

Status of Coral Reefs of the World: 2020

Chapter 7. Status and trends of coral reefs of the East Asian Seas region

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Chapter 7.

Status and trends of coral reefs of the East Asian Seas region

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1. Geographic information and context

Key numbers:

- Total area of coral reefs: 78,272 km²
- Proportion of the world's coral reefs: 30.15%
- Number of countries with coral reefs: 14
- Number of Marine Ecoregions of the World (MEOW) ecoregions: 24

Regional Context:

The coral reefs of the East Asian Seas (EAS) region, which comprises the countries of Northeast and Southeast Asia, are distributed over a wide geographic area within the Indian and Pacific Oceans. The region supports the largest area of coral reefs of all the GCRMN regions, accounting for over 30% (78,272 km²) of the world's total. The region is also home to two of the world's largest archipelagic states—Indonesia with more than 17,000 islands and the Philippines with over 7,000 islands.

Overlapping with the Coral Triangle, an area recognized as the global epicentre of marine biodiversity, the EAS region boasts the world's greatest diversity of reef-building corals with nearly 600 species, six of the world's seven marine turtle species and more than 2,000 reef fish species. It also includes some of the most important spawning grounds for commercially important tuna species, supporting the largest tuna fisheries in the world.

There are significant differences in the magnitude of direct (e.g. protein consumption) and indirect (e.g. seafood exports) dependence on coral reef resources within the EAS region, with coastal populations in many Southeast Asian countries being considerably more dependent than Northeast Asian countries. This has led to significant impacts on the marine environment in the region, driven by overfishing and

expansion of coastal aquaculture, and exacerbated by land use changes that contribute to siltation and eutrophication to the marine environment. Adding to these impacts is the emerging threat posed by marine litter, particularly marine plastics and microplastics, with the region estimated to generate as much as half the world's marine plastic litter. Climate-related impacts on the marine environment are also increasingly recognized as a major concern, particularly for archipelagic states with large coastline to land area ratios where impacts can potentially be magnified across a wider area.

Table 7.1. The subregions comprising the East Asian Seas region, the area of reef they support, and the constituent Marine Ecoregions of the World (MEOW)

Subregion	Reef Area (km ²)*	Proportion of Total Reef Area Within the East Asia Region(%)	Constituent Marine Ecoregions of the World
1	32,567	41.6	126: Palawan/North Borneo 127: Eastern Philippines 128: Sulawesi Sea/Makassar Strait
2	20,568	26.3	129: Halmahera 130: Papua 131: Banda Sea 133: Northeast Sulawesi 138: Gulf of Papua 139: Arafura Sea
3	6,497	8.3	115: Gulf of Thailand 116: Southern Vietnam 117: Sunda Shelf/Java Sea 118: Malacca Strait
4	4,279	5.5	119: Southern Java 132: Lesser Sunda
5	6,192	7.9	109: Andaman and Nicobar Islands 110: Andaman Sea Coral Coast 111: Western Sumatra
6	5,600	7.2	112: Gulf of Tonkin 113: Southern China 114: South China Sea Oceanic Islands
7	2,569	3.3	051: Central Kuroshio Current 052: East China Sea 121: South Kuroshio

*World Resources Institute. Tropical Coral Reefs of the World (500-m resolution grid), 2011. Global Coral Reefs composite dataset compiled from multiple sources for use in the Reefs at Risk Revisited project incorporating products from the Millennium Coral Reef Mapping Project prepared by IMaRS/USF and IRD.
<https://datasets.wri.org/dataset/tropical-coral-reefs-of-the-world-500-m-resolution-grid>

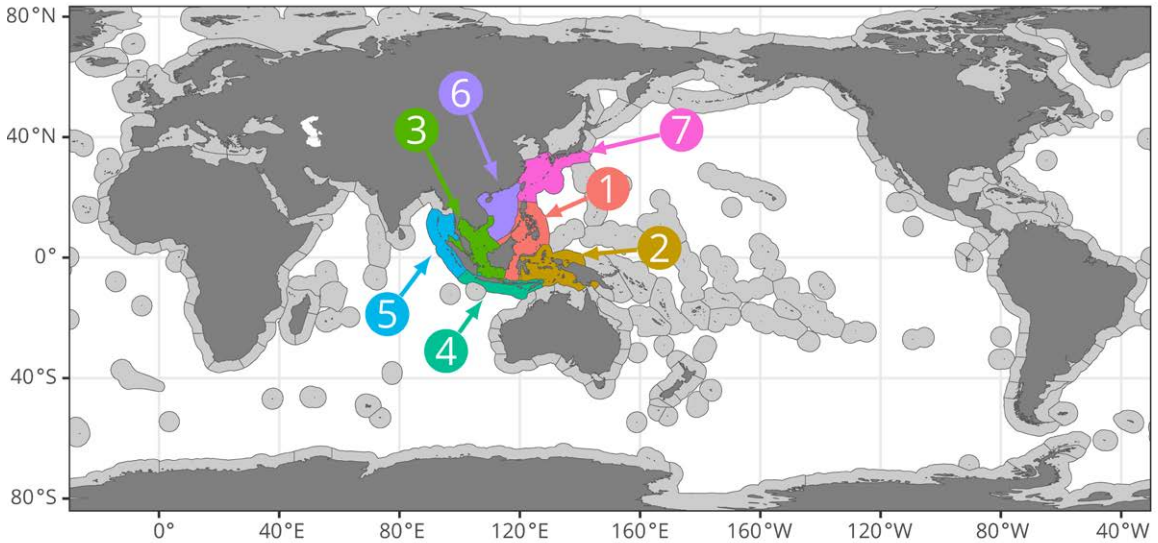


Figure 7.1. Map of each subregion comprising the East Asian Seas region. The number ascribed to each subregion corresponds with that in Table 7.1.

2. Summary of data contributed to this report

Key numbers:

- Number of countries from which monitoring data were used: 11 (of 14)
- Number of sites: 2,570
- Number of observations: 80,382
- Longest time series: 26 years

General features:

More than 80,000 records collected across 2,570 sites were contributed from the EAS region, representing 8.3% of the overall global dataset (Tab. 7.2). The greatest proportion of these records were collected within subregions 2 (28%) and 3 (30%). Fewer observations were collected from subregions 1, 4, 5, 6 and 7 (Tab. 7.2). The vast majority of sites (82%) have been surveyed only once (Fig. 7.2, Fig. 7.3A). Slightly more than 10% of sites have records that were collected over periods exceeding a decade, with about 4% of these exceeding 15 years (Fig. 7.2, Fig. 7.3A). Across the entire EAS region there were 158 long-term monitoring sites (>15 years), of which 142 (90%) occurred within subregion 7. A small number of long-term monitoring sites were monitored in subregions 2 (6) and 3 (10). Subregions 1, 4, 5 and 6 did not have any sites from which long-term monitoring data were collected (Tab. 7.1, Fig. 7.3A). A range of methods were used to collect the data, with visual census and point intercept transects being the most common (Fig. 7.4).

Table 7.2. Summary statistics describing data contributed from the East Asian Seas region. An observation is a single record within the global dataset (i.e. one row). A site is a unique GPS position where data were recorded. A site was considered a long-term monitoring site if the time between the first survey and the most recent survey was greater than 15 years. Such sites may have been surveyed multiple times during the intervening period.

East Asian Seas subregions	Observations		Sites		Long term monitoring sites	
	Total Number	Proportion of global dataset	Total Number	Proportion of global dataset	Total Number	Proportion of global dataset
All	80,382	8.29	2,570	21.13	158	26.87
1	11,235	1.16	171	1.41	0	0
2	22,445	2.31	503	4.14	6	1.02
3	24,264	2.5	635	5.22	10	1.7
4	5,964	0.62	310	2.55	0	0
5	8,020	0.83	319	2.62	0	0
6	1,109	0.11	19	0.16	0	0
7	7,345	0.76	613	5.04	142	24.15

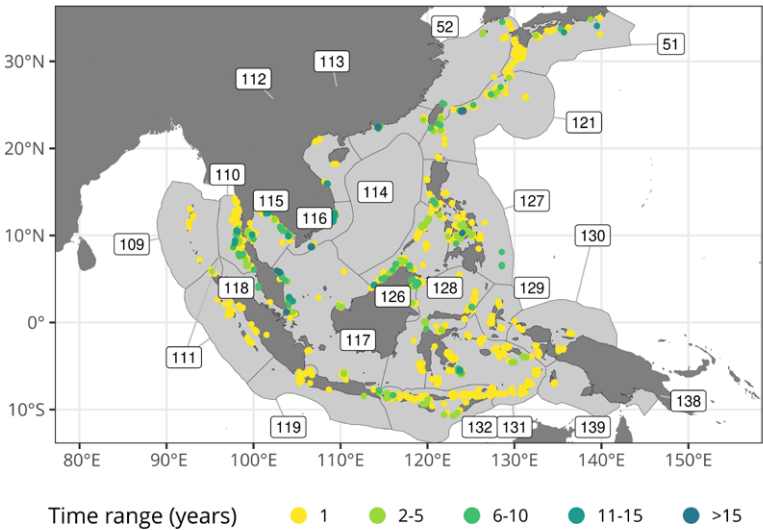


Figure 7.2. The distribution and duration of monitoring at sites across the East Asian Seas region. The colours of dots represent the time span between the first survey and the most recent survey at each site. Numbers refer to the MEOW ecoregions listed in Table 7.1.

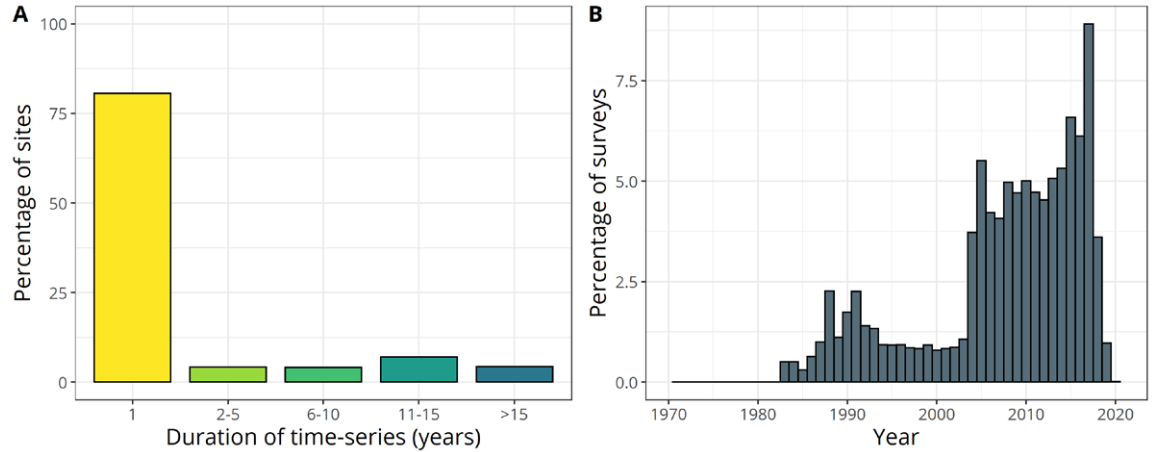


Figure 7.3. The proportion of sites in the East Asian Seas region within each category describing the time span between the first and most recent surveys (A), and the proportion of the total number of surveys conducted in each year (B). The total number of surveys was 9,785.

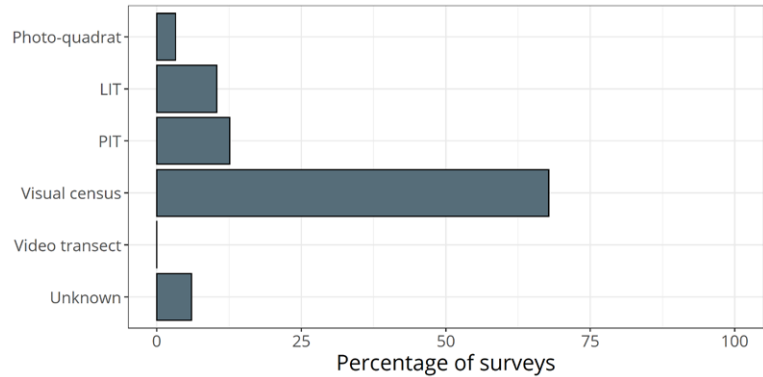


Figure 7.4. The proportion of the total number of surveys conducted in the East Asian Seas region using each survey method. PIT: Point Intercept Transect; LIT: Line Intercept Transect.

3. Status of coral reefs in the East Asian Seas region

- Regional trends in the cover of live hard coral and algae

The estimated average live hard coral cover in the EAS region in 2019 (36.8%) was slightly greater than in 1983 (32.8%) when the first records contributed to this analysis were collected (Fig. 7.5A). However, hard coral cover varied during the intervening 37 years. Between 1983 and 1999, live coral cover remained relatively stable with only minor fluctuations ranging between 31.5% (1987) and 33.7% (1998). During the subsequent decade between 1999 and 2009, hard coral cover increased from 32.9% to 40.8%, but then declined abruptly to 35% by 2012, as a result of the 2010 mass coral bleaching event. Coral cover showed small signs of recovery over the next three years reaching 35.8% in 2015, but declined to 33.9% in 2017 likely due to the 2016 mass coral bleaching event. Since then, coral cover has recovered to around 36.8% (Fig. 7.5A).

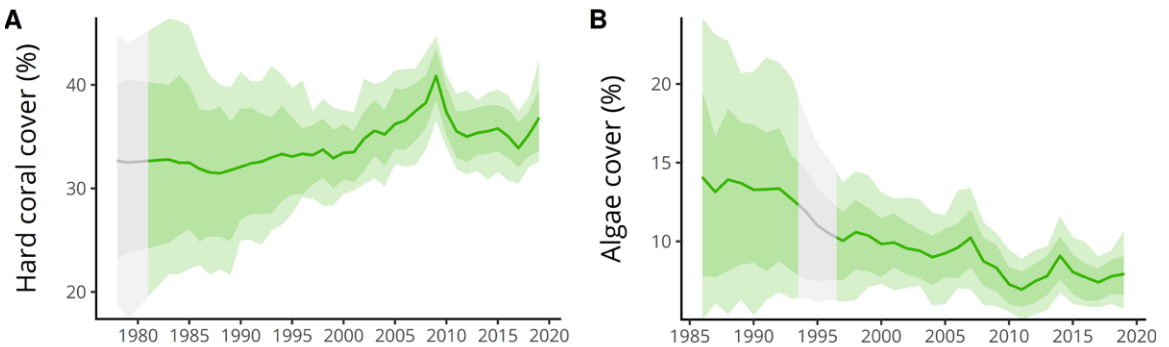


Figure 7.5. Estimated regional average cover of live hard coral (A) and algae (B) for the East Asian Seas region. The solid line represents the estimated mean and associated 80% (darker shade) and 95% (lighter shade) credible intervals, which represent levels of uncertainty. Grey areas represent periods during which no field data were available.

While coral cover has increased slightly over the last 37 years, during the last decade, coral cover has declined slightly. Comparison of the average hard coral cover between five-year periods (2005-09, 2010-14, 2015-19) indicates that despite the uncertainty in individual yearly estimates, there is strong evidence (96% probability) that average coral cover has declined during the last decade (Tab. 7.3). On average, this decline equates to a loss of almost 11% of the hard coral, of which more than 90% occurred between 2005-09 and 2010-15 (Tab. 7.3).

Table 7.3. Probability and magnitude of mean absolute and relative change in the percent cover of live hard coral in the East Asian Seas region among each of the three five-year periods comprising the last 15 years.

Comparison	Probability of change (%)	Mean absolute change (%)	Mean relative change (%)
2005-09 - 2010-14	96	-2.7	-10.5
2010-14 - 2015-19	54	-0.2	-0.8
2005-09 - 2015-19	96	-2.8	-10.9

The first records of the cover of algae were collected in 1986 when average cover was 14.1% (Fig. 7.5B). During the subsequent 26 years, the average cover of algae across the region has generally declined, reaching a minimum of 6.9% in 2011. Since 2011, the cover of algae has fluctuated between 7.4% (2017) and 9.1% (2014), but has remained relatively low. Early estimates of algal cover, particularly prior to

1997, were accompanied by large uncertainties because of a scarcity of data. Comparison of average algal cover between the three five-year periods comprising the last 15 years provides weak evidence (86% probability) of a small decline (1.1%) in absolute algal cover on coral reefs in the EAS (Tab. 7.4).

Table 7.4. Probability and magnitude of mean absolute and relative change in the percent cover of algae in the East Asian Seas region between each of the three five-year periods comprising the last 15 years.

Comparison	Probability of change (%)	Mean absolute change (%)	Mean relative change (%)
2005-09 - 2010-14	87	-0.9	-11.0
2010-14 - 2015-19	59	-0.1	-0.2
2005-09 - 2015-19	86	-1.1	-11.7

- The primary causes of change in the cover of live hard coral and algae

Analysis of trends in the condition of coral reefs in the EAS region was limited by the availability of historical data, as well as the distribution of survey sites across the region. Monitoring efforts tended to concentrate on easily accessible or well-known reefs, as many coral reefs, particularly in the large archipelagic states which have most of the coral reefs in the region, are hidden or inaccessible to researchers and NGOs, and potentially could have been destroyed or degraded before being monitored.

While there was an overall slight increase in regional coral cover between 1983 and 2019, the initial baseline coral cover was relatively low compared with historical and anecdotal accounts of coral cover in the region, suggesting that the earliest data provided reflected an already altered state of coral reefs in the region. Notwithstanding, the declines recorded in 2012 and 2016 are likely to be associated with the 2010 and 2016 mass coral bleaching events, which resulted in a relative decline in coral cover in the order of 11% during the last decade.

- Changes in resilience of coral reefs within the East Asian Seas region

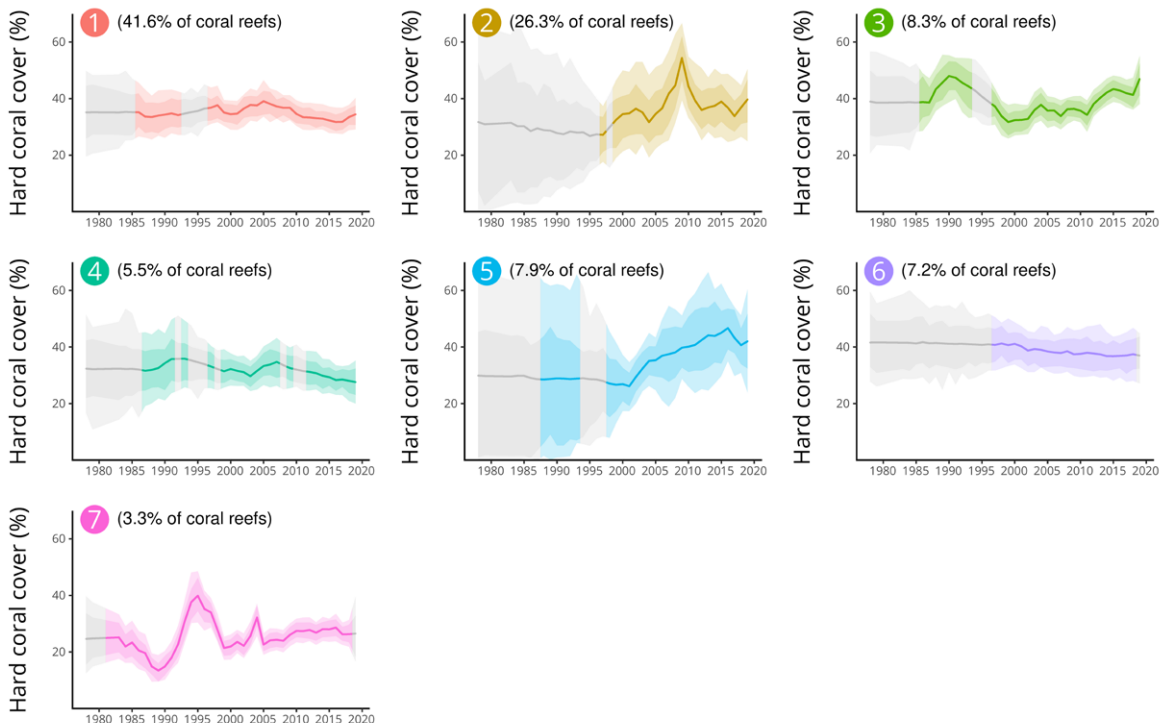
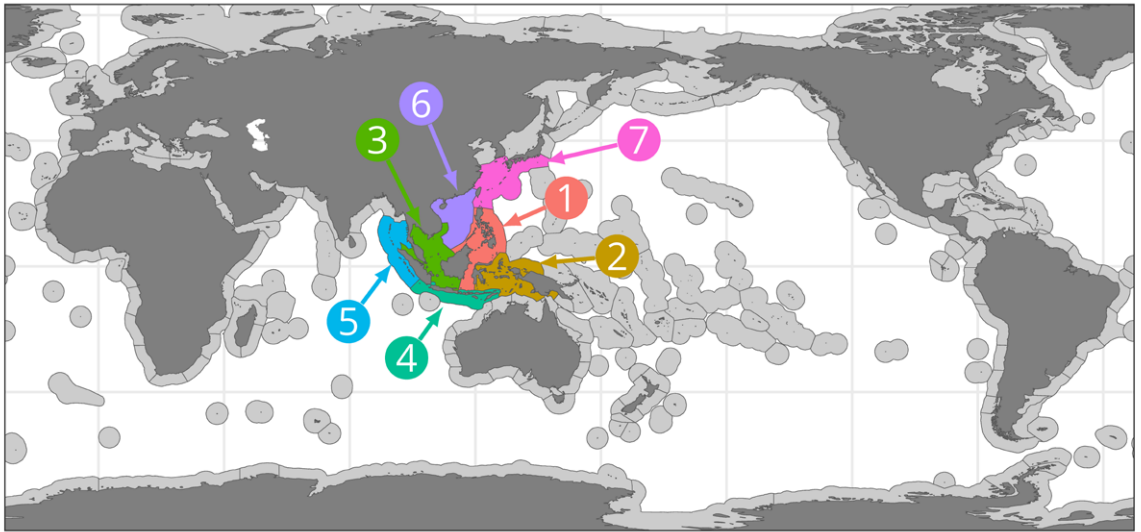
To identify changes in the resilience of coral reefs in the EAS region, patterns of disturbance and recovery were examined within sampling units that had been surveyed repeatedly over a period of at least 15 years and had, at some point, experienced a relative decline in hard coral cover of at least 20%. Of the 55 such sampling units in the EAS region, 25 did not recover to at least 90% of their pre-disturbance hard coral cover (Tab. 7.5). Among those sampling units, the average decline in hard coral cover between the first and most recent surveys was 1.7%, representing a loss of 4.7% of the existing hard coral. The average maximum decline in absolute hard coral cover was 18.9%, representing a loss of 69.3% of the hard coral within these sampling units.

Table 7.5. The mean maximum decline and the mean difference between first and last survey expressed as absolute and relative declines in percent live coral cover. N is the total number of sampling units for which >15 years of data were available and had experienced a relative decline in live coral cover of at least 20 percent. n is the number of sampling units that did not exhibit recovery to 90 percent of the initial live coral cover. Percent is the proportion of the total number of sampling units that did not exhibit recovery to 90 percent of the initial live coral cover. A sampling unit is defined as the specific area that was surveyed repeatedly. Depending on the survey methods used and how the data were provided, a sampling unit could be a transect, a quadrat or even a site.

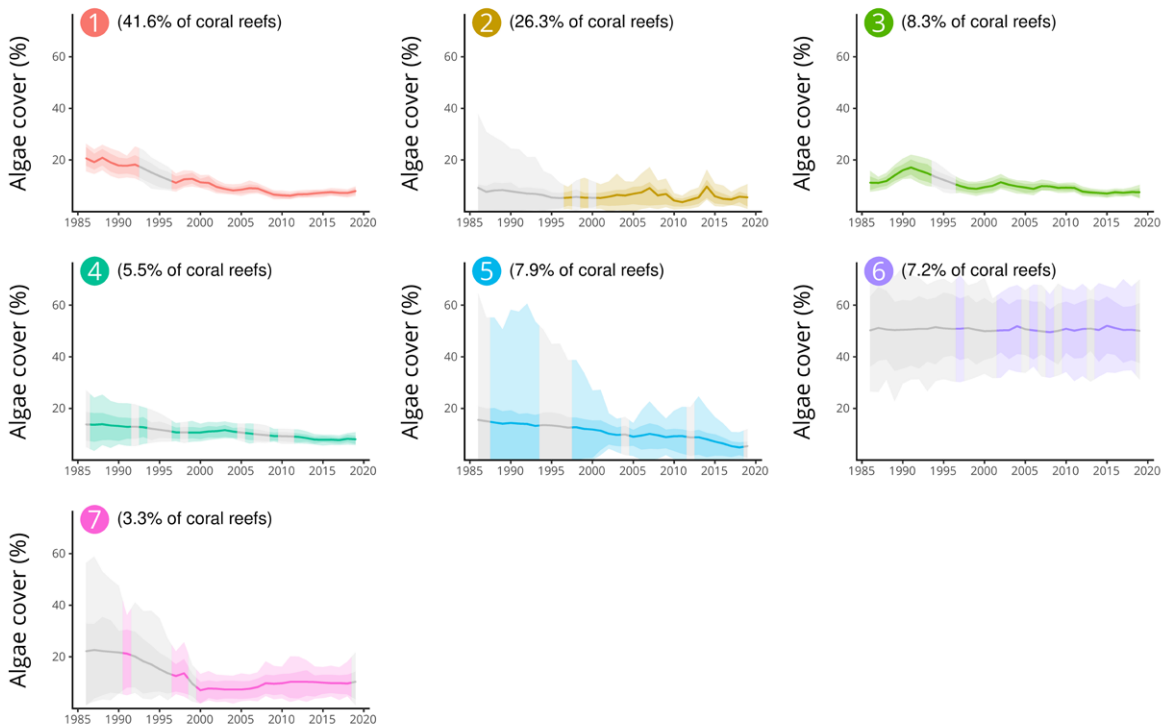
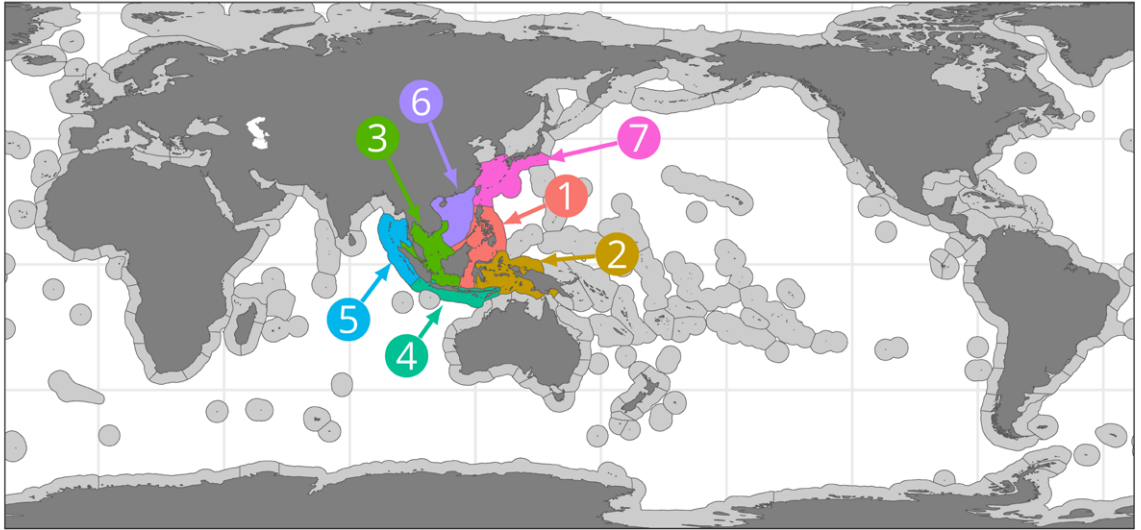
N	n	Percent	Mean maximum absolute decline	Mean maximum relative decline	Mean long-term absolute decline	Mean long-term relative decline
55	25	45.5	18.9	69.3	1.7	4.7

4. Subregional trends in the cover of live hard coral and algae within the East Asian Seas region

Within the EAS region, the trends in hard coral cover among the different subregions varied, indicating some heterogeneity in exposure to disturbance and subsequent recovery (Fig. 7.6). Average hard coral cover in subregions 1, 2, 3, 4 and 7 show considerable fluctuations, while subregion 5 shows a progressive increase in coral cover and subregion 6 remained stable throughout, although there is considerable uncertainty associated with the modelled estimate.



In general, the cover of algae has decreased regionally (Fig. 7.7). Substantial decreases in algal cover were evident in subregions 1 and 3, while subregions 4 and 5 showed a progressive decline. Algal cover in subregions 2, 6 and 7 remained relatively constant throughout.





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