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Marine Environmental Protection in the South China Sea: Challenges and Prospects

Part I

By

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ABSTRACT

The South China Sea (SCS) is an important body of water that affects a wide range of human security aspects, including economy, food, health and environment, of the countries and people around it. In view of the growing international will to protect the marine environment, it is timely to examine whether and how such commitment can be successfully translated into effective policies, actions, and cooperation in the SCS. This NTS Insight is the first part of a series of two that evaluates the current challenges in marine environmental protection in the SCS and explores opportunities for improvement. An analysis of why the environment in the SCS is a non-traditional security issue is presented. The examination of the causes behind environmental degradation in the SCS and the implications for the security of countries and people in the region leads us to conclude that the alarming state of the environment in the SCS points to the urgency for enhancing cooperation among concerned countries.

South China Sea. Credit: Flickr/Jean-Pierre Bluteau

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INTRODUCTION

The importance of oceans and seas for mankind is increasingly recognised by the international community. The inclusion of an ocean-related goal into the Sustainable Development Goals (SDGs), namely SDG 14 "Life below Water", is a move to this end. Further development of this momentum has been seen this year, with important international meetings convened to discuss necessary policies and initiatives for saving the marine environment. Among the many meetings, the first Ocean Conference convened by the UN in June 2017 in New York was the most high-profile.[5] This was followed by the High-level Political Forum (HLPF) for Sustainable Development in July 2017, during which the protection of marine biodiversity in the high seas was discussed amidst a host of sustainable development issues.[6] These high-level events have successfully shaped the perspectives of the policy makers, increasing global attention towards the health of our oceans. During the Ocean Conference this year, the United Nations (UN), governments, NGOs, regional institutions, the private sector, the scientific community, and other stakeholders offered more than 1,400 voluntary commitments, pledging to take action in saving our shared marine environment.[7]

In Southeast Asia, where water bodies account for over two thirds of the region's area, these voluntary commitments, if translated into policies, may have important implications. The South China Sea (SCS), an important body of water in the region, has attracted growing international attention in recent years for maritime disputes involving several claimants, which include Brunei, the People's Republic of China, Taiwan, Malaysia, Indonesia, the Philippines, and Vietnam. Marine environmental protection has been overshadowed by maritime disputes in regional and international security discourses. For instance, between 2009 and 2016, the number of news reports that covered the maritime disputes was 8795 as compared to 25 news reports on environmental protection.[8]

[5] UN General Assembly, Resolution 71/312, "Our Ocean, Our Future: Call for Action", 6 July 2017, http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/71/312&Lang=E.

[6] Lauren Anderson, 2017, "An Ocean in Chains: Reviewing SDG 14 in Advance of the HLPF", International Institute for Sustainable Development, SDG Knowledge Hub, 6 July 2017.

[7] "Voluntary Commitment", The Ocean Conference, United Nations, https://oceanconference.un.org/commitments/, accessed on 15 October 2017.

[8] We used 'South China Sea' as the key word in the headline and lead paragraph to search for news articles between 2009 and 2016 in Factiva, a database of global news reports. The result shows that there are 71,013 entries on the SCS in total. The search was conducted on 16 September 2017.

The same tendency to prioritise territorial disputes was also observed in official discourse. For instance, in the Chairman's Statement of the 30th ASEAN Summit in Manila in April 2017, the SCS was the first issue of the section on regional and international issues, followed by maritime security and cooperation that included maritime environment. It was only in November 2017, at the 20th ASEAN-China Summit in Manila, when state leaders agreed to pay attention to the marine environment in the SCS with the issuance of the *Declaration for the Decade of Coastal and Marine Environmental Protection in the South China Sea* (2017-2027).[9] This joint declaration may hopefully jumpstart the cooperation needed to prevent the deterioration of the marine environment in the SCS. It indicates the realisation among SCS states that urgent cooperative actions are necessary despite the unresolved territorial disputes among them.

As mentioned earlier, the international will to protect marine environments is evidently growing. The translation of such commitments into effective policies, actions, and cooperation in the SCS will be examined in this study. This NTS insight is one of a series of two that evaluates the current marine environmental challenges facing the Southeast Asian nations around the SCS. It examines the environmental risks induced by human activities and climate change, and explores collaborative opportunities and mechanisms to enhance regional governance and protection of the SCS and other seas in the region.

The debate on maritime security has been framed as a sovereignty dilemma as opposed to environmental protection. This is also the case in the SCS. The question remains whether littoral states can cooperate on marine environmental protection despite nationalist rhetoric and overlapping territorial claims. Moving away from thorny sovereignty issues, we seek to engage in the debate on maritime security from a Non-Traditional Security (NTS) perspective, which is non-state centric and collaborative. We are offering a different framing on maritime security while recognising that an NTS perspective is not the only non-state centric framework that can be used in examining this multifaceted issue. Using an NTS perspective, we call for balanced attention to both traditional and non-traditional security issues identified in the 2002 *Declaration of Conduct of the Parties in the South China Sea,* such as maritime scientific research, maritime search and rescue, transnational crimes, and marine environmental protection. This balance may facilitate and advance collaboration in these contested waters. Furthering the discussion, we examine the security implications of marine environmental degradation for Southeast Asia, especially how they are magnified by climate change.

IMPORTANCE OF MARINE ENVIRONMENT FROM AN NTS PERSPECTIVE

The ramifications of ocean-related problems are not limited to the sphere of economic development but also felt in the realm of security. NTS issues refer to non-military challenges that pose imminent threats to state security and people's well-being. The emergence of the NTS notion in the international, particularly East Asian, security discourse is a result of broadening security agendas. Environmental concerns have been viewed as a security

[9] Declaration for the Decade of Coastal and Marine Environmental Protection in the South China Sea (2017-2027), Manila, Philippines, 13 November 2017.

issue by many people in the international community since the 1987 Brundtland Report that explicitly acknowledges the threat posed by environmental crisis to national security and human security.[10] In 1992, the UN Conference on Environment and Development lifted the environmental discourse to a higher level by bringing it to a more influential audience.[11] Environmental security issues made further headways into the international security agenda as the UN Security Council convened meetings in 2007 and 2011 to discuss the implications of climate change for international peace and security.

Ocean-related problems should be part of the environmental security discourse. The oceans play a critical role in ensuring human security as challenges to the marine environment have important implications for food security, health security, economic security and environmental security. In 2015, the World Wildlife Fund (WWF) estimated that oceans were worth of 24 trillion USD, equivalent to the 7th largest economy in the world.[12] According to the Food and Agriculture Organization of the United Nations (FAO), the value of exports of fishery products, inedible fish by-products and aquatic plants was 130.6 billion USD in 2012.[13] The ocean economy creates hundreds of millions of jobs, with more than 10 percent of the world's population relying on fisheries and aquaculture for livelihoods, most of whom are in developing countries.[14]

According to the FAO, aquaculture products play a crucial role in food and nutrition security for many people. Seafood is an essential component of healthy diets because of its nutritional composition, and the quality and safety of these food products have important bearings on people's health security. Apart from enhancing various components of human security, oceans are also essential regulators of the global climate, absorbing about 30 percent of carbon dioxide generated by human activities.[15] Marine and coastal ecosystems are rich in biodiversity, housing over 200,000 identified species and millions of unidentified ones.[16] Therefore, protecting the marine environment is vital for global efforts to combat the impacts of climate change.

In East Asia, a majority of regional countries are either island states or have long coast lines. Hence, the importance of the seas is even more evident in the region. Marine economy accounted for 9.5 percent of China's national GDP in 2016 and created 35.5 million jobs.[17] China's fishery output accounted for one third of the world's total in 2013, generating a trade surplus in fishery of 11.6 billion USD.[18] Fish are also a major source of protein for people in Southeast Asia. For instance, nearly 40 percent of the animal protein supply in the Philippines comes from fish and

[10] United Nations (UN), *Our Common Future - Brundtland Report* (Oxford: Oxford University Press, 1987): 9.
[11] J. Jackson Ewing, "Environmental Security", in *An Introduction to Non-Traditional Security Studies: A Transnational Approach*, ed. Mely Caballero-Anthony (London: Sage, 2016): 97-98.
[12] Ove Hoegh-Guldberg et al., *Reviving the Ocean Economy: The Case for Action-2015* (Gland, Switzerland: WWF, 2015): 12.
[13] FAO, *The State of World Fisheries and Aquaculture: Opportunities and Challenges* (Rome: FAO, 2014), 6.
[14] Ibid.
[15] "Goal 14: Conserve and Sustainably Use the Oceans, Seas and Marine Resources", Sustainable Development Goals (New York: United Nations). http://www.un.org/sustainabledevelopment/oceans/
[16] Ibid.
[17] "China's Gross Oceanic Product Exceeds $1 Trillion", Xinhua, 17 March 2017. http://www.chinadaily.com.cn/business/2017-03/17/content_28589909.htm
[18] Zhang, Hongzhou, "China's Fishing Industry: Current Status, Government Policies and Future Prospects", in *Becoming a Great "Maritime Power": A Chinese Dream*, Report, ed. Michael McDevitt, (Arlington, VA: can, 2016). https://www.cna.org/news/events/china-and-maritime-power

seafood, and over 50 percent in Indonesia.[19] The consumption of seafood is projected to grow in the future as more countries in the region are reaching middle-income levels. The SCS sea lanes saw the transit of one fifth of global trade in 2016,[20] which indicates the significance of the SCS for China, the world's largest trader, as well as Southeast Asian countries that have rapidly-growing economies.

Given that the SCS is expansive and sea currents and marine life are mobile, addressing environmental degradation in the sea requires cooperation and coordination among littoral states. Bilateral and multilateral frameworks and mechanisms are needed to facilitate effective collaborative environmental governance in the SCS. In addition, a more participatory approach involving the civil society and the business sector is helpful in attracting more resources, capacities and expertise for protecting the sea. This is in line with the NTS perspective that we propose. Having multiple actors across different levels of governance not only gives greater representation but also assists in identifying potentially risky and destabilising issues that might just exist at the peripheral vision of the State. These issues, if not holistically addressed, could undermine the stability of countries and the region, affecting large populations and huge tracts of terrestrial and maritime areas.

CAUSES OF ENVIRONMENTAL DEGRADATION IN THE SCS

SCS is one of the world's most diverse marine ecosystems, hosting 76 percent of the world's coral species and 37 percent of reef-fish species.[21] It is home to more than 8600 species of marine plants and animals.[22] However, the marine environment in the SCS is without an overarching environmental regime. Environmental degradation in the SCS has reached an alarming point. According to the Southeast Asian Fisheries Development Centre in Bangkok, 30 percent of seagrass, 16 percent of mangroves, and 16 percent of live coral cover are lost every ten years since 2007.[23]

Human-Induced Pollution

The targets of SDG 14 identify land-based activities as the main sources of marine pollution. Marine biologists estimate that human activities have destroyed 16,200 hectares of coral reefs, nearly 10 percent of the total reefs in the SCS.[24] The current rate of reef destruction translates to the SCS littoral states suffering a 6 billion USD a year in

[19] FAO, "*Fishery and Aquaculture Country Profiles: The Republic of the Philippines; and the Republic of Indonesia",* Country Profile Fact Sheets, (Rome: FAO, 2014), http://www.fao.org/fishery/facp/PHL/en and http://www.fao.org/fishery/facp/IDN/en

[20] "China Trade Depends More on Peace in South China Sea Shipping Lanes", *China Daily*, 7 August 2017. http://usa.chinadaily.com.cn/epaper/2017-08/07/content_30359481.htm

[21] Abhit Singh, "A Looming Environmental Crisis in the South China Sea", *Asia Maritime Transparency Initiative*, 12 August 2016, https://amti.csis.org/looming-environmental-crisis-south-china-sea/.

[22] Marie Antonette Juinio-Menez, "Biophysical and Genetic Connectivity Considerations in Marine Biodiversity Conservation and Management in the South China Sea", *Journal of International Wildlife Law and Policy* 18 (2015): 111.

[23] "South China Sea Countries Continue to Cooperate on Integrating Fisheries and Marine Ecosystem Management", *SEAFDEC News,* 1 November 2016, http://www.seafdec.org/south-china-sea-countries-cooperate-integrating-fisheries-marine-ecosystem-management/.

[24] Akshat Rathi, "The Most Ignored Aspect of the South China Sea Brawl Might be the Key to Solving it", Quartz, 26 July, https://qz.com/741989/the-most-ignored-aspect-of-the-south-china-sea-brawl-might-be-the-key-to-solving-it/.

potential economic loss.[25] Human-induced pollution includes discharge of untreated domestic and industrial waste, port and harbour operations, agricultural and aquaculture production, and mining activity. For instance, it is common in countries bordering the SCS to convert coastal areas to aquaculture farms, particularly for shrimp farming. [26] The resulting contaminants include pathogenic bacteria, nutrient and organic matter, heavy metals and toxic particles, which cause pollution in a variety of forms like red tide, algal bloom, and poisoning and death of marine creatures.[27] Such practices are detrimental to mangrove habitats, resulting in the loss of 16 percent of mangroves in the SCS every 10 years, according to an estimate in 2007.[28]

Unsustainable exploitation of resources constitutes another major stressor on the marine environment in the SCS. It includes overfishing and illegal, unreported and unregulated (IUU) fishing. Southeast Asia and China together account for around 25 percent of the world's total population, many of whom have improved living conditions brought about by the region's fast economic development.[29] Unsustainable fishing in the region is driven by the growing appetite for seafood. As domestic consumption expands, China's fishermen tend to overfish, depleting China's own fish resources. Surging market demands have driven Chinese fishing fleets to explore oceans afar, which is criticised by experts as threatening the global fishery.[30] However, the depletion of fish stocks is not a unique problem of China, but is also seen in Southeast Asian countries. Ninety percent of fishing vessels in Indonesian waters have no permits. Ten out of 13 designated fishing grounds in the Philippine waters are overfished.[31] Moreover, destructive fishing practices like bottom trawling and the use of poison and explosives pose a serious threat to coral reefs in the SCS. Sixteen percent of coral reefs will be lost every 10 years based on an estimate in 2007.[32]

Other forms of anthropogenic pollution include land reclamation, plastic waste, and unsustainable tourism. Among the top 10 countries in the world that throw plastic waste into the oceans, five are around the SCS – China, Indonesia, the Philippines, Vietnam and Malaysia.[33] Plastic waste pollutes the seas, releasing toxins in the dissolving process. The toxic chemicals can enter human food chains via fish that consume the toxins.[34] Plastic

[25] Ibid.
[26] Si Tuan Vo et al., "Status and Trends in Coastal Habitats of the South China Sea", *Ocean and Coastal* Management 85 (2013): 156.
[27] UNEP, "Land-Based Pollution in the South China Sea", UNEP/GEF/SCS Technical Publication No.10 (Bangkok, 2007).
[28] Ibid.
[29] According to the data from the World Bank DataBank, the population of ASEAN and China was 1.83 billion and the world's total was about 7.44 billion in 2016. See, World Bank, "2.1 World Development Indicators: Population Dynamics", World Development Indicators, New York, http://wdi.worldbank.org/table/2.1.
[30] Andrew Jacobs, "China's Appetite Pushes Fisheries to the Brink", *The New York Times*, 30 April 2017. https://www.nytimes.com/2017/04/30/world/asia/chinas-appetite-pushes-fisheries-to-the-brink.html
[31] "Battle to Save Dwindling Fish Stocks in S-E Asia", *The Straits Times*, 31 August 2017. http://www.straitstimes.com/asia/se-asia/battle-to-save-dwindling-fish-stocks-in-s-e-asia
[32] Si Tuan Vo et al. (2013): 157.
[33] Li Jing, "China Produces about a Third of Plastic Waste Polluting the World's Oceans, Says Report", *The South China Morning Post*, 14 February 2015. http://www.scmp.com/article/1711744/china-produces-about-third-plastic-waste-polluting-worlds-oceans-says-report
[34] Graeme Wearden, "More Plastic than Fish in the Sea by 2050, Says Ellen MacArthur", *The Guardian*, 19 January 2016. https://www.theguardian.com/business/2016/jan/19/more-plastic-than-fish-in-the-sea-by-2050-warns-ellen-macarthur

waste can be life-threatening to sea creatures swallowing big pieces of plastic debris[35]. Such hazardous waste can alter the marine ecosystems, having a ripple effect across the global hydrospheric environment. In view of the detrimental impacts of human activities in the SCS, these unsustainable practices should be targeted in the efforts to protect the sea.

Climate Change Effects in the SCS

Climate variability poses an even more pressing challenge to marine protection. Marine environments play an important role in mitigating climate change impacts. Bodies of water, for example, are capable of absorbing carbon dioxide from the air while coral reefs and mangroves can provide natural breaks against storm surges. At the same time, however, the marine habitats are 'victims' of the changing climate itself; as warming sea surface temperatures, increasing sea salinity, rising sea levels, and other climate-related changes pose threats to marine ecosystem.

Broad assessments at global and regional levels have identified the general trends of climate change impacts on the marine environment. The Intergovernmental Panel on Climate Change (IPCC), however, points out that these assessments alone are not enough. This point is clearly demonstrated by the large variations of sea level rise from one region to another.[36] As such, there is a need to downscale these studies to a local level in order to enable better understanding of future climate-related scenarios and consequences at more specific locales.

This observation applies to the SCS as well. The SCS, although often referred to as a single body of water, is not a uniform entity. Different parts of the SCS are impacted differently by climate variability.[37] For example, changes in water temperature and salinity vary across the SCS, and also between coastal and offshore areas (as illustrated in Figures 1a and b below). As indicated in 1a, the circled region has experienced varying surface temperature changes ranging from approximately 0.2 to 1 degree Celsius between 1958 and 2014 illustrating differential heating of surface waters of the SCS. Similarly, 1b illustrates salinity level changes within the SCS ranging from around -0.4 to -0.8 between 1958 and 2008.[38]

[35] Jose G.B. Derraik, "The Pollution of the Marine Environment by Plastic Debris: A Review", *Marine Pollution Bulletin* 44 (2002): 844-847; Susan Smillie, "From Sea to Plate: How Plastic Got into Our Fish", *The Guardian*, 14 February 2017, https://www.theguardian.com/lifeandstyle/2017/feb/14/sea-to-plate-plastic-got-into-fish.

[36] Gabriel Blanco et al., "Drivers, Trends and Mitigation", in Climate Change 2014: Mitigation of Climate Change, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, eds., O. Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2014).

[37] Cai Rongshuo et al., "Response and Adaptation to Climate Change in the South China Sea and Coral Sea", in Walter Leal Filho, *Climate Change Management: Climate Change Adaptation in Pacific Countries: Fostering Resilience and Improving the Quality of Life* (Basel, Switzerland: Springer International Publishing AG, 2017): 163-176.

[38] Ibid.

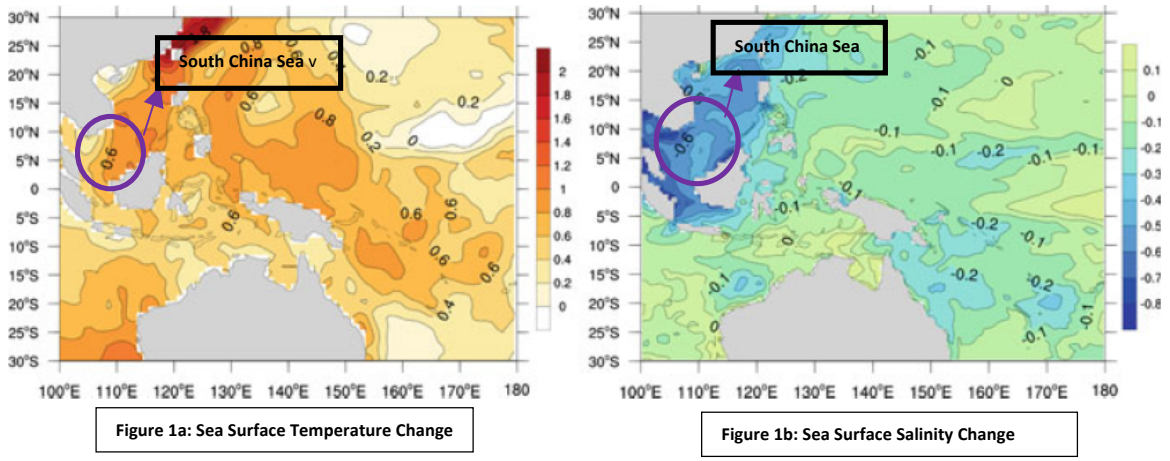

Figure 1: Different parts of the South China Sea experience different degrees of changes in sea surface temperature between 1958 and 2014 and sea surface salinity between 1958 and 2008. The circled South China Sea area is an approximate illustration.

Another indication of the different effects of climate change on the SCS is in the concentrations of chlorophyll-a.[39] As shown in Figure 2 below, between 1958 and 2014 the concentrations of chlorophyll-a increased by up to 0.2 mg/m-3 along the coastal lines of Vietnam but decreased by close to 0.2 mg/m-3 along coastal lines of northwestern Borneo island. The changes of chlorophyll-a concentrations appear to range from -0.05 to 0.05 mg/m-3 in different offshore areas of the SCS. These concentrations will be affected by increased rainfall brought about by rising sea surface temperatures.[40]

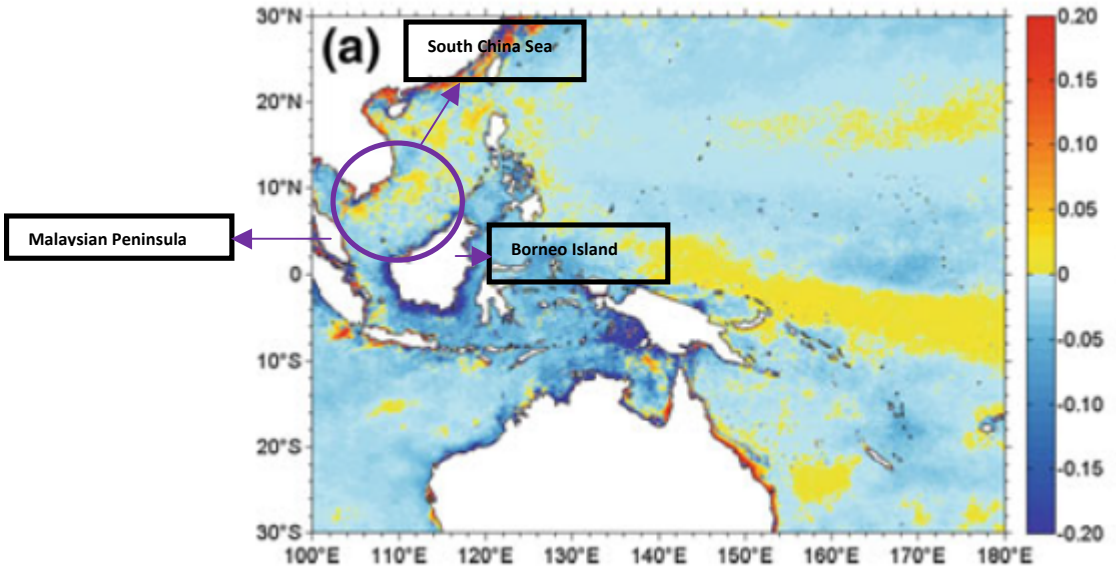

Figure 2: The changes in chlorophyll-a concentrations are not uniform within the South China Sea area.[41] The circled South China Sea area is an approximate illustration.

[39] Chlorophyll-a is a specific form of pigments used in oxygenic photosynthesis. Its concentrations are often measured to indicate marine productivity.
[40] Cai Rongshuo et al., "Response and Adaptation to Climate Change in the South China Sea and Coral Sea", in Walter Leal Filho, *Climate Change Management: Climate Change Adaptation in Pacific Countries: Fostering Resilience and Improving the Quality of Life* (Basel, Switzerland: Springer International Publishing AG, 2017): 163-176.
[41] Ibid.

Additionally, sea level rise will be experienced differently across the SCS as illustrated in Figure 3. The estimated changes range from 2 to 4 mm/year at the waters east of the Malaysian peninsula to 4 to 6 mm/year off northwestern coast of Borneo island.

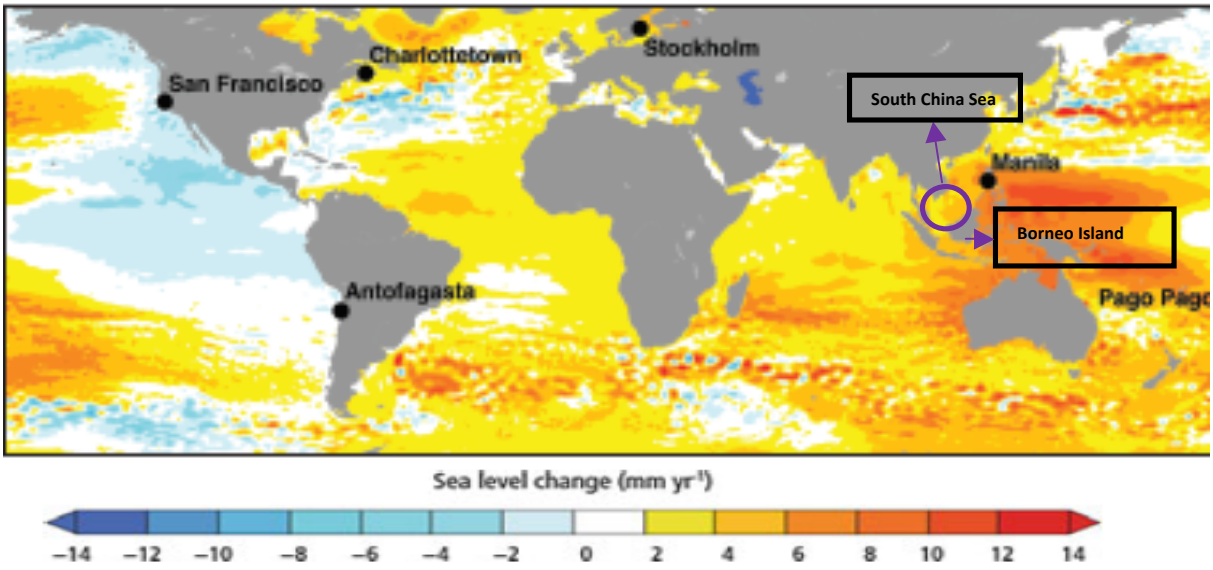

Figure 3: The different degrees of sea level changes in the South China Sea.[42] The illustration is taken from the original report by Ove Hoegh-Guldberg et al. where they used the cities of Manila, Pago Pago, Stockholm, Charlottetown, San Francisco and Antofagasta in their study. The circled South China Sea area is an approximate illustration.

Due to differences in distinct variables mentioned above, the impacts on marine habitats in the SCS will also vary. Possible effects of climate variability on mangroves, fisheries, seagrass and coral reefs are briefly described below.

- Climate Change Impacts on Mangroves in the SCS

Mangroves have a significant role in reducing flooding risk, as they provide protection against coastal erosion and inundation. Their underground root networks and complex vegetation structure are capable of reducing waves by 75 percent.[43] Mangroves along the margins of the SCS basin are important as they make up 11 percent of world's mangroves.[44] While the distribution of mangroves seem to cover most areas surrounding the SCS basin as shown

[42] Ove Hoegh-Guldberg et al., "The Ocean", in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. Vicente R. Barros et al. (Cambridge, UK: Cambridge University Press): 1655-1731.
[43] Louise Maureen Simeon, 'Sustainable Mangrove Management Pushed amid Climate Change', *The Philippine Star*, 3 September 2017, http://www.philstar.com/agriculture/2017/09/03/1735155/sustainable-mangrove-mngmt-pushed-amid-climate-change.
[44] Beth A. Polidoro et al., "The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern", *PLoS ONE* 5, no.4, (2010): e10095, https://doi.org/10.1371/journal.pone.0010095; Mark Spalding, Mami Kainuma and Lorna Collins, *World Atlas of Mangroves* (London, UK: Earthscan, 2010); UN Environmental Programme (UNEP), *National Reports on Mangroves in South China Sea*, UNEP/GEF/THE SOUTH CHINA SEA Technical Publication No. 14 (Bangkok, Thailand: UNEP, 2008); Si Tuan Vo, John C. Pernetta, and Christopher J. Paterson, "Status and Trends in Coastal Habitats of the South China Sea", *Ocean & Coastal Management 85* (2013): 153–163.

in Figure 4 below, the decreasing mangrove population at an annual rate of 1.61 percent between 1990 and 2000, which was higher than the rate of the world average at 1.04 percent during the same period,[45] poses a cause for concern. Such reduction signifies reduced natural barriers against flood risk in coastal areas of littoral states in the SCS.

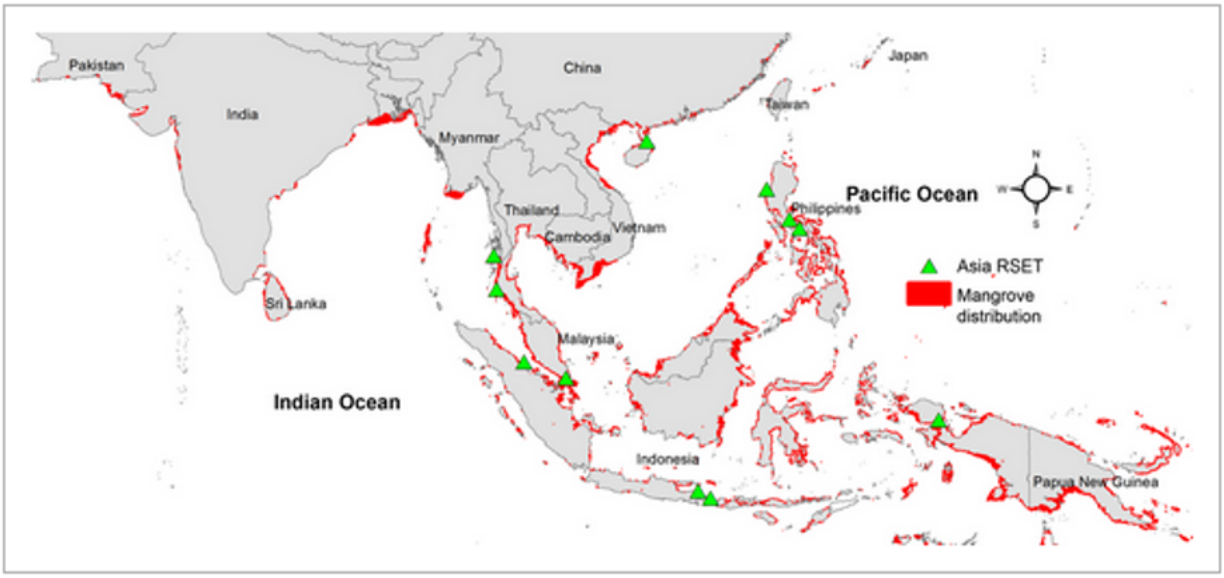

Figure 4: Mangrove distribution in Asia (2010-2015)[46]

Climate change-induced sea level rise, warming sea surface temperatures, precipitation and storminess would affect mangroves in a significant way. Increased salinity also affects mangrove growth and has the potential to damage plant life.[47] Sea level rise and attendant coastal inundation are the biggest threats to mangrove ecosystems, although certain types of mangroves can be more resilient.[48] It is broadly projected that more resilient mangrove species would be able to adapt to sea-level rise by moving landwards. However, their pathways may be blocked by natural or artificial hard structures.[49] Additionally, global warming brought about by greenhouse gas emission, which is also responsible for climate change, has resulted in mangroves expanding pole wards

[45] UNEP, *Strategic Action Programme for the South China Sea,* UNEP/GEF/THE SOUTH CHINA SEA Technical Publication No. 16 (Bangkok, Thailand: UNEP, 2008).
[46] Chandra Giri et al., "Status and Distribution of Mangrove Forests of the World Using Earth Observation Satellite Data", *Global Ecology and Biogeography* 20 (2011): 154–159.
[47] Jashimuddin Karim and Ansarul Karim, "Effect of Salinity on the Growth of Some Mangrove Plants in Bangladesh" in *Towards the Rational Use of High Salinity Tolerant Plants*, eds. H. Lieth and A. Al Masoom, Vol. J (1993): 187-192, https://link.springer.com/chapter/10.1007/978-94-011-1858-3_20.
[48] A.C. Jackson, and J. MacIlvenny, 'Coastal Squeeze on Rocky Shores in Northern Scotland and Some Possible Ecological Impacts', *Journal of Experimental Marine Biology and Ecology* 400 (2011): 314–321.
[49] Ibid.

worldwide.[50] Due to the large variants and wide distribution of mangroves species,[51] effects of climate change may vary from one region to another. There is a dearth of regional and localised studies on these effects. [52]

- Climate Change Impacts on Fisheries in the SCS

A study on terrestrial habitats' response to climate change found that terrestrial animal and plant species have been moving away from the Equator at around 20 cm per hour in the last 40 years. In addition, it is projected to continue doing so until at least the end of this century.[53] It appears that several marine species are exhibiting similar behaviour. A study by the US Navy confirmed fish migration northwards.[54] This is further observed in the projections of catch potential which show an overall decrease particularly in tropical areas. Figure 5 illustrates temperature increases and corresponding fish stock depletion. In tropical waters, where the SCS is located, subtropical fish species have already decreased significantly, following a change in average sea surface temperatures between 1970 and 2000. With a projected continuous rise in temperature, even the typically tropical or warm-water fish species may leave tropical waters, causing severe fish stock depletion along the tropical areas.

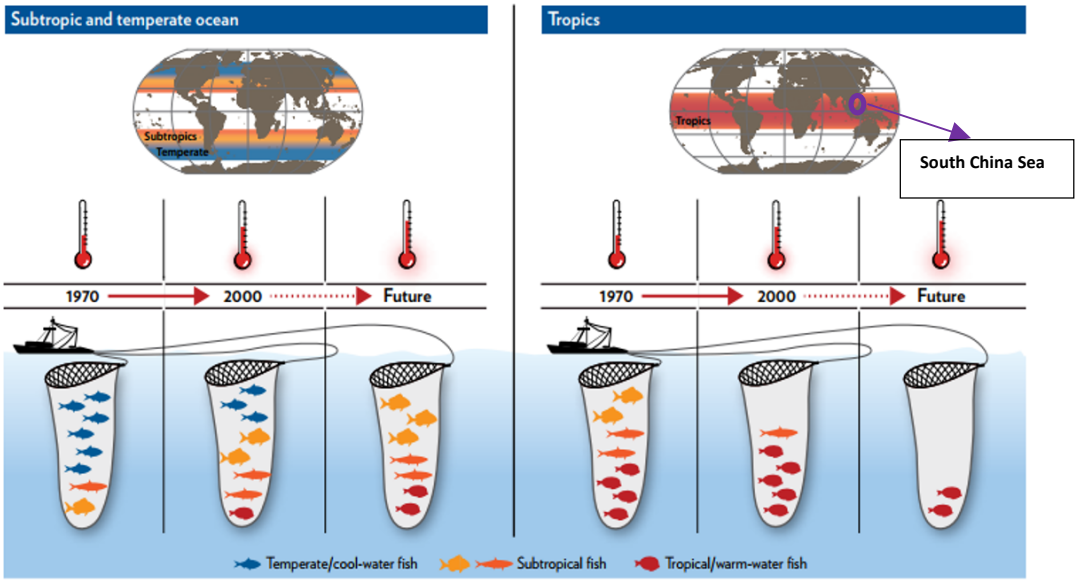

Figure 5: Fish stocks from tropical waters, including the South China Sea, may reduce in the future as they move toward more temperate or cooler seas.[55]

[50] Mario D.P. Godoy and Luiz D. De Lacerda, *Mangroves Response to Climate Change: A Review of Recent Findings on Mangrove Extension and Distribution*, *Annals of the Brazilian Academy of Sciences* 87, no.2 (2015): 651-667, http://www.scielo.br/pdf/aabc/v87n2/0001-3765-aabc-201520150055.pdf.

[51] Peter Saenger, *Mangrove Ecology, Silviculture and Conservation* (Dordrecht, the Netherlands: Springer, 2002); Mark Spalding et al. (2010).

[52] Raymond D. Ward et al., 'Impacts of Climate Change on Mangrove Ecosystems: A Region by Region Overview', *Ecosystem Health and Sustainability* 2, no 4 (2016), http://onlinelibrary.wiley.com/doi/10.1002/ehs2.1211/full.

[53] University of York, 'Further, Faster, Higher: Wildlife Responds Increasingly Rapidly to Climate Change', News Release, 18 August 2011, https://www.york.ac.uk/news-and-events/news/2011/research/wildlife-responds/.

[54] The Office of the Oceanographer of the Navy, *Arctic Environmental Assessment and Outlook Report*, August 2011, http://greenfleet.dodlive.mil/files/2011/08/U.S.-Navy-Arctic-Environmental-Assessment.pdf.

[55] William W.L. Cheung et al., 'Signature of Ocean Warming in Global Fisheries Catch', *Nature* 497 (2013): 365–368; Graphics from: The Pew Charitable Trusts, 'Warming Oceans Are Reshaping Fisheries: Scientists Detect Global Shift in Species' (2013), http://www.pewtrusts.org/~/media/assets/2013/05/15/osdwarmingoceansweb.pdf.

The impacts on fish stock in tropical waters can further be illustrated in the projected change in catch potential. Figure 6 below shows that between 2005 and 2055, parts of the SCS will experience a wide range of changes in maximum catch potential (with some areas losing 5 to 16 percent while others experiencing an increase of up to 16 to 30 percent).[56] The sizes of fish are projected to shrink as well. A study suggests that increasing sea temperatures may reduce fish size by 14 to 24 percent globally from 2000 to 2050.[57]

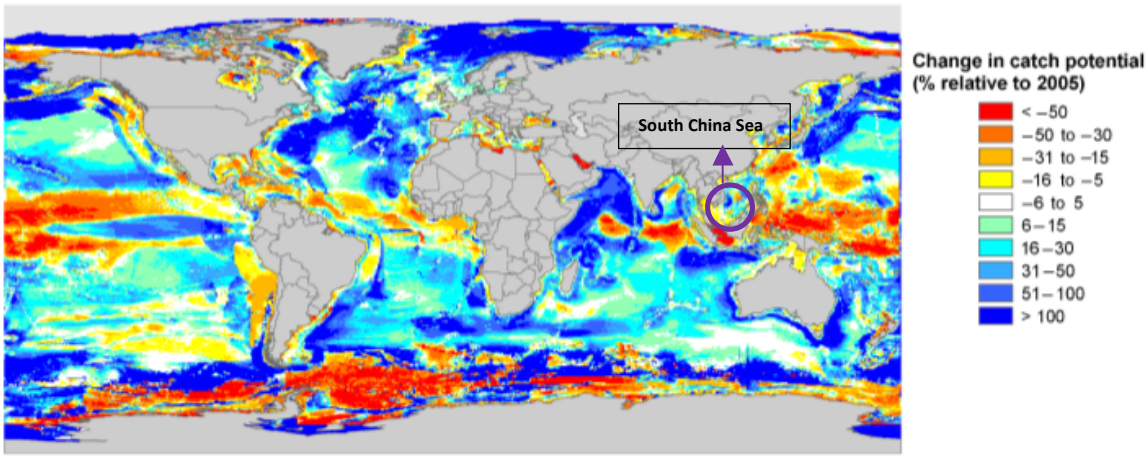

Figure 6: Change in maximum catch potential between 2005 and 2055 based on a climate change scenario in the Special Report on Emission Scenarios A1B.[58] The circled South China Sea area is an approximate illustration.

- Climate Change Impacts on Seagrass in the SCS

Eighteen out of the 60 seagrass species in the world are found in or adjacent to SCS.[59] It is broadly predicted that seagrass is heading towards extinction due to anthropogenic activities such as irrigation, coastal developments, wastewater discharge and fisheries development.[60] About 30 to 40 percent of seagrass beds have disappeared in Indonesia, while the figures stand at 20 to 30 percent in Thailand and 30 to 50 percent in the Philippines.[61] Patchy seagrass has been severely damaged in Singapore due to landfill activities.[62] The destruction of seagrass habitats is damaging not only to marine biodiversity, but also to the economy and food security. This is because seagrass

[56] William W.L. Cheung et al., 'Large-scale Redistribution of Maximum Fisheries Catch Potential in the Global Ocean under Climate Change', *Global Change Biology* 16 (2010):24-35, https://s3-us-west-2.amazonaws.com/legacy.seaaroundus/doc/Researcher+Publications/dpauly/PDF/2010/JournalArticles/LargeScaleRedistributionOfMaximumFisheriesCatchPotential.pdf.
[57] William W.L. Cheung et al., 'Shrinking of Fishes Exacerbates Impacts of Global Ocean Changes on Marine Ecosystems', *Nature Climate Change* 3 (2013), http://www.nature.com/nclimate/journal/v3/n3/full/nclimate1691.html?foxtrotcallback=true.
[58] Ibid.
[59] UNEP, *Seagrass in the South China Sea*, UNEP/GEF/THE SOUTH CHINA SEA Technical Publication No. 3 (Bangkok, Thailand: UNEP, 2004), http://iwlearn.net/resolveuid/6abc857925542c108f72e2f1e9147b97.
[60] Biodiversity Information Sharing Service (ASEAN Clearing House Mechanism), Seagrass, n.d. http://chm.aseanbiodiversity.org/index.php?option=com_content&view=article&id=169&Itemid=169.
[61] UNEP, *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*, Report of the Seventh Meeting of the Regional Working Group for the Seagrass (Bangkok, Thailand: UNEP, 2006).
[62] Ibid.

beds provide spawning spaces for fish.[63] As seagrass also serves as food to certain types of fishes (such as rabbitfish and wrasse), depleting seagrass means reducing fish stocks for human consumption.

- Climate Change Impacts on Coral Reefs in the SCS

Coral reefs in SCS have been subject to warming sea surface temperatures and ocean acidification since the early 1980s.[64] It was estimated that coral reefs in SCS decreased by 16 percent between 1994 and 2004.[65] In fact, 40 percent of corals were bleached on Dongsha Atoll in the northern part of SCS due to a two degree Celsius sea surface temperature rise during the 2015 El Niño event—a mass coral bleaching phenomenon unseen in the last 40 years.[66]

On the subject of ocean acidification, a study suggests that the surface of the SCS will become 0.3 to 0.35 pH levels more acid, and this acidification will somewhat be uniform throughout the SCS as shown in Figure 7.[67] However, little is known about the ability of coral reefs and other calcifying reef organisms to adapt to acidifying sea waters.[68]

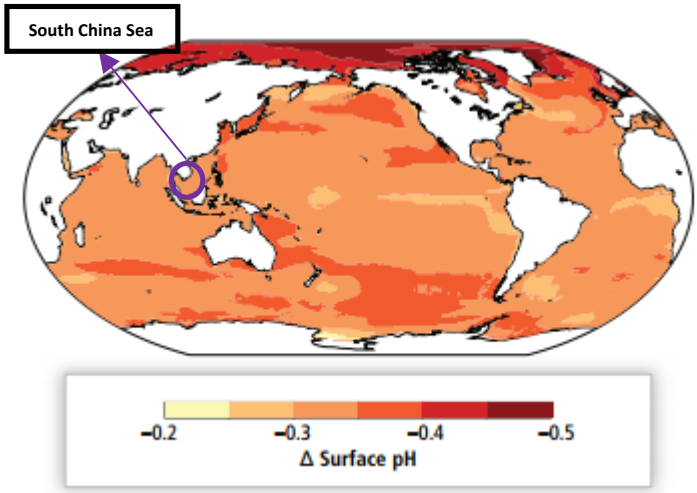

Figure 7: The South China Sea will become more acidic, and the study suggests that the degree would be somewhat uniform throughout the South China Sea area.[69] The circled South China Sea area is an approximate illustration.

[63] UNEP, *Seagrass in the South China Sea*, UNEP/GEF/The South China Sea Technical Publication No. 3 (Bangkok, Thailand: UNEP, 2004), http://iwlearn.net/resolveuid/6abc857925542c108f72e2f1e9147b97.
[64] China-SNAP, *The Second National Chinese Assessment Report on Climate Change Chinese Government* (Beijing: Science Press, 2011): 245–256, (in Chinese, with English abstract); Ove Hoegh-Guldberg, et al., *The Coral Triangle and Climate Change: Ecosystems, People and Societies at Risk* (Brisbane, Australia: World Wide Fund for Nature (WWF) Australia, 2009):276, cited in Cai Rongshuo (2017).
[65] UNEP, Strategic Action Programme for the South China Sea, UNEP/GEF/THE SOUTH CHINA SEA Technical Publication No. 16 (Bangkok, Thailand: UNEP, 2008).
[66] Thomas M. DeCarlo et al., 'Mass Coral Mortality under Local Amplification of 2°C Ocean Warming', *Science Reports* 7, Article No. 44586 (2017), doi: 10.1038/srep44586.
[67] Ove Hoegh-Guldberg et al., 'The Ocean', in Vincent R. Barros et al. (2014).
[68] Carles Pelejero, et al., 'Preindustrial to Modern Interdecadal Variability in Coral Reef Ph', *Science* 309, no 5744 (2005): 2204–2207.
[69] Ove Hoegh-Guldberg et al., 'The Ocean', in Vincent R. Barros et al. (2014).

SECURITY IMPLICATIONS OF ENVIRONMENTAL DEGRADATION IN THE SCS

Marine environmental degradation has the potential to inflict serious security threats for the region, considering the importance of the SCS on the well-being of people living in the littoral states. Deterioration of marine environments, induced by human activities and climate change, causes economic, food, health and environmental insecurities for communities that depend on the seas for survival. Coral reef fish, seagrass and mangroves are sources of food for more than 100 million people in Southeast Asia, and losing them may result in acute food insecurities for the region.[70] Accumulation and concentration of toxic matters and heavy metals in sea creatures threaten the health of people who consume contaminated seafood.[71] Fishery, aquaculture, and marine and coastal tourism are big sectors for employment. Loss of coral reefs, seagrass and mangroves will have serious impacts on the economic security of hundreds of millions of people whose livelihoods are directly and indirectly related to the marine economy.

Marine plants play a critical role in protecting shorelines in the face of extreme weather events that are becoming more frequent as a result of climate change.[72] Sea level rise, induced by global warming, translates to flooding and salt intrusion. Increased salinity means death of mangroves and reduced agricultural productivity. In Vietnam, for instance, 85 percent of flooding will occur in the Mekong River Delta affecting mainly agriculture and aquaculture lands, and a one meter sea level rise will impact six million people.[73] In Malaysia, sea level rise may inundate 1000km^2 of agricultural lands and displace more than 0.05 million people in 2100.[74]

In addition, it is argued in some research that IUU breeds other NTS threats such as human trafficking, slavery, piracy, other organised transnational crimes and even terrorism.[75] Marine environments can become a challenge to traditional security in the sense that depletion of marine resources like fish stocks fuels competition between states and strains inter-state relations. For instance, fishing boats from some countries are confiscated for poaching by their neighbours. Indonesia destroyed 81 fishing boats from Vietnam, the Philippines, Malaysia and China in April 2017.[76] Malaysia burned two fishing boats from a neighbouring country in August 2017.[77] Such cases add complications to efforts addressing maritime disputes, and even instigate tensions between agents of traditional/state security. It is thus imperative to carry out effective protection of the seas, like curbing IUU and

[70] Toni O'Loughlin, "WWF Warns Vast Coral Reef in Southeast Asia May Disappear by End of the Century", *The Guardian*, 13 May 2009, https://www.theguardian.com/environment/2009/may/13/coral-reef-asia-disappearing/
[71] Zhai Wu et al., "Metals in the Fishes from Yongshu Island, Souther South China Sea: Human Health Risk Assessment", *Journal of Toxicology* (2017): 1-17.
[72] Si (2015): 156.
[73] Jeremy Carew-Reid, "Rapid Assessment of the Extent and Impact of Sea Level Rise in Viet Nam" (Indooroopilly, Australia: International Centre for Environmental Management, 2008), http://www.icem.com.au/documents/climatechange/icem_slr/ICEM_SLR_final_report.pdf.
[74] Sarkar, et al., "Impacts of and Adaptations to Sea Level Rise in Malaysia", *Asian Journal of Water, Environment and Pollution*, Vol. 11, No. 2 (2014): 29-36.
[75] Gregory B. Poling and Conor Cronin, *Illegal, Unreported, and Unregulated Fishing as a National Security Threat* (Washington D.C.: Center for Strategic and International Studies (CSIS), 2017): 8-12.
[76] Chan, Francis, 'Indonesia Blows Up and Sinks Another 81 Fishing Boats for Poaching', *The Straits Times*, 2 April 2017. http://www.straitstimes.com/asia/se-asia/indonesia-blows-up-and-sinks-another-81-fishing-boats-for-poaching
[77] Rodzi Nadhira, 'Malaysia turns up the heat, sets foreign boats ablaze for illegal fishing', *The Straits Times*, 30 August 2017. http://www.straitstimes.com/asia/se-asia/malaysia-turns-up-the-heat-sets-foreign-boats-ablaze-for-illegal-fishing

promoting sustainable exploitation of marine resources, so as to prevent the issue from becoming more threatening to human security and regional peace.

THE NEED FOR MARINE ENVIRONMENTAL GOVERNANCE

Maritime disputes in the SCS that have heightened tensions among littoral states have significantly shifted attention and resources from arising non-traditional insecurities. As China and the Philippines restart bilateral talks in the SCS and ASEAN and China are currently negotiating a legally binding *Code of Conduct* in these waters, we should push for more attention to be given to the natural marine environment in these dialogues. Marine environmental protection, viewed as a 'soft security' issue, might hold the key to building mutual trust and confidence among littoral states. Instead of further militarising troubled waters, ASEAN, together with China, should form a cooperative management framework in the SCS with marine environmental protection as one of its main pillars.

The alarming state of the environment in the SCS indicates the urgency for enhancing cooperation among countries concerned, as effective governance of the waters is beyond the capacity of any individual country. Cooperative avenues highlighted in both the Sustainable Development Goals and the ASEAN Community Blueprint 2025 include protection of marine environment and biodiversity, scientific research and technology transfer, sustainable use of marine resources and collective response to threats to the seas.[78] The next NTS Insight in this series will assess the region's performance in the aforementioned areas of interest by (1) examining various national and regional mechanisms, (2) canvassing lessons and practices of other regions in transboundary marine governance, and (3) putting forward recommendations for initiating and enhancing cooperation.

[78] The ASEAN Secretariat, *ASEAN 2025: Forging Ahead Together*, (Jakarta: ASEAN Secretariat, 2015), http://www.asean.org/storage/2015/12/ASEAN-2025-Forging-Ahead-Together-final.pdf.

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