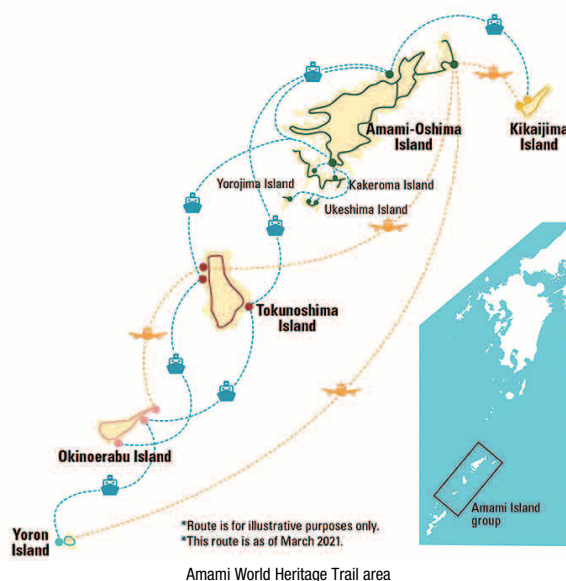
The committee evaluated these areas as meeting the conditions required for the inscription because of the wide variety of flora and fauna that grow and inhabit them, including living creatures unique to the islands. The Nansei Islands have a subtropical climate, and they have repeatedly been connected and separated from the Eurasian continent through tectonic and climatic changes before taking their present form. In addition, the warm Kuroshio Current and the seasonal winds that blow from across the Pacific Ocean in summer and from the continent in winter provide warmth and abundant rainfall throughout the year. Under these conditions, plants and animals that were separated from the continent and other islands evolved independently

on each island creating a unique ecosystem. In particular, four of the most biodiverse areas were inscribed as World Natural Heritage sites, but the other islands are no less spectacular.

These areas were inscribed on the World Natural Heritage List to preserve their precious natural environments, to make more people aware of their beauty, and to pass it on to future generations. It is crucial to maintain their natural environments even after being inscribed, and balancing conservation and utilization is key to this effort. To realize these efforts, Kagoshima Prefecture, where Amami-Oshima and Tokunoshima islands are located, has been working on such as measures against invasive alien species and protecting rare species. The prefecture also formulated the “Master Plan of the Amami Island Group Sustainable Tourism” in fiscal 2015. The plan aims to conserve the natural environment, preserve and pass on environmental cultures, and revitalize the entire community while also going forward with plans for sustainable tourism. One of the plan’s initiatives is the Amami World Heritage Trail (the “Amami Trail”).

The Amami Trail is filled with local charms and attractions

Along with Amami-Oshima Island and Tokunoshima Island, the Amami Island group has a total of 8 inhabited islands, including Kakeroma Island with its beautiful rows of Indian coral trees, Ukeshima Island with its rare insects and plants, Yorojima Island with its traditional coral stone walls, Kikaijima Island, one of the fastest-rising coral reef islands in the world, Okinoerabu Island with its flowers and limestone caves, and Yoron Island with its white sandy beaches and beautiful Yoron blue sea. The Amami Trail is a long-distance nature walking trail connecting these inhabited islands. It is designed to enable locals and visitors become familiar with the islands’ nature and culture, and also to spread the benefits of having Amami-Oshima and Tokunoshima Islands inscribed as World Natural Heritage sites to the entire region, and to strengthen ties between the islands.



The Natural World Heritage Site Amami Trail

The Amami Trail is divided into 14 areas covering the 8 inhabited islands, with 3 to 6 courses in each area. In setting up the courses, local municipal offices, local community development cooperatives, and local residents were asked to gather for meetings at places like assembly halls and community centers. Inviting experts on trails as instructors, we exchanged ideas with everyone. This style allowed information about local attractions and pleasant walking trails to be shared. Examples included routes with beautiful ocean views, trails lined with giant trees, and paths that provide a sense of the traditional culture. We also developed the proposed courses based on convenience and safety factors, such as whether there are public restrooms and rest areas nearby and whether there are dangerous areas. For some of the proposed courses, local participants actually walked the course together and exchanged opinions to complete the courses.

After the courses were finalized, trail maps were produced for each area. They include information on points of interest, facilities and stores where visitors could take breaks and get drinking water, and precautions for walking. Guide boards were also installed along the courses to post the information. The maps were drawn by illustrators with ties to each area, and the designs vary from map to map.

In this way, each course was opened in order of completion. Course selection began in fiscal 2016 and was completed for all 14 areas by fiscal 2019. All courses were opened by January 2021 (14 areas, 51 courses, total length of approximately 550 km).

To celebrate the opening of the entire route, Mr. Naomi Nomoto (representative of Kagoshima Kayaks), who assisted as a lecturer when the courses were selected, walked the entire route as a trail monitor over about six weeks. His

journey can be seen on the Amami World Heritage Trail's Facebook page.^{※1}

What you feel and see when you walk

The natural environment and culture of the Amami Island group are similar in some ways to the mainland and other islands but unique in others. The charms of each area, which cannot be expressed in words alone, are scattered throughout the Amami Trail.

By walking each course while viewing the ocean and forests, feeling the presence of living things, and thinking about local history, culture, and legends, visitors can experience things they would never see from a car or bus and take in unique landscapes. In addition to local nature and culture, the Amami Trail also provides opportunities to interact with other walkers and local residents. Some of the courses also pass through mountains. The use of a local eco-tour guide is particularly recommended on these courses. Walking the mountain courses while listening to these guides will help you learn more about the charms of the area and trails.

The current spread of COVID-19 infections continues to make it difficult for people to travel and move around as they wish. The Amami Island group, which are remote islands, do not have fully-fledged medical systems, so the spread of infection is a serious problem. Although it may take some time, we hope that when the risk of Covid-19 infection recedes, you will take the opportunity to visit the islands and walk the Amami Trail. Information about the Amami Trail is available on Facebook and the Kagoshima Prefectural Government's website^{※2}. (End)



Trail Maps



Oganeku beach in the Yoron Island area. The three courses on Yoron Island primarily focus on the coastline (total length : 24.3 km). The clear Yoron blue sea and white sandy beaches soothe walkers' bodies and souls.

※1 Facebook : Amami World Natural Heritage Trail
<https://www.facebook.com/amamitrail.kagoshima/>

※2 Kagoshima Prefectural Government's Website
<https://www.pref.kagoshima.jp/ad04/kurashi-kankyo/kankyo/amami/amami-trail.html>

A New Approach for a Fertile Seto Inland Sea

OKADA Mitsumasa

Professor Emeritus, Hiroshima University and The Open University of Japan
(Ocean Newsletter No.506, 5 September 2021)

Improvements are being made to the water quality of the Seto Inland Sea, once called the “Dying Sea,” through a variety of water quality conservation measures such as wastewater regulations. However, as new issues such as declining fish catches and frequent occurrences of color-fading in nori (dried seaweed) have come to the forefront, special measures have been approved for the management of nutrients to ensure the diversity and productivity of estuarine ecosystems. It can be said that this large shift in the water environment administration is completely different from wastewater regulations to date, namely, the simple reduction of pollutants such as nutrients.

Improvements to Water Quality in the Seto Inland Sea

The Seto Inland Sea became increasingly polluted during Japan's period of rapid economic growth, at one point deteriorating to the point that it became known as a "dying sea." Measures to combat this situation included effluent regulations and total loading reductions under the Water Pollution Control Law and the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea¹⁾ (hereinafter referred to as the Seto Law), which resulted in improvements to the quality of the water. However, in recent years, new issues have come to light, such as declining fish catches and frequent color fading in *nori* (dried seaweed). This article will introduce the history of the various efforts to restore the Seto Inland Sea and the new system enacted this year, which aims to create a more fertile sea through a focus on nutrient management.

Water Quality Targets for Environmental Conservation and Their Achievement

When conserving and restoring any environment, it is essential to define the desired state of the environment, i.e., the goals being aimed for. For example, the first Seto Law aimed to conserve water quality and natural landscape in response to rapidly worsening water pollution in the Seto Inland Sea between 1965 and 1974. The first measure to improve water quality involved using chemical oxygen demand (COD) as a parameter for environmental water quality standards (EWQS) to prevent organic pollution²⁾. To achieve these standards or targets, various effluent regulations based around COD have been implemented. However, it became clear that COD alone was not enough to prevent eutrophication like the outbreaks of red tide. Therefore, nutrients (total nitrogen and total phosphorus), which are the limiting factors of eutrophication, were added to EWQS, and their effluent has also been regulated.

So, what happened to the water quality as a result? According to the Results of the FY 2019 Water Quality Survey of Public Water Areas, the compliance rate for EWQS in COD in the Seto Inland Sea excluding Osaka Bay

— as well as Osaka Bay itself — were still low at 77% and 66.7%, respectively. However, the EWQS compliance rates for total nitrogen and total phosphorus were extremely high at 98% and 100%, respectively. Compared to the compliance rates of 0% and 60% for total nitrogen and total phosphorus, respectively, when the standards were introduced (1995-1996), these results indicate that effluent control and other measures have been successful.

From Conserving Water Quality to Restoring the Seto Inland Sea

Despite EWQS having been largely achieved, biological productivity is stagnant, as revealed through declines in fish catches and frequent color fading in *nori*. There is a growing awareness that water quality conservation alone will not restore the once bountiful Seto Inland Sea.

Alongside the previous notion of focusing on water quality conservation, the 2015 revision to the Seto Law also includes the concept of "making the sea rich in biodiversity and productivity, and maximizing its diverse values and functions." It additionally mentions that measures for environmental conservation in the Sea "shall be implemented in accordance with the respective conditions of bays and other open sea areas." The two previous goals of conserving water quality and natural landscape were replaced by four new goals: "conservation, restoration and creation of the coastal environment," "conservation and management of water quality," "conservation of natural and cultural landscape," and "ensuring sustainable use of fishery resources." In particular, the revision clarifies conservation, regeneration, and creation of the coastal environment, including the conservation of submerged aquatic vegetation (SAV) and tidal flats, as new goals for restoring a bountiful Seto Inland Sea. At the same time, the perspective of managing water quality in accordance with regional and seasonal characteristics was also added. Additionally, a new major goal was set to ensure the sustainable use of fishery resources by promoting the growth of aquatic plants and animals while considering the perspective of biodiversity and harmony

A New Approach for a Fertile Seto Inland Sea

with the environment.

Since these changes were made, it was pointed out that the impact on fishery resources due to nutrient deficiencies such as nitrogen and phosphorus, which were reduced through past efforts, and the decrease in SAV and tidal flats due to development, may worsen further. This situation has also been coupled with environmental changes such as the increase in water temperatures due to climate change. Furthermore, there has been increasing concern about the adverse effects of marine debris, including plastic litter, on the marine environment and its ecosystems.

In response, a further amendment to the Seto Law was enacted on June 3, 2021³⁾. The change adds a new objective: conserving the environment of the Seto Inland Sea by adding special measures for nutrient management in order to ensure biological diversity and productivity. Additionally, the law's basic principles now include the notion that the environmental conservation of the Sea must account for increases in water temperature and other environmental impacts due to climate change, and that these impacts may continue for a long time.

In particular, under the new nutrient management system, new special provisions have been established to allow for appropriate increases in nutrients in specific sea areas, such as through the direct release of nutrients and changes in wastewater treatment processes. Although the law makes it mandatory to ensure harmony and compatibility between nutrient management and conserving the surrounding environment, this change is a significant shift in the water environmental administration that is entirely unlike the previous regulations, which were based around one-way reductions.

However, the change manages nutrients essential for plant growth; excessive nutrients can lead to eutrophication problems such as red tides, while deficient nutrients can lead to reduced biological productivity. It can be said this regulation is unique in controlling substances that can have both positive and negative effects.

In the initial Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea, the entire Sea was treated as a single body of water. However, as water quality recovered, the Seto Inland Sea and Osaka Bay began to be treated as separate sea areas. In the previous revision in 2015, the Seto Inland Sea was managed according to the respective conditions of bay, and other open sea areas to achieve a more bountiful marine environment. In the 2021 revision, it can be said that the sea areas under the management were more precisely defined.



Areas covered by the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea (Source: Ministry of Land, Infrastructure, Transport and Tourism)

Aiming for a Newly Restored Seto Inland Sea

In this way, instead of managing the Seto Inland Sea as a homogeneous area, it has become possible to manage bays and even some specific areas of the Sea independently with targets that differ from those of the surrounding areas, enabling the restoration of the highly diverse Seto Inland Sea. To achieve this, biodiversity and biological productivity targets will need to be set for each marine area, and management methods will have to be extremely diverse.

However, each area of the Seto Inland Sea, its bays and specific marine areas are also interconnected. Therefore, target setting and nutrient management in one area should be consistent with other areas and the Sea as a whole. As the unique role of each area become even more critical, ensuring consistency in how the Seto Inland Sea as a whole is managed without conflicts will pose a significant challenge in the future.

It should be noted that nutrient management is only one aspect of ensuring biological productivity and diversity. There is no guarantee that nutrient management alone will achieve these goals. We must not forget that the conservation, restoration, and creation of SAV and tidal flats, as well as improvements to bottom sediment quality, must be implemented simultaneously. ■

1) When first enacted in 1973, it was called the Law Concerning Temporary Measures for Conservation of the Environment of the Seto Inland Sea, and followed in 1978 by the present act.

2) The amount of oxygen required to oxidize organic matter in water chemically. Acts as a metric for organic pollution in ocean regions. The higher the value, the more organic matter is in the water and the greater the degree of pollution.

3) An overview of the draft law to partially revise the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea: <https://www.env.go.jp/press/109207.html>

CARBIS BAY G7 SUMMIT COMMUNIQUÉ

Our Shared Agenda for Global Action to Build Back Better

We, the leaders of the Group of Seven, met in Cornwall on 11-13 June 2021 determined to beat COVID-19 and build back better. We remembered everyone who has been lost to the pandemic and paid tribute to those still striving to overcome it. Inspired by their example of collaboration and determination, we gathered united by the principle that brought us together originally, that shared beliefs and shared responsibilities are the bedrock of leadership and prosperity. Guided by this, our enduring ideals as free open societies and democracies, and by our commitment to multilateralism, we have agreed a shared G7 agenda for global action to:

- **End the pandemic and prepare for the future** by driving an intensified international effort, starting immediately, to vaccinate the world by getting as many safe vaccines to as many people as possible as fast as possible. Total G7 commitments since the start of the pandemic provide for a total of over two billion vaccine doses, with the commitments since we last met in February 2021, including here in Carbis Bay, providing for one billion doses over the next year. At the same time we will create the appropriate frameworks to strengthen our collective defences against threats to global health by: increasing and coordinating on global manufacturing capacity on all continents; improving early warning systems; and support science in a mission to shorten the cycle for the development of safe and effective vaccines, treatments and tests from 300 to 100 days.
- **Reinvigorate our economies** by advancing recovery plans that build on the \$12 trillion of support we have put in place during the pandemic. We will continue to support our economies for as long as is necessary, shifting the focus of our support from crisis response to promoting growth into the future, with plans that create jobs, invest in infrastructure, drive innovation, support people, and level up so that no place or person, irrespective of age, ethnicity or gender is left behind. This has not been the case with past global crises, and we are determined that this time it will be different.
- **Secure our future prosperity** by championing freer, fairer trade within a reformed trading system, a more resilient global economy, and a fairer global tax system that reverses the race to the bottom. We will collaborate to ensure future frontiers of the global economy and society, from cyber space to outer space, increase the prosperity and wellbeing of all people while upholding our values as open societies. We are convinced of the potential of technological transformation for the common good in accordance with our shared values.
- **Protect our planet** by supporting a green revolution that creates jobs, cuts emissions and seeks to limit the rise in global temperatures to 1.5 degrees. We commit to net zero no later than 2050, halving our collective emissions over the two decades to 2030, increasing and improving climate finance to 2025; and to conserve or protect at least 30 percent of our

land and oceans by 2030. We acknowledge our duty to safeguard the planet for future generations.

- **Strengthen our partnerships** with others around the world. We will develop a new partnership to build back better for the world, through a step change in our approach to investment for infrastructure, including through an initiative for clean and green growth. We are resolved to deepen our current partnership to a new deal with Africa, including by magnifying support from the International Monetary Fund for countries most in need to support our aim to reach a total global ambition of \$100 billion.
- **Embrace our values** as an enduring foundation for success in an ever changing world. We will harness the power of democracy, freedom, equality, the rule of law and respect for human rights to answer the biggest questions and overcome the greatest challenges. We will do this in a way that values the individual and promotes equality, especially gender equality, including by supporting a target to get 40 million more girls into education and with at least \$2¾ billion for the Global Partnership for Education.

We shall seek to advance this open agenda in collaboration with other countries and within the multilateral rules-based system. In particular, we look forward to working alongside our G20 partners and with all relevant International Organisations to secure a cleaner, greener, freer, fairer and safer future for our people and planet.

G7 2030 Nature Compact (excerpt)

A. We, the G7 Leaders, commit to the global mission to **halt and reverse biodiversity loss by 2030**. We will act now, building on the **G7 Metz Charter on Biodiversity** and the **Leaders' Pledge for Nature**, championing their delivery, to help set the necessary trajectory for nature to 2030.

B. Through this Compact, **we commit to supporting global consensus and to taking bold action for delivery of ambitious outcomes for nature in 2021** at the Convention on Biological Diversity (CBD) COP15 in Kunming and United Nations Framework Convention on Climate Change (UNFCCC) COP26 in Glasgow in particular. Climate change is one key driver of biodiversity loss, and protecting, conserving and restoring biodiversity is crucial to addressing climate change. Ahead of COP15 and COP26, as we embark upon this pivotal decade, we commit to tackle these interdependent and mutually reinforcing crises in an integrated manner, thereby contributing to the achievement of the Sustainable Development Goals and a green, inclusive and resilient recovery from COVID-19.

PILLAR ONE / Leading the Transition to sustainable and legal use of natural resources

We will shift incentives and use all appropriate levers to address unsustainable and illegal activities negatively impacting nature.

(1E) **Addressing the adverse impact of human activity, such as litter and unsustainable fishing practices, on the marine environment:** building on the Osaka Blue Ocean Vision, we will accelerate action to tackle the increasing levels of plastic pollution in the ocean from all sources - land and marine - including by working through the UN Environment Assembly on options including strengthening existing instruments and a potential new global agreement or other instrument to address marine plastic litter, including at UNEA-5. We will also work with or support the Global Ghost Gear Initiative (GGGI). We recognise the importance of international action to deter and end illegal, unreported and unregulated (IUU) fishing, including through support to developing countries, and we commit to concluding ongoing WTO negotiations as swiftly as possible to prohibit certain harmful fisheries subsidies that contribute to overfishing, overcapacity and IUU fishing.

PILLAR THREE / Protecting, Conserving and Restoring nature, including through ambitious global targets

We will support and drive the protection, conservation and restoration of ecosystems critical to halt and reverse biodiversity loss and environmental degradation, and to tackle climate change.

(3A) **Supporting new global targets to conserve or protect at least 30% of global land and at least 30% of the global ocean by 2030 as a critical foundation for the conservation and restoration efforts required this decade:** we will advocate for improved quality, effectiveness and connectivity of protected areas and other effective area-based conservation measures (OECMs), and recognise Indigenous Peoples as well as local communities as full partners in the implementation of these targets. We will lead by example, effectively conserving or protecting at least the same percentage of our national land, including terrestrial and inland waters, and coastal and marine areas by 2030, according to national circumstances and approaches, including, where appropriate, with legislation and adequate resourcing and enforcement to drive delivery.

(3C) Working together to agree and meet targets to increase the abundance of species populations worldwide, significantly reduce overall species extinction risk and eventually stop human-induced extinctions.

(3D) Driving increased global cooperation on the ocean, recognising that two thirds is outside of national jurisdiction: in support of increased ocean protection and conservation this decade, we will work to conclude the negotiation of a new and ambitious international legally binding instrument under the UN Convention on the Law of the Sea (UNCLOS) on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, if possible by the end of 2021. We also fully support the commitment of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to develop a representative system of Marine Protected Areas (MPAs) in the Convention area in the Southern Ocean based on the best available scientific evidence, and the proposals to establish new MPAs in East Antarctica, the Weddell Sea and the Antarctic Peninsula.

(3E) Supporting the UN Decade of Ocean Science for Sustainable Development: endorsing the G7 Ocean Decade Navigation Plan to drive developments in transformational ocean science to protect and further our sustainable relationship with the ocean. As part of this work we will convene scientific and policy experts to discuss the carbon absorption function of the ocean, furthering targeted and effective ocean action.

With the adoption of this Compact...

We commit to take strong and integrated global action on nature and climate, working alongside political leaders and other actors to drive ambitious outcomes for nature in 2021 at the CBD COP15, UNFCCC COP26 and the UN Ocean Conference, as well as at the UN Environment Assembly and the UN Convention on Combating Desertification in 2022. We will continue to increase our efforts throughout this critical decade.

Headline Statements from the Summary for Policymakers

A. The Current State of the Climate

- A.1** It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.
- A.2** The scale of recent changes across the climate system as a whole – and the present state of many aspects of the climate system – are unprecedented over many centuries to many thousands of years.
- A.3** Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5.
- A.4** Improved knowledge of climate processes, paleoclimate evidence and the response of the climate system to increasing radiative forcing gives a best estimate of equilibrium climate sensitivity of 3°C, with a narrower range compared to AR5.

B. Possible Climate Futures

- B.1** Global surface temperature will continue to increase until at least mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO₂) and other greenhouse gas emissions occur in the coming decades.
- B.2** Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, heavy precipitation, and, in some regions, agricultural and ecological droughts ; an increase in the proportion of intense tropical cyclones ; and reductions in Arctic sea ice, snow cover and permafrost.
- B.3** Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.
- B.4** Under scenarios with increasing CO₂ emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO₂ in the atmosphere.
- B.5** Many changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets and global sea level.

C. Climate Information for Risk Assessment and Regional Adaptation

- C.1** Natural drivers and internal variability will modulate human-caused changes, especially at regional scales and in the near term, with little effect on centennial global warming. These modulations are important to consider in planning for the full range of possible changes.
- C.2** With further global warming, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers. Changes in several climatic impact-drivers would be more widespread at 2°C compared to 1.5°C global warming and even more widespread and/or pronounced for higher warming levels.
- C.3** Low-likelihood outcomes, such as ice-sheet collapse, abrupt ocean circulation changes, some compound extreme events, and warming substantially larger than the assessed *very likely* range of future warming, cannot be ruled out and are part of risk assessment.

D. Limiting Future Climate Change

- D.1** From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO₂ emissions, reaching at least net zero CO₂ emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH₄ emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.
- D.2** Scenarios with very low or low greenhouse gas (GHG) emissions (SSP1–1.9 and SSP1–2.6) lead within years to discernible effects on greenhouse gas and aerosol concentrations and air quality, relative to high and very high GHG emissions scenarios (SSP3–7.0 or SSP5–8.5). Under these contrasting scenarios, discernible differences in trends of global surface temperature would begin to emerge from natural variability within around 20 years, and over longer time periods for many other climatic impact-drivers (*high confidence*).

Headline Statements from the Summary for Policymakers

B. Observed and Projected Impacts and Risks

- B.1** Human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability. Some development and adaptation efforts have reduced vulnerability. Across sectors and regions the most vulnerable people and systems are observed to be disproportionately affected. The rise in weather and climate extremes has led to some irreversible impacts as natural and human systems are pushed beyond their ability to adapt (*high confidence*).
- B.2** Vulnerability of ecosystems and people to climate change differs substantially among and within regions (*very high confidence*), driven by patterns of intersecting socio-economic development, unsustainable ocean and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism, and governance (*high confidence*). Approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change (*high confidence*). A high proportion of species is vulnerable to climate change (*high confidence*). Human and ecosystem vulnerability are interdependent (*high confidence*). Current unsustainable development patterns are increasing exposure of ecosystems and people to climate hazards (*high confidence*).
- B.3** Global warming, reaching 1.5°C in the near-term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (*very high confidence*). The level of risk will depend on concurrent near-term trends in vulnerability, exposure, level of socioeconomic development and adaptation (*high confidence*). Near-term actions that limit global warming to close to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems, compared to higher warming levels, but cannot eliminate them all (*very high confidence*).
- B.4** Beyond 2040 and depending on the level of global warming, climate change will lead to numerous risks to natural and human systems (*high confidence*). For 127 identified key risks, assessed mid- and long-term impacts are up to multiple times higher than currently observed (*high confidence*). The magnitude and rate of climate change and associated risks depend strongly on near-term mitigation and adaptation actions, and projected adverse impacts and related losses and damages escalate with every increment of global warming (*very high confidence*).
- B.5** Climate change impacts and risks are becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions. Some responses to climate change result in new impacts and risks (*high confidence*).
- B.6** If global warming transiently exceeds 1.5°C in the coming decades or later (overshoot), then many human and natural systems will face additional severe risks, compared to remaining below 1.5°C (*high confidence*). Depending on the magnitude and duration of overshoot, some impacts will cause release of additional greenhouse gases (*medium confidence*) and some will be irreversible, even if global warming is reduced (*high confidence*).

C. *Current Adaptation and its Benefits*

- C.1** Progress in adaptation planning and implementation has been observed across all sectors and regions, generating multiple benefits (*very high confidence*). However, adaptation progress is unevenly distributed with observed adaptation gaps (*high confidence*). Many initiatives prioritize immediate and near-term climate risk reduction which reduces the opportunity for transformational adaptation (*high confidence*).
- C.2** There are feasible and effective adaptation options which can reduce risks to people and nature. The feasibility of implementing adaptation options in the near-term differs across sectors and regions (*very high confidence*). The effectiveness of adaptation to reduce climate risk is documented for specific contexts, sectors and regions (*high confidence*) and will decrease with increasing warming (*high confidence*). Integrated, multi-sectoral solutions that address social inequities, differentiate responses based on climate risk and cut across systems, increase the feasibility and effectiveness of adaptation in multiple sectors (*high confidence*).
- C.3** Soft limits to some human adaptation have been reached, but can be overcome by addressing a range of constraints, primarily financial, governance, institutional and policy constraints (*high confidence*). Hard limits to adaptation have been reached in some ecosystems (*high confidence*). With increasing global warming, losses and damages will increase and additional human and natural systems will reach adaptation limits (*high confidence*).
- C.4** There is increased evidence of maladaptation across many sectors and regions since the AR5. Maladaptive responses to climate change can create lock-ins of vulnerability, exposure and risks that are difficult and expensive to change and exacerbate existing inequalities. Maladaptation can be avoided by flexible, multi-sectoral, inclusive and long-term planning and implementation of adaptation actions with benefits to many sectors and systems (*high confidence*).
- C.5** Enabling conditions are key for implementing, accelerating and sustaining adaptation in human systems and ecosystems. These include political commitment and follow-through, institutional frameworks, policies and instruments with clear goals and priorities, enhanced knowledge on impacts and solutions, mobilization of and access to adequate financial resources, monitoring and evaluation, and inclusive governance processes (*high confidence*).

D. *Climate Resilient Development*

- D.1** Evidence of observed impacts, projected risks, levels and trends in vulnerability, and adaptation limits, demonstrate that worldwide climate resilient development action is more urgent than previously assessed in AR 5. Comprehensive, effective, and innovative responses can harness synergies and reduce trade-offs between adaptation and mitigation to advance sustainable development (*very high confidence*).
- D.2** Climate resilient development is enabled when governments, civil society and the private sector make inclusive development choices that prioritise risk reduction, equity and justice, and when decision-making processes, finance and actions are integrated across governance levels, sectors and timeframes (*very high confidence*). Climate resilient development is facilitated by international cooperation and by governments at all levels working with communities, civil society, educational bodies, scientific and other institutions, media, investors and businesses; and by developing partnerships with traditionally marginalised groups, including women, youth, Indigenous Peoples, local communities and ethnic minorities (*high confidence*). These partnerships are most effective when supported by enabling political leadership, institutions, resources, including finance, as well as climate services, information and decision support tools (*high confidence*).

- D.3** Interactions between changing urban form, exposure and vulnerability can create climate change- induced risks and losses for cities and settlements. However, the global trend of urbanisation also offers a critical opportunity in the near-term, to advance climate resilient development (*high confidence*). Integrated, inclusive planning and investment in everyday decision-making about urban infrastructure, including social, ecological and grey/physical infrastructures, can significantly increase the adaptive capacity of urban and rural settlements. Equitable outcomes contribute to multiple benefits for health and well-being and ecosystem services, including for Indigenous Peoples, marginalised and vulnerable communities (*high confidence*). Climate resilient development in urban areas also supports adaptive capacity in more rural places through maintaining peri-urban supply chains of goods and services and financial flows (*medium confidence*). Coastal cities and settlements play an especially important role in advancing climate resilient development (*high confidence*).
- D.4** Safeguarding biodiversity and ecosystems is fundamental to climate resilient development, in light of the threats climate change poses to them and their roles in adaptation and mitigation (*very high confidence*). Recent analyses, drawing on a range of lines of evidence, suggest that maintaining the resilience of biodiversity and ecosystem services at a global scale depends on effective and equitable conservation of approximately 30% to 50% of Earth's land, freshwater and ocean areas, including currently near-natural ecosystems (*high confidence*).
- D.5** It is unequivocal that climate change has already disrupted human and natural systems. Past and current development trends (past emissions, development and climate change) have not advanced global climate resilient development (*very high confidence*). Societal choices and actions implemented in the next decade determine the extent to which medium- and long-term pathways will deliver higher or lower climate resilient development (*high confidence*). Importantly climate resilient development prospects are increasingly limited if current greenhouse gas emissions do not rapidly decline, especially if 1.5°C global warming is exceeded in the near term (*high confidence*). These prospects are constrained by past development, emissions and climate change, and enabled by inclusive governance, adequate and appropriate human and technological resources, information, capacities and finance (*high confidence*).

IPCC Sixth Assessment Report-Working Group III

Headline Statements from the Summary for Policymakers**B. Recent developments and current trends**

- B.1** Total net anthropogenic GHG emissions⁶ have continued to rise during the period 2010–2019, as have cumulative net CO₂ emissions since 1850. Average annual GHG emissions during 2010–2019 were higher than in any previous decade, but the rate of growth between 2010 and 2019 was lower than that between 2000 and 2009. (*high confidence*)
- B.2** Net anthropogenic GHG emissions have increased since 2010 across all major sectors globally. An increasing share of emissions can be attributed to urban areas. Emissions reductions in CO₂ from fossil fuels and industrial processes, due to improvements in energy intensity of GDP and carbon intensity of energy, have been less than emissions increases from rising global activity levels in industry, energy supply, transport, agriculture and buildings. (*high confidence*)
- B.3** Regional contributions¹⁷ to global GHG emissions continue to differ widely. Variations in regional, and national per capita emissions partly reflect different development stages, but they also vary widely at similar income levels. The 10% of households with the highest per capita emissions contribute a disproportionately large share of global household GHG emissions. At least 18 countries have sustained GHG emission reductions for longer than 10 years. (*high confidence*)
- FOOTNOTE 17 : See Working Group III Annex II, Part 1 for regional groupings adopted in this report.
- B.4** The unit costs of several low-emission technologies have fallen continuously since 2010. Innovation policy packages have enabled these cost reductions and supported global adoption. Both tailored policies and comprehensive policies addressing innovation systems have helped overcome the distributional, environmental and social impacts potentially associated with global diffusion of low-emission technologies. Innovation has lagged in developing countries due to weaker enabling conditions. Digitalisation can enable emission reductions, but can have adverse side-effects unless appropriately governed. (*high confidence*)
- B.5** There has been a consistent expansion of policies and laws addressing mitigation since AR5. This has led to the avoidance of emissions that would otherwise have occurred and increased investment in low-GHG technologies and infrastructure. Policy coverage of emissions is uneven across sectors. Progress on the alignment of financial flows towards the goals of the Paris Agreement remains slow and tracked climate finance flows are distributed unevenly across regions and sectors. (*high confidence*)
- B.6** Global GHG emissions in 2030 associated with the implementation of nationally determined contributions (NDCs) announced prior to COP26²⁴ would make it likely that warming will exceed 1.5°C during the 21st century.²⁵ Likely limiting warming to below 2°C would then rely on a rapid acceleration of mitigation efforts after 2030. Policies implemented by the end of 2020²⁶ are projected to result in higher global GHG emissions than those implied by NDCs. (*high confidence*)
- B.7** Projected cumulative future CO₂ emissions over the lifetime of existing and currently planned fossil fuel infrastructure without additional abatement exceed the total cumulative net CO₂ emissions in pathways that limit warming to 1.5°C (>50%) with no or limited overshoot. They are approximately equal to total cumulative net CO₂ emissions in pathways that limit warming to 2°C (>67%). (*high confidence*)

C. System transformations to limit global warming

- C.1** Global GHG emissions are projected to peak between 2020 and at the latest before 2025 in global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot and in those that limit warming to 2°C (>67%) and assume immediate action. [Table SPM footnote [# 9], ³⁸ In both types of modelled pathways, rapid and deep GHG emissions reductions follow throughout 2030, 2040 and 2050 (*high confidence*). Without a strengthening of policies beyond those that are implemented by the end of 2020, GHG emissions are projected to rise beyond 2025, leading to a median global warming of 3.2 [2.2 to 3.5] °C by 2100 ^{39,40} (*medium confidence*).
- C.2** Global net zero CO₂ emissions are reached in the early 2050s in modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and around the early 2070s in modelled pathways that limit warming to 2°C (>67%). Many of these pathways continue to net negative CO₂ emissions after the point of net zero. These pathways also include deep reductions in other GHG emissions. The level of peak warming depends on cumulative CO₂ emissions until the time of net zero CO₂ and the change in non-CO₂ climate forcers by the time of peaking. Deep GHG emissions reductions by 2030 and 2040, particularly reductions of methane emissions, lower peak warming, reduce the likelihood of overshooting warming limits and lead to less reliance on net negative CO₂ emissions that reverse warming in the latter half of the century. Reaching and sustaining global net zero GHG emissions results in a gradual decline in warming. (*high confidence*)
- C.3** All global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and those that limit warming to 2°C (>67%) involve rapid and deep and in most cases immediate GHG emission reductions in all sectors. Modelled mitigation strategies to achieve these reductions include transitioning from fossil fuels without CCS to very low- or zero-carbon energy sources, such as renewables or fossil fuels with CCS, demand side measures and improving efficiency, reducing non-CO₂ emissions, and deploying carbon dioxide removal (CDR) methods to counterbalance residual GHG emissions. Illustrative Mitigation Pathways (IMPs) show different combinations of sectoral mitigation strategies consistent with a given warming level. (*high confidence*)
- C.4** Reducing GHG emissions across the full energy sector requires major transitions, including a substantial reduction in overall fossil fuel use, the deployment of low-emission energy sources, switching to alternative energy carriers, and energy efficiency and conservation. The continued installation of unabated fossil fuel⁵⁵ infrastructure will 'lock-in' GHG emissions. (*high confidence*)
- C.5** Net-zero CO₂ emissions from the industrial sector are challenging but possible. Reducing industry emissions will entail coordinated action throughout value chains to promote all mitigation options, including demand management, energy and materials efficiency, circular material flows, as well as abatement technologies and transformational changes in production processes. Progressing towards net zero GHG emissions from industry will be enabled by the adoption of new production processes using low and zero GHG electricity, hydrogen, fuels, and carbon management. (*high confidence*)
- C.6** Urban areas can create opportunities to increase resource efficiency and significantly reduce GHG emissions through the systemic transition of infrastructure and urban form through low-emission development pathways towards net-zero emissions. Ambitious mitigation efforts for established, rapidly growing and emerging cities will encompass 1) reducing or changing energy and material consumption, 2) electrification, and 3) enhancing carbon uptake and storage in the urban environment. Cities can achieve net-zero emissions, but only if emissions are reduced within and outside of their administrative boundaries through supply chains, which will have beneficial cascading effects across other sectors. (*very high confidence*)

- C.7** In modelled global scenarios, existing buildings, if retrofitted, and buildings yet to be built, are projected to approach net zero GHG emissions in 2050 if policy packages, which combine ambitious sufficiency, efficiency, and renewable energy measures, are effectively implemented and barriers to decarbonisation are removed. Low ambitious policies increase the risk of lock-in buildings in carbon for decades while well-designed and effectively implemented mitigation interventions, in both new buildings and existing ones if retrofitted, have significant potential to contribute to achieving SDGs in all regions while adapting buildings to future climate. (*high confidence*)
- C.8** Demand-side options and low-GHG emissions technologies can reduce transport sector emissions in developed countries and limit emissions growth in developing countries (*high confidence*). Demand-focused interventions can reduce demand for all transport services and support the shift to more energy efficient transport modes (*medium confidence*). Electric vehicles powered by low emissions electricity offer the largest decarbonisation potential for land-based transport, on a life cycle basis (*high confidence*). Sustainable biofuels can offer additional mitigation benefits in land-based transport in the short and medium term (*medium confidence*). Sustainable biofuels, low emissions hydrogen, and derivatives (including synthetic fuels) can support mitigation of CO₂ emissions from shipping, aviation, and heavy-duty land transport but require production process improvements and cost reductions (*medium confidence*). Many mitigation strategies in the transport sector would have various co-benefits, including air quality improvements, health benefits, equitable access to transportation services, reduced congestion, and reduced material demand (*high confidence*).
- C.9** AFOLU mitigation options, when sustainably implemented, can deliver large-scale GHG emission reductions and enhanced removals, but cannot fully compensate for delayed action in other sectors. In addition, sustainably sourced agricultural and forest products can be used instead of more GHG intensive products in other sectors. Barriers to implementation and trade-offs may result from the impacts of climate change, competing demands on land, conflicts with food security and livelihoods, the complexity of land ownership and management systems, and cultural aspects. There are many country-specific opportunities to provide co-benefits (such as biodiversity conservation, ecosystem services, and livelihoods) and avoid risks (for example, through adaptation to climate change). (*high confidence*)
- C.10** Demand-side mitigation encompasses changes in infrastructure use, end-use technology adoption, and socio-cultural and behavioural change. Demand-side measures and new ways of end-use service provision can reduce global GHG emissions in end use sectors by 40–70% by 2050 compared to baseline scenarios, while some regions and socioeconomic groups require additional energy and resources. Demand side mitigation response options are consistent with improving basic wellbeing for all. (*high confidence*)
- C.11** The deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO₂ or GHG emissions are to be achieved. The scale and timing of deployment will depend on the trajectories of gross emission reductions in different sectors. Upscaling the deployment of CDR depends on developing effective approaches to address feasibility and sustainability constraints especially at large scales. (*high confidence*)
- C.12** Mitigation options costing USD100 tCO₂-eq⁻¹ or less could reduce global GHG emissions by at least half the 2019 level by 2030 (*high confidence*). Global GDP continues to grow in modelled pathways⁶⁵ but, without accounting for the economic benefits of mitigation action from avoided damages from climate change nor from reduced adaptation costs, it is a few percent lower in 2050 compared to pathways without mitigation beyond current policies. The global economic benefit of limiting warming to 2°C is reported to exceed the cost of mitigation in most of the assessed literature. (*medium confidence*)

D. *Linkages between mitigation, adaptation, and sustainable development*

- D.1** Accelerated and equitable climate action in mitigating, and adapting to, climate change impacts is critical to sustainable development. Climate change actions can also result in some trade-offs. The trade-offs of individual options could be managed through policy design. The Sustainable Development Goals (SDGs) adopted under the UN 2030 Agenda for Sustainable Development can be used as a basis for evaluating climate action in the context of sustainable development. (*high confidence*)
- D.2** There is a strong link between sustainable development, vulnerability and climate risks. Limited economic, social and institutional resources often result in high vulnerability and low adaptive capacity, especially in developing countries (*medium confidence*). Several response options deliver both mitigation and adaptation outcomes, especially in human settlements, land management, and in relation to ecosystems. However, land and aquatic ecosystems can be adversely affected by some mitigation actions, depending on their implementation (*medium confidence*). Coordinated cross-sectoral policies and planning can maximise synergies and avoid or reduce trade-offs between mitigation and adaptation (*high confidence*).
- D.3** Enhanced mitigation and broader action to shift development pathways towards sustainability will have distributional consequences within and between countries. Attention to equity and broad and meaningful participation of all relevant actors in decision-making at all scales can build social trust, and deepen and widen support for transformative changes. (*high confidence*)

E. *Strengthening the response*

- E.1** There are mitigation options which are feasible⁷² to deploy at scale in the near term. Feasibility differs across sectors and regions, and according to capacities and the speed and scale of implementation. Barriers to feasibility would need to be reduced or removed, and enabling conditions⁷³ strengthened to deploy mitigation options at scale. These barriers and enablers include geophysical, environmental-ecological, technological, and economic factors, and especially institutional and socio-cultural factors. Strengthened near-term action beyond the NDCs (announced prior to UNFCCC COP26) can reduce and/or avoid long-term feasibility challenges of global modelled pathways that limit warming to 1.5 °C (>50%) with no or limited overshoot. (*high confidence*)
- E.2** In all countries, mitigation efforts embedded within the wider development context can increase the pace, depth and breadth of emissions reductions (*medium confidence*). Policies that shift development pathways towards sustainability can broaden the portfolio of available mitigation responses, and enable the pursuit of synergies with development objectives (*medium confidence*). Actions can be taken now to shift development pathways and accelerate mitigation and transformations across systems (*high confidence*).
- E.3** Climate governance, acting through laws, strategies and institutions, based on national circumstances, supports mitigation by providing frameworks through which diverse actors interact, and a basis for policy development and implementation (*medium confidence*). Climate governance is most effective when it integrates across multiple policy domains, helps realise synergies and minimize trade-offs, and connects national and sub-national policy-making levels (*high confidence*). Effective and equitable climate governance builds on engagement with civil society actors, political actors, businesses, youth, labour, media, Indigenous Peoples and local communities (*medium confidence*).
- E.4** Many regulatory and economic instruments have already been deployed successfully. Instrument design can help address equity and other objectives. These instruments could support deep emissions reductions and stimulate innovation if scaled up and applied more widely (*high confidence*). Policy packages that enable innovation and build capacity are better able to support a shift towards equitable low-emission futures

than are individual policies (*high confidence*). Economy-wide packages, consistent with national circumstances, can meet short-term economic goals while reducing emissions and shifting development pathways towards sustainability (*medium confidence*).

- E.5** Tracked financial flows fall short of the levels needed to achieve mitigation goals across all sectors and regions. The challenge of closing gaps is largest in developing countries as a whole. Scaling up mitigation financial flows can be supported by clear policy choices and signals from governments and the international community. (*high confidence*) Accelerated international financial cooperation is a critical enabler of low-GHG and just transitions, and can address inequities in access to finance and the costs of, and vulnerability to, the impacts of climate change (*high confidence*).
- E.6** International cooperation is a critical enabler for achieving ambitious climate change mitigation goals. The UNFCCC, Kyoto Protocol, and Paris Agreement are supporting rising levels of national ambition and encouraging development and implementation of climate policies, although gaps remain. Partnerships, agreements, institutions and initiatives operating at the sub-global and sectoral levels and engaging multiple actors are emerging, with mixed levels of effectiveness. (*high confidence*)

Contributors

- Peter Thomson : United Nations Secretary-General's Special Envoy for the Ocean
- Yuri Takeda : Environmental Journalist
- Atsushi Sunami : The Sasakawa Peace Foundation
- Tomohiko Tsunoda : Ocean Policy Research Institute of The Sasakawa Peace Foundation
- Mai Fujii : Ocean Policy Research Institute of The Sasakawa Peace Foundation
- Akihiro Tamura : Maritime Bureau, Ministry of Land, Infrastructure, Transport and Tourism
- Atsuki Ito : Maritime Bureau, Ministry of Land, Infrastructure, Transport and Tourism
- Yasuyuki Niwa : The Nippon Foundation
- Junko Toyoshima : Ocean Policy Research Institute of The Sasakawa Peace Foundation
- Mengyao Zhu : Ocean Policy Research Institute of The Sasakawa Peace Foundation
- Chiyo Setouchi : Ocean Journalist
- Sakiko Hataya : Ocean Policy Research Institute of The Sasakawa Peace Foundation
- John A. Dolan : Ocean Policy Research Institute of The Sasakawa Peace Foundation (Editing)
- Kanako Matsuda : Ocean Policy Research Institute of The Sasakawa Peace Foundation (Editing)
- Junko Ujiie : USJ Consulting LLC (Translation)

*Affiliation as of the end of March 2022

- Cover Illustration : Sounds of the Sea by SUZUE Toshiya
Draw Your Dreams of the Ocean on a Postcard Contest 11th MEXT Minister Award
(Image Courtesy of Japan Agency for Marine-Earth Science and Technology)

