

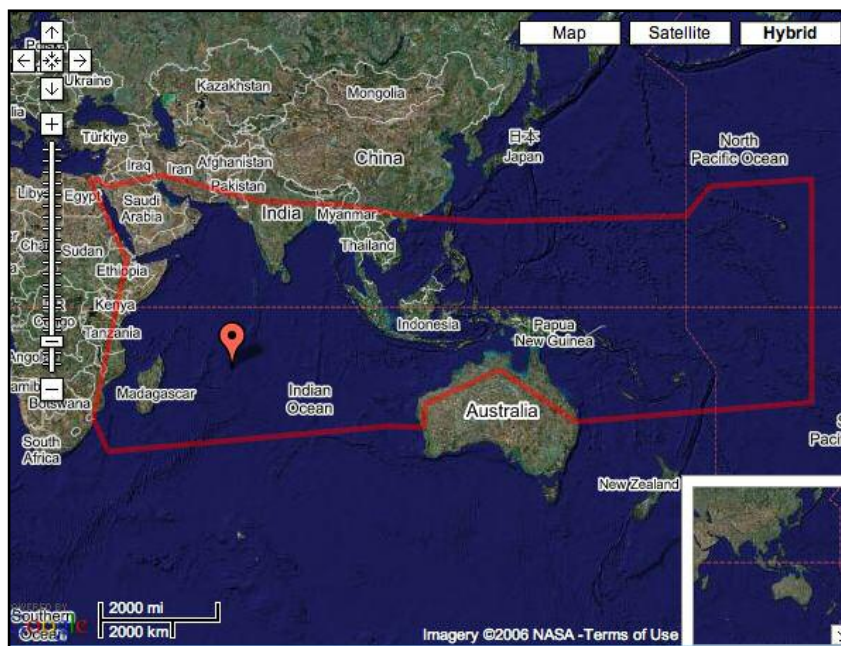


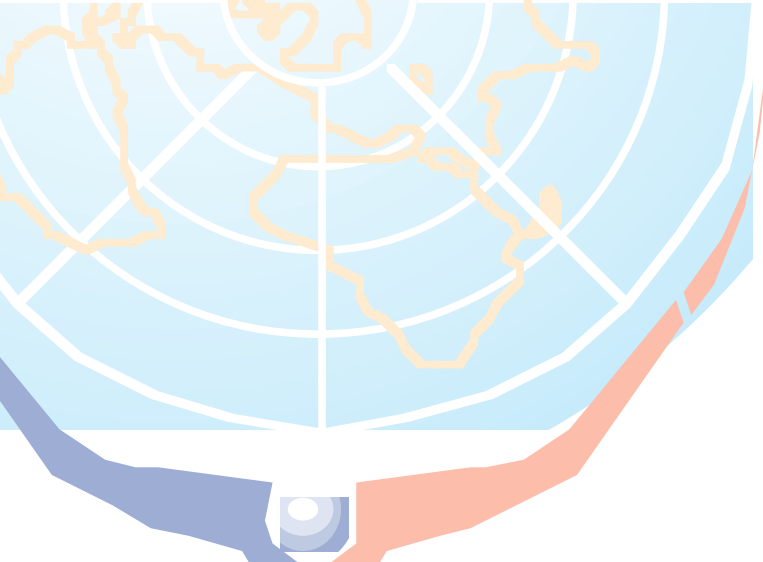
EARTHDIVE

“The health of our oceans is intrinsically linked to the future of life on this planet”

PRE-DIVE BRIEFING PACK

Eco-Region 8 Tropical Indo-Pacific





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1.0 General Information

This booklet is a **pre-dive briefing pack** for the **Tropical Indo-Pacific** eco-region. Please feel free to print it and take it with you as an 'aide memoir' for your dive. It contains all the information you need to contribute to the **EARTHDIIVE** Global Dive Log.

1.1 Introduction

The **EARTHDIIVE Global Dive Log** is a pioneering methodology that has been developed in partnership with **UNEP-WCMC** and marine scientists from around the world. These marine scientists helped establish thirty **EARTHDIIVE** eco-regions - areas of water that share a relatively similar climate and contain a common assembly of natural habitats and species. They then identified key indicator species for each region - an important set of marine animals whose numbers and changing population can tell us a lot about the changing state of our oceans.

You can help observe and record sightings of these marine animals during a dive or snorkel trip and enter observations into the **Global Dive Log**. You can also record evidence of key anthropogenic pressures - changes in the marine environment brought about by human activity such as pollution and overfishing. Any data you enter onto the **EARTHDIIVE** website can be viewed by you and other visitors.

The **EARTHDIIVE** eco-regions span all of the world's oceans - not just those areas with warm water and coral reefs. Whether you are diving in Scotland or Saint Lucia, Connecticut or Cocos, Denmark or Dominica, your data collection is equally valid and valuable. So you don't have to wait for the next exotic dive trip - home waters are just as important!

Each eco-region also has its own types of megafauna, from dolphins to whale sharks, from whales to polar bears (if you like really cold water) and provision is also made in the Global Dive Log to record sightings of these exciting animals.

Collecting this valuable information for **EARTHDIIVE** helps create a **Global Dive Log** - a valuable research tool.

This briefing pack lists the indicator species and anthropogenic pressures for the **Mediterranean** eco-region.

Thank you for recording scientific information for **EARTHDIIVE**.

1.2 How to record your observations into the Global Dive Log

When recording scientific information for **EARTHDIIVE**, divers are recommended to follow our 7 Point Plan. You will find the use of a slate or some other method of taking notes underwater, such as a laminated fish identification card, invaluable. Always try to transfer your data to the **EARTHDIIVE** website as soon as possible following your dive. Let dive buddies and dive leaders know what you are measuring, as they may be able to help with some post-dive questions on identification.

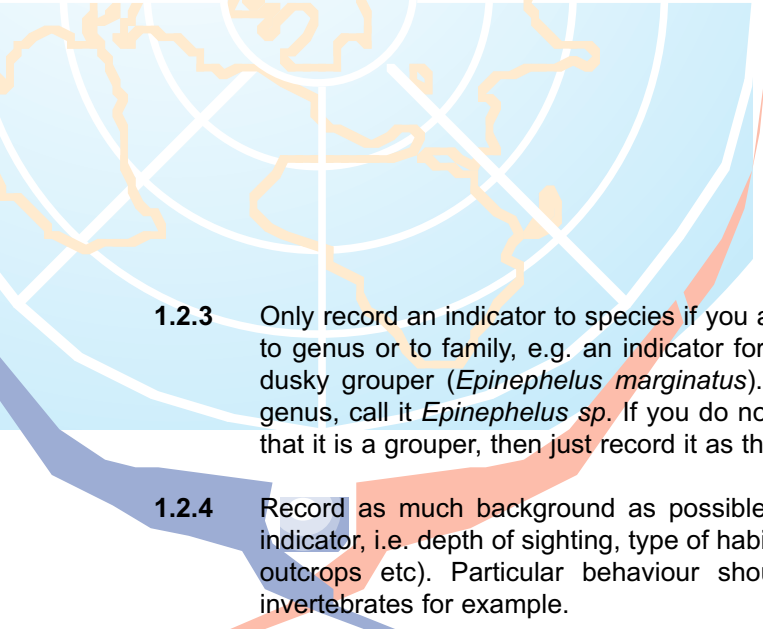
1.2.1 Try and ensure that the time of the underwater recording session is accurately noted. The length of the session can be all of the dive or just a period during the dive e.g. 10 minutes. You may even spend periods of time recording different indicators. For example there may be a dense aggregation of drums, which you count for 10 or 15 minutes. On the other hand you may look for other species such as groupers for most of the dive. Whatever your choice, the data is important so try to add the recording time in the notes for each indicator.

1.2.2 When possible always record **actual** counts of indicator species. If this is too difficult on the dive then enter your data into the abundance scale in the Global Dive Log as an estimate.



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- 1.2.3 Only record an indicator to species if you are 100% certain that it is that species. Otherwise record to genus or to family, e.g. an indicator for the sub-tropical Atlantic Coast of South America is the dusky grouper (*Epinephelus marginatus*). If you are uncertain of the species but recognise the genus, call it *Epinephelus sp.* If you do not have time to recognise it, or do not know it apart from that it is a grouper, then just record it as that - it's just as important!
 - 1.2.4 Record as much background as possible in the notes section of the Global Dive Log for each indicator, i.e. depth of sighting, type of habitat (lower reef slope, kelp bed, sand with scattered rocky outcrops etc). Particular behaviour should also be noted - spawning behaviour in fish or invertebrates for example.
 - 1.2.5 When recording always fin slowly and evenly with minimal sudden movements. Moving rapidly will disturb resident fish causing them to hide from view more quickly. By moving slowly and evenly you have more chance of seeing indicator species and recording their presence/absence more accurately. Always look carefully for particular indicators such as lobsters, which are often under overhangs or in crevices.
 - 1.2.6 On your way to and from your dive site, record any observations you have made regarding the listed anthropogenic pressures for this eco-region.
 - 1.2.7 Following your dive, make notes from your slate or memory and keep them in a safe place. Add any further comments within 24 hours before you lose some of the detail from your memory.

Thank you.

2.0 The Tropical Indo-Pacific Eco-Region

The Tropical Indo-Pacific is the largest of all the **earthdive** eco-regions and home to many of the world's important coral reef systems. It embraces large tranches of the tropical waters of the Indian and Pacific Oceans, including the popular diving location of the Red Sea.

The countries, island states, islands and other dependencies that comprise this vast eco-region include, in alphabetical order: American Samoa, Ashmore and Cartier Islands, Australia; Northern Territory, Queensland and Western Australia (North of Geraldton), Bahrain, Baker Island, Bangladesh, Bassas da India, British Indian Ocean Territory, Brunei Darussalam, Burma, Cambodia, China (South China Sea), Christmas Island, Cocos (Keeling) Islands, Comoros, Cook Islands, Djibouti, East Timor, Easter Island, Egypt (Red Sea Coast), Eritrea, Europa Island, Fiji, French Polynesia, Glorioso Islands, Guam, Hawaii, Howland Island, India, Indonesia, Iran (Persian Gulf), Israel (Red Sea Coast), Jarvis Island, Johnston Atoll, Juan de Nova Island, Kenya (Indian Ocean Coast), Kingman reef, Kiribati, Kuwait, Madagascar, Malaysia, Maldives, Marquesas, Marshall Islands, Mauritius, Mayotte, Micronesia, Midway, Mozambique, Nauru, New Caledonia, Niue, Northern Mariana Islands, Oman, Pakistan, Palau, Palmyra Atoll, Papua New Guinea, Paracel Islands, Philippines, Pitcairn, Qatar, Reunion, Samoa, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, Spratly Islands, Sri Lanka, Sudan, Tanzania (Indian Ocean Coast), Thailand, Tokelau, Tonga, Tromelin Island, Tuvalu, United Arab Emirates, Vanuatu, Viet Nam, Wake Island, Wallis and Futuna Islands and the Yemen.



In an eco-region as large as the tropical Indo-Pacific region, you would expect a diverse range of habitats, and indeed there are many.



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River delta marshland and mangrove ecosystems are important in the health and diversity of our oceans. The **Rufiji River** and the **Tana River** deltas of East Africa host a mangrove ecosystem that is vital to the maintenance of nearby reef and fish populations.

The vast complex of shallow freshwater lakes, marshes, and seasonally inundated plains between the **Tigris and Euphrates rivers** are among the most important wintering areas for migratory birds in Eurasia, but large scale drainage work, plus the not inconsiderable effects of the Iran-Iraq war of 1980-1988 have taken their toll on the delicate environmental balance.

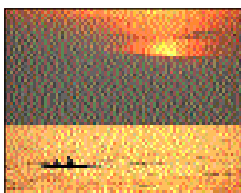
The Mekong River Delta Mangroves of Vietnam and Cambodia were nearly destroyed during the Vietnam War by napalm and defoliants like Agent Orange. Conservation and restoration efforts have led to successful re-establishment of thousands of hectares, which now supply fuel wood, fish, and prawns, and many birds have returned. Within the Mekong Delta, there are 260 species of fish, 35 reptiles (including the endangered river terrapin), 6 amphibians, and 23 mammals, as well as numerous birds.



The Sundarbans is a vast complex of intertidal and estuarine areas situated on the border of India and Bangladesh where the **Ganges, Brahmaputra, and Meghna rivers** converge in the Bengal Basin. The Sundarbans, the most extensive area of mangrove in continental Asia, provides nursery grounds for many species of fish and invertebrates, including exploited species such as tiger prawns. The productivity of the Sundarbans plays a major role in supporting fisheries along the east coast of India. Species found in and around the mangroves include marine turtles, dolphins, estuarine crocodiles, and seabirds.

The Rann of Kutch is a large inlet of the Arabian Sea, criss-crossed with mangrove-lined creeks. There is a complex of fringing coral reefs backed by mud and tidal flats, coastal marsh, and mangrove forest. The area also supports numerous sponges, mollusks, fish, algae, seabirds, and marine mammals.

It is, however, the coral reef and associated marine ecosystems that are arguably the most important to the health of our oceans. They are certainly one of the planet's greatest natural attractions, and in the face of the abundance and diversity of flora and fauna in the reef environment, even the mighty rain forests pale by comparison.

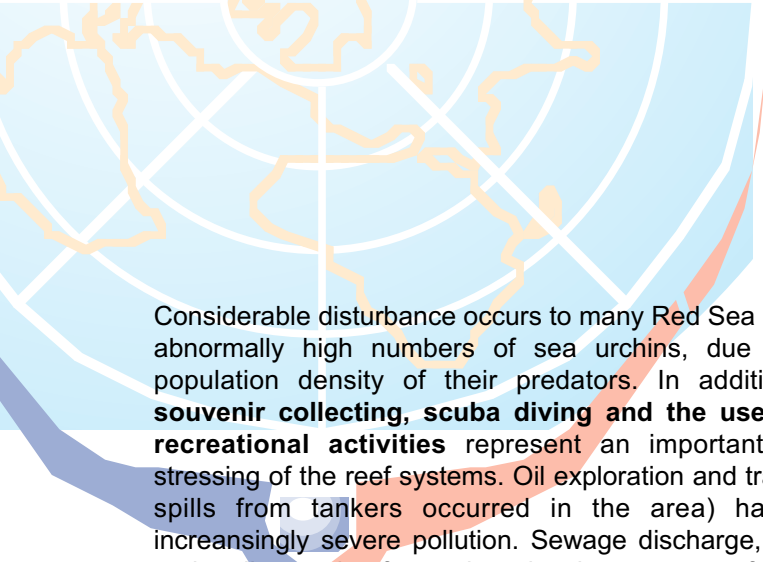


As mentioned above, the Rufiji Delta is one of the most important coastal wetlands in East Africa. Elsewhere along the coastline of **Tanzania** and **Kenya**, coral reefs form an almost continuous fringing reef. On **Mafia** and other islands, patch reefs predominate on the western sides and well-developed fringing reefs on the eastern sides, which may be among the finest remaining reefs in the area. The reefs around Mafia support 350 species of fish and 40 genera of corals. The Basaruto Archipelago supports a diverse range of marine habitats, including deep-sea areas, coral reefs, rocky intertidal areas, sandy beaches, tidal sand flats, seagrass meadows, and mangrove communities.

The barrier reefs of southwest Madagascar are the most extensive in the Indian Ocean and among the largest in the world, with about 200 km. of true barrier reef (including the 18-24 km-long Gran Recife de Toliara) and a number of offshore coral islands. Madagascar has high coral species diversity, with over 60 coral genera. The Toliara reefs have high fish diversity, with over 550 species, and supports an important artisanal fishery. Several endemic marine species occur here. The region also contains mangrove and extensive seagrass beds

The **Red Sea** is the warmest and most saline of the world's seas. No permanent coastal rivers or streams flow into it, and it is partially isolated from the open ocean. All of these features contribute to the presence of unique flora and fauna. The diverse and spectacular coral reefs for which the Red Sea is renowned are found only in the central and northern portions, where the reefs are well developed and drop steeply into deep water.

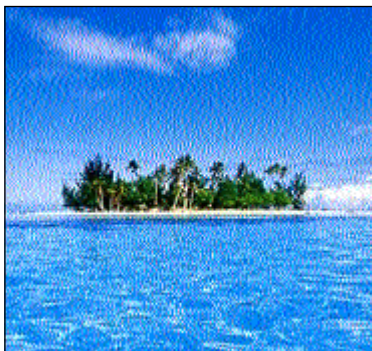




Considerable disturbance occurs to many Red Sea reefs, as a result of abnormally high numbers of sea urchins, due to decline in the population density of their predators. In addition, **spearfishing, souvenir collecting, scuba diving and the use of the coast for recreational activities** represent an important disturbance and stressing of the reef systems. Oil exploration and transport (several oil spills from tankers occurred in the area) have given rise to increasingly severe pollution. Sewage discharge, chemical pollution and sedimentation from urban development pose further threats to the Red Sea's coral reefs. Species of particular interest in the area are the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Eretmochelys imbricata*), dugong (*Dugong dugong*), white-tip reef sharks (*Triaenodon obesus*), butterfly fish (*Chaetodon spp.*), giant clams (*Tridacna spp.*) and different species of dolphins (*Delphinidae*).



The Arabian Sea and Persian Gulf contain rare, high-latitude coral reefs and green turtle-nesting beaches. The shallow waters of Kuwait Bay are a critical nursery habitat for commercial species of shrimp and fish and contain a unique species of mudskipper. Dugongs are both actively hunted and caught by accident.



The Maldives, the Chagos Archipelago, and Lakshadweep are composed entirely of atolls, with reefs and sandy islands, and form the Laccadive-Chagos chain that extends southward from India to the Central Indian Ocean. The Maldives contain extensive and largely intact reefs, and comprise perhaps one of the world's most complex reef systems. The Chagos Archipelago has the largest expanse of undisturbed reefs in the Indian Ocean, as well as some of the most diverse. In addition to five atolls, including Great Chagos Bank, the world's largest atoll in terms of area, there are two areas of raised reef and several large submerged reefs. The Chagos reefs are of particular interest for the presence of an endemic coral, *Ctenella chagius*. The Chagos Archipelago forms the British Indian Ocean Territories and have been inhabited since the late 18th Century. However, the islanders

suffered a forced evacuation in the 1970's when the US-UK military base in Diego Garcia was established. There are strict environmental controls in place, and diving or snorkeling is forbidden in the area.

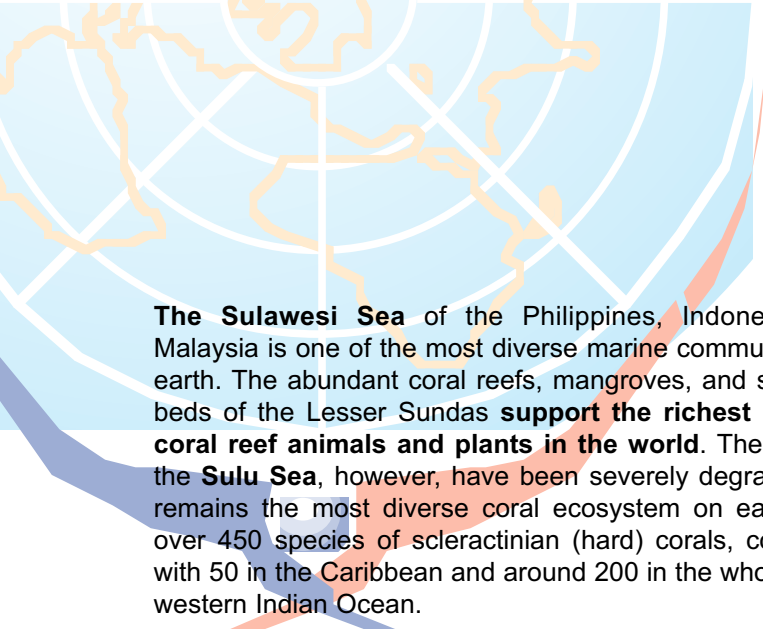
The Maldives and Chagos islands are important nesting sites for green turtles (*Chelonia mydas*), and many of the islands in the chain have seabird nesting colonies.

In the developed parts of the chain, the greatest threats to the reefs come from the relatively rapid establishment and growth of the tourist industry and the introduction of mechanized fishing. The natural vegetation is often cleared to make the islands "more attractive". On several islands the organic litter is burned and is lost to the island ecosystem. Coral mining has caused significant damage to the reefs. The construction of groynes, breakwaters and jetties has caused locally severe disturbance to some fringing reefs.

Unlike the Laccadive-Chagos chain, the **Andaman and Nicobar Islands** in the Bay of Bengal are high volcanic islands, arising from a submerged mountain chain that follows a southward extension of the continental shelf. The Andaman and Nicobars have fringing reefs around many islands, and a 320 km- long barrier reef on the west coast. While poorly known scientifically, these reefs may prove to be the most diverse and best preserved in India.

The Isthmus of Kra extends south off mainland Southeast Asia, forming a boundary between the Indian and Pacific Oceans and linking Thailand to Peninsular Malaysia. This ecoregion includes some of the best-developed reefs in Thailand, on the west side of the isthmus, and globally important reefs belonging to Malaysia, on the eastern side.

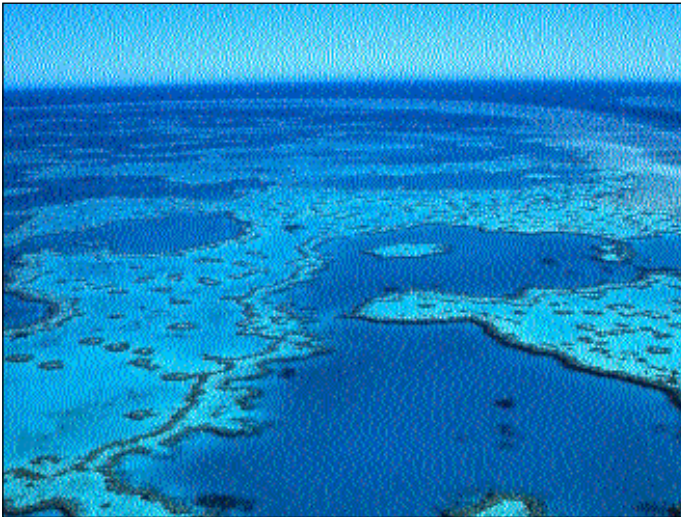




The Sulawesi Sea of the Philippines, Indonesia and Malaysia is one of the most diverse marine communities on earth. The abundant coral reefs, mangroves, and seagrass beds of the Lesser Sundas **support the richest array of coral reef animals and plants in the world.** The reefs of the **Sulu Sea**, however, have been severely degraded, yet remains the most diverse coral ecosystem on earth, with over 450 species of scleractinian (hard) corals, compared with 50 in the Caribbean and around 200 in the whole of the western Indian Ocean.



The diverse and complex coral reefs and marine ecosystems of **Papua New Guinea** and the **Moluccas** support numerous endemic species of coral, fish and invertebrates, as well as populations of marine turtles, dugongs, and giant clams.



Coral reefs extend for over 3,000 km along the **western coast of Australia**, with numerous reef systems. A wide variety of reefs are found, ranging from open ocean atolls to fringing and barrier reefs. The reefs contain a great diversity of fish, corals, and other invertebrates. Ten percent of the world's dugong population occurs at Shark Bay in this region.

The Great Barrier Reef along the **northeastern coast of Australia** is the largest single reef system in the world, extending 2,000 km. from the low-latitude tropics to temperate zones. It provides habitat for a great many forms of marine life. There are an estimated 1500 species of fish and about 350 species of hard-reef-building corals; more than 4000 mollusc species and over

400 species of sponge have been collected. It is the most diverse in reef types, habitats, and environmental regimes, making this an area of enormous scientific importance. The northern tropical waters are highly diverse, though there are relatively few endemics species. The temperate portions of the reef, in contrast, have low overall species diversity but a higher proportion of endemic species. Outbreaks of crown-of-thorns starfish (*Acanthaster planci*) occur, destroying a high proportion of hard coral cover.

Palau is considered to have some of the richest and most diverse coral reefs in the Pacific, with 300 species of coral. **Micronesia's** reefs also support diverse communities of coral, fish, and marine mammals. Species to be found here include all of the seven known species of giant clam (*Tridacnidae spp.*), hawksbill (*Eretmochelys imbricata*) and green turtle (*Chelonia mydas*).

The **South Pacific** Marine Ecosystems include **Vanuatu, Fiji, New Caledonia, Samoa, Tonga, and Tuvalu** and contain many internationally and regionally important sites for marine biodiversity, particularly coral reefs and mangroves. There are numerous lagoons, barrier and fringe reefs, and eelgrass beds.

The Eastern Polynesian Island Marine Ecosystems include **Hawaii, the Marquesas, Easter Island, Societies and Tuamotus.** These isolated oceanic islands are at a greater distance from a continent than any other islands in the world. The Marquesas, along with Hawaii and Easter Island, have the highest levels of marine endemism of any island or island group in the Pacific. On the major islands, land run-off and sedimentation have limited reef development in many areas. Urbanization and associated anthropogenic pressures pose serious challenges to water quality. With the increase in fishing technology and demand, overfishing is a persistent problem on the high islands. Outbreaks of crown-of-thorns starfish (*Acanthaster planci*) have been reported for several areas.



3.0 Indicator Species

What to look for and record in the **Tropical Indo-Pacific** eco-region.

All Sharks

Low numbers are indicators of overfishing

Groupers (*Serranidae*)

Low numbers are indicators of overfishing

Crown of Thorns Starfish (*Acanthaster planci*)

High numbers or population outbreaks are indicators of eco-system imbalance

All Marine Turtles

Target of exploitation – low numbers are indicators of exploitation

Butterfly Fish (*Chaetodontidae*)

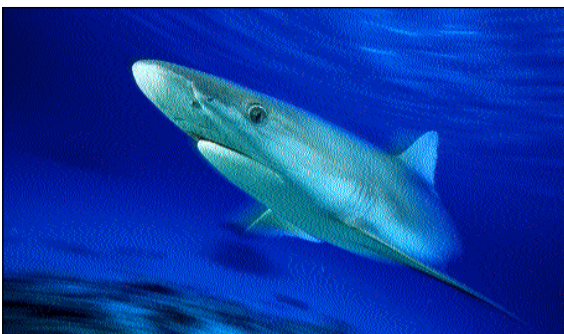
High numbers are indicators of good eco-system health



The International Union for Conservation of Nature and Natural Resources (IUCN) provides a listing of species that are at risk of global extinction. The 'IUCN Red List Categories and Criteria' are intended to be an easily and widely understood system and can be found at <http://www.redlist.org> The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk. If any of the indicator species for this Eco-Region have been classified as Critically Endangered, Endangered or Vulnerable on the list, then we have included that information below.

3.1 Sharks

Identifying sharks in the wild is a great challenge! While scientists can spend weeks examining every detail of a species, divers may encounter a shark for only a few seconds or minutes. Many species look alike and one individual may not be identical to the next. There are, however, relatively few species in any one specific dive site and with some preparation and a little practice it is possible for all of us to recognise the more common and distinctive species.



Grey Reef Shark

The key to successful shark identification underwater is a process of elimination, based on a mental checklist of the main features to look for in every animal encountered. One feature alone is rarely enough for a positive identification, so gather as much information as you can before drawing firm conclusions.

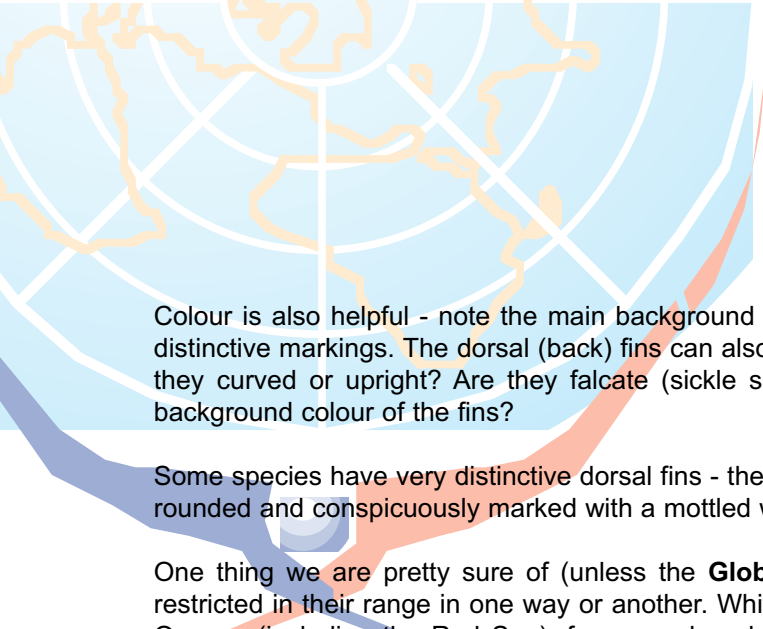
EARTHDIVE wants you to record sightings of sharks. That in itself is valuable. A total count of all species and the time duration of the count is important information in itself and you can record this data in the Global Dive **Log**.

However, identifying the actual species is even more important. If you do not recognise a species, ask your buddy, dive leader or other divers in the group, who may have seen it also. Or, record unusual features like, needle sharp teeth, incredibly long tail, diamond-shaped open mouth or a flattened hammer-shaped head. All these observations are sufficiently distinctive to help us and others make an identification. Record these details in the notes section for each indicator in the Global Dive Log.



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Colour is also helpful - note the main background colours of both the upperside and underside as well as distinctive markings. The dorsal (back) fins can also tell us a lot. Do they have a broad or narrow base? Are they curved or upright? Are they falcate (sickle shaped)? Are the tips rounded or pointed? What is the background colour of the fins?

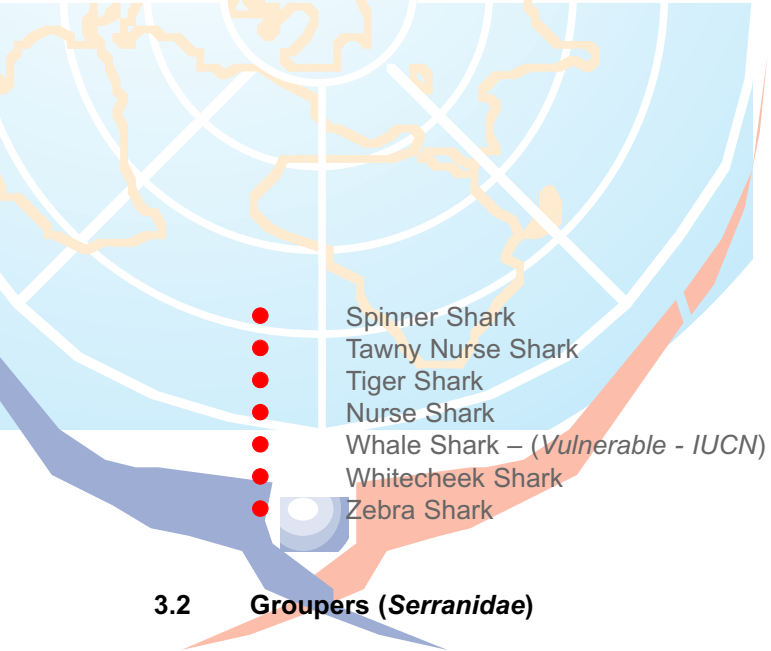
Some species have very distinctive dorsal fins - the first dorsal of the oceanic whitetip, for instance, is huge, rounded and conspicuously marked with a mottled white tip.

One thing we are pretty sure of (unless the **Global Snapshot** proves us wrong!), is that all sharks are restricted in their range in one way or another. Whitetip reef sharks are only found in the Pacific and Indian Oceans (including the Red Sea), for example, while bull sharks are found virtually worldwide but only in tropical and sub-tropical waters. Caribbean reef sharks occur mainly around island reefs, whereas oceanic whitetip sharks are more common farther offshore in oceanic waters.

In this way we can tell you which sharks you might encounter in the **Tropical Indo-Pacific** eco-region and some of these are listed below, but given the enormous diversity of species within the region, this list is not all-inclusive:

- Basking Shark
 - Bigeye Thresher Shark
 - Bigeye Sixgill Shark
 - Bignose Shark
 - Blacktip Shark
 - Blacktip Reef Shark
 - Blue Shark
 - Bluntnose Sixgill Shark
 - Bull Shark
 - Caribbean Reef Shark
 - Copper Shark
 - Finetooth Shark
 - Great Hammerhead Shark
 - Great White Shark – (*Vulnerable* - IUCN)
 - Graceful Shark
 - Grey Reef Shark
 - Nervous Shark
 - Oceanic Whitetip Shark
 - Pelagic Thresher Shark
 - Pigeye Shark
 - Sandbar Shark
 - Sand Tiger Shark – (*Vulnerable* - IUCN)
 - Scalloped Hammerhead Shark
 - School or Tope Shark (*Vulnerable* - IUCN)
 - Shortfin Mako Shark
 - Sicklefins Lemon Shark
 - Silky Shark
 - Silvertip Shark
 - Smalltail Shark
 - Smalltooth Sand Shark
 - Smalltooth Sawfish – (*Endangered* - IUCN)
 - Smooth Hammerhead Shark
 - Snaggletooth Shark
 - Spottail Shark
- Cetorhinus maximus*
 - Alopias superciliosus*
 - Hexanchus nakamurai*
 - Carcharhinus altimus*
 - Carcharhinus limbatus*
 - Carcharhinus melanopterus*
 - Prionace glauca*
 - Hexanchus griseus*
 - Carcharhinus leucas*
 - Carcharhinus perezii*
 - Carcharhinus brachyurus*
 - Carcharhinus isodon*
 - Sphyrna mokarran*
 - Carcharodon carcharias*
 - Carcharhinus amblyrhynchoides*
 - Carcharhinus amblyrhynchos*
 - Carcharhinus cautus*
 - Carcharhinus longimanus*
 - Alopias pelagicus*
 - Carcharhinus amboinensis*
 - Carcharhinus plumbeus*
 - Carcharias taurus*
 - Sphyrna lewini*
 - Galeorhinus galeus*
 - Isurus oxyrinchus*
 - Negaprion acutidens*
 - Carcharhinus falciformis*
 - Carcharhinus albimarginatus*
 - Carcharhinus porosus*
 - Odontaspis ferox*
 - Pristis pectinata*
 - Sphyrna zygaena*
 - Hemipristis elongata*
 - Carcharhinus sorrah*





- Carcharhinus brevipinna*
- Nebrius ferrugineus*
- Galeocerdo cuvier*
- Ginglymostoma cirratum*
- Rhincodon typus*
- Carcharhinus dussumieri*
- Stegostoma fasciatum*

3.2 Groupers (*Serranidae*)



Enoplometopus occidentalis

When people talk about coral reefs, fishermen tend to shrug their shoulders and complain about snagged lines and torn nets. But when you talk about groupers, they suddenly sit up and pay attention. Groupers are among the economically most important fishes of the coral reef, because of their popularity as food. Yet without the coral reef there would probably be no groupers. For this reason, groupers are an extremely important indicator species and your record of their existence or non-existence during your dive tells us a lot.

The giant grouper is the largest bony fish found in coral reefs. Common in shallow waters. Found in caves or wrecks; also in estuaries. Individuals more than a meter long have been caught from shore and in harbours. It feeds on spiny lobsters, fishes, including small sharks and batoids, and juvenile sea turtles and crustaceans.

Like all indicators, it is valuable if you can record the particular species you sight.

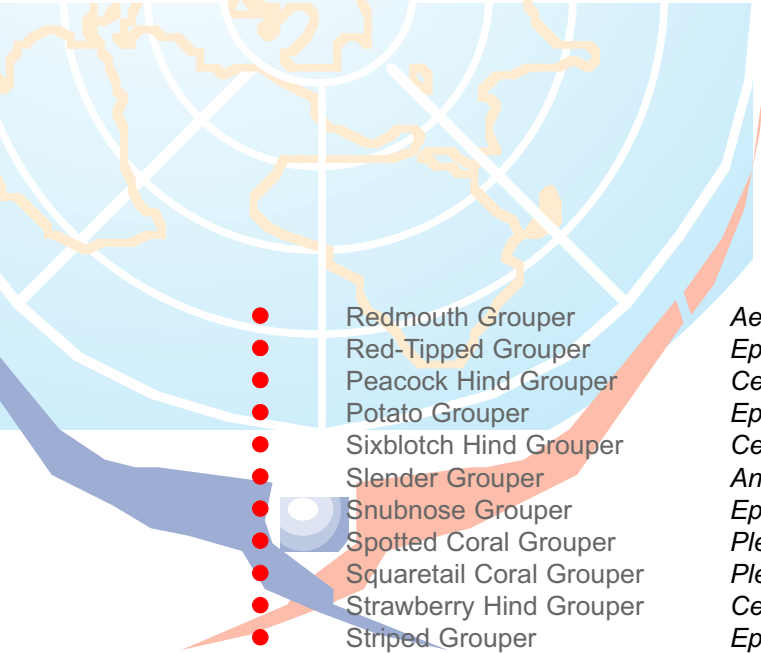
However, recording the total number of groupers is just as important. The species that you may encounter in the Indo Pacific eco-region are listed below:



Giant Grouper

- | | | |
|---|---------------------------|-----------------------------------|
| ● | Areolate Grouper | <i>Epinephelus areolatus</i> |
| ● | Blacktip Grouper | <i>Epinephelus fasciatus</i> |
| ● | Barred-Chest Grouper | <i>Epinephelus faveatus</i> |
| ● | Blacksaddled Coralgrouper | <i>Plectropomus laevis</i> |
| ● | Blue and Yellow Grouper | <i>Epinephelus flavocaeruleus</i> |
| ● | Brownspeckled Grouper | <i>Epinephelus chlorostigma</i> |
| ● | Camouflage Grouper | <i>Epinephelus polyphkadion</i> |
| ● | Cloudy Grouper | <i>Epinephelus erythrurus</i> |
| ● | Coral Hind Grouper | <i>Cephalopholis miniata</i> |
| ● | Darkfin Hind Grouper | <i>Cephalopholis urodeta</i> |
| ● | Foursaddle Grouper | <i>Epinephelus spilotoceps</i> |
| ● | Giant Grouper | <i>Epinephelus lanceolatus</i> |
| ● | Greasy Grouper | <i>Epinephelus tauvina</i> |
| ● | Highfin Grouper | <i>Epinephelus maculatus</i> |
| ● | Highfin Coral Grouper | <i>Plectropomus oligacanthus</i> |
| ● | Honeycomb Grouper | <i>Epinephelus merra</i> |
| ● | Leopard Coral Grouper | <i>Plectropomus leopardus</i> |
| ● | Longspine Grouper | <i>Epinephelus longispinis</i> |
| ● | Malabar Grouper | <i>Epinephelus malabaricus</i> |
| ● | Marbled Coral Grouper | <i>Plectropomus punctatus</i> |
| ● | Masked Grouper | <i>Gracila albomarginata</i> |
| ● | Netfin Grouper | <i>Epinephelus miliaris</i> |
| ● | Orange-Speckled Grouper | <i>Epinephelus coioides</i> |
| ● | Oval Grouper | <i>Triso dermatopterus</i> |





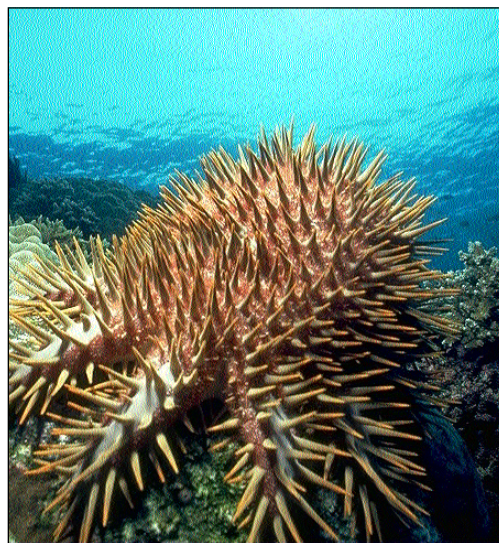
- Redmouth Grouper *Aethaloperca rogae*
- Red-Tipped Grouper *Epinephelus retouti*
- Peacock Hind Grouper *Cephalopholis argus*
- Potato Grouper *Epinephelus tukula*
- Sixblotch Hind Grouper *Cephalopholis sexmaculata*
- Slender Grouper *Anyperodon leucogrammicus*
- Snubnose Grouper *Epinephelus macrospilos*
- Spotted Coral Grouper *Plectropomus maculatus*
- Squaretail Coral Grouper *Plectropomus areolatus*
- Strawberry Hind Grouper *Cephalopholis spiloparaea*
- Striped Grouper *Epinephelus latifasciatus*
- Tomato Hind Grouper *Cephalopholis sonnerati*
- Wavy-Lined Grouper *Epinephelus undulosus*
- White-Edged Lyretail Grouper *Variola albimarginata*
- Whitespotted Grouper *Epinephelus coeruleopunctatus*
- White-Streaked Grouper *Epinephelus ongus*
- Yellow-Edged Grouper *Variola louti*

3.3 Crown of Thorns Sea Star (*Acanthaster planci*)

Sea stars (group name *Stelleroidea*), are sometimes called starfish, though lacking both vertebrae and fins, they are not real fish. There are two sub-types of sea stars: *Asteroideas* are the true sea stars and sun stars, whereas *Ophiuroideas* are brittle stars and basket stars.

Ophiuroid means 'snake-like', referring to the form and motion of the arms. The arms of brittle stars are easily broken off, but will regenerate in a few days to weeks. Sea stars can also regenerate arms that are broken off, but for most species, the central region of the body must remain intact

Class Asteroidea, the true sea stars, contains about 1700 living species of these echinoderms. Unlike the superficially similar brittle stars, true starfish have no sharp demarcation between arms and central body, and they move using tube feet, or podia, rather than wriggling movements of the whole arms.



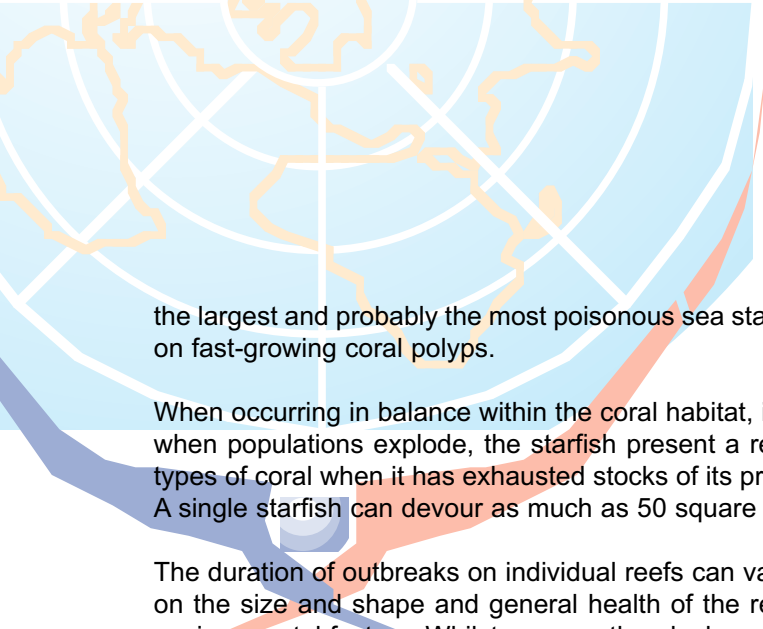
Each arm, or ray has a light sensitive organ called an eyespot, enabling it to detect light and general direction.

Most starfish are predators, feeding on sessile or slow-moving prey such as molluscs and barnacles. A few species, such as the spiny star of the North Atlantic, eat other sea stars! Many, but not all, starfish are able to turn a portion of their stomachs out through the mouth (called eversion), and thus digest food outside of the body.

This star-shaped carnivorous animal is usually a dull yellow or orange, but can also be brightly coloured. As a natural defence mechanism, the starfish is able to change its body color to hide or escape from predators. Starfish vary greatly in size from a few centimetres over one metre. The arms of the starfish are used for movement, catching prey and digestion. Unlike other animals, the starfish is able to grow a new arm if one is lost. Many starfish have five arms, but there are some deep-water species that carry more than fifty.

The crown of thorns starfish (*Acanthaster planci*) – so named because it has spiny arms radiating from a central disk that resembles a crown - is a true sea star and is





the largest and probably the most poisonous sea star in the region. It grows up to 50cm in diameter and feeds on fast-growing coral polyps.

When occurring in balance within the coral habitat, it plays a central role in the lifecycle of the reef. However when populations explode, the starfish present a real threat to the reef, because it moves to feed on all types of coral when it has exhausted stocks of its preferred species – fast growing staghorn and plate corals. A single starfish can devour as much as 50 square cm of coral a day

The duration of outbreaks on individual reefs can vary widely. The duration of an outbreak probably depends on the size and shape and general health of the reef, the number of starfish in the population and certain environmental factors. Whilst some outbreaks have lasted for 4-5 years, others have been exhausted within 1-2 years.

The crown-of-thorns starfish is sinister yet beautiful in appearance, being covered by a large number of 4-5 cm long, very sharp spines which can produce a toxic and inflammatory reaction if touched. This starfish is multi-coloured and ranges in colour from purplish-blue with red tipped spines to green with yellow-tipped spines. Their colour may change somewhat depending on diet and the degree to which hair-like projections (*papulae*) extend from the skin.

The crown-of-thorns starfish prefers to live in more sheltered areas such as lagoons, and in deeper water along reef fronts.

3.4 All Marine Turtles

They have traveled the oceans and have outlived the dinosaurs. They have become an integral part of the traditional culture of many coastal indigenous peoples throughout the world. Today, all but one of the species features on the **IUCN RED List** as endangered or critically endangered. Extinction looms!



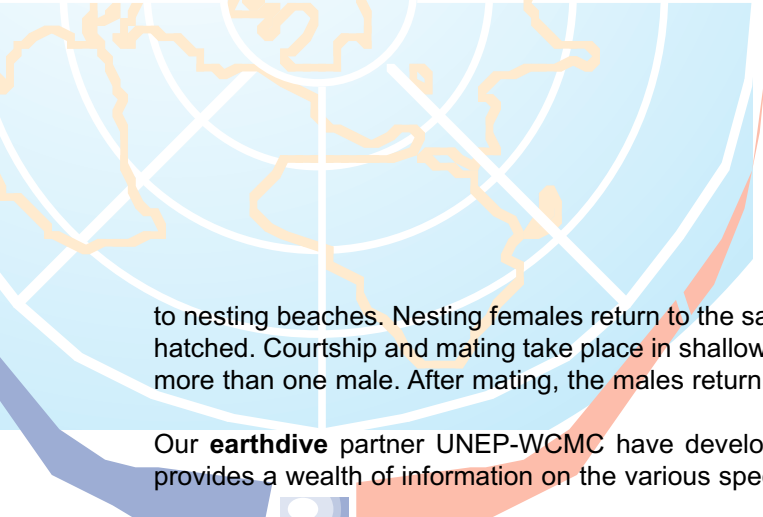
There are only a few large nesting populations of the green, hawksbill and loggerhead turtles left in the world. Australia has some of the largest marine turtle nesting areas in the Indo-Pacific region and has the only nesting populations of the flatback turtle.

Until fairly recent times, their long presence in the tropical and sub-tropical seas and beaches of the planet seemed set to continue. However, a myriad of threats such as hunting for meat, shell and eggs; fisheries bycatch; pollution; boat strikes; and introduced predators have had the effect of wiping out entire turtle populations, or at the very least reducing them significantly. Changes to important turtle habitats, Habitat change and destruction, especially of coral reefs, seagrass beds, mangrove forests and nesting beaches compounds their problems.

Marine turtles are one indicator species that is very difficult to miss. The most unique and recognizable feature of a turtle is its shell, the design of which has changed little in almost 200 million years and which comprises many separate bones. There are two parts of the shell, the upper part called the carapace, and a lower part known as the plastron. The carapace and plastron of most turtles are joined at the sides by a bridge. Hard scales (or scutes) cover all but the leatherback, and the number and arrangement of these scutes can be used to determine the species. They have four strong, paddle-like flippers and like all reptiles, air-breathing lungs. The characteristic beak-like mouth is used to shear or crush food.

Young marine turtles drift and feed in the open ocean until ready to settle near inshore feeding grounds. They grow slowly and take between 30 and 50 years to reach sexual maturity. They live for years in the one place before they are ready to make the long breeding migration of up to 3000 kilometres from the feeding grounds

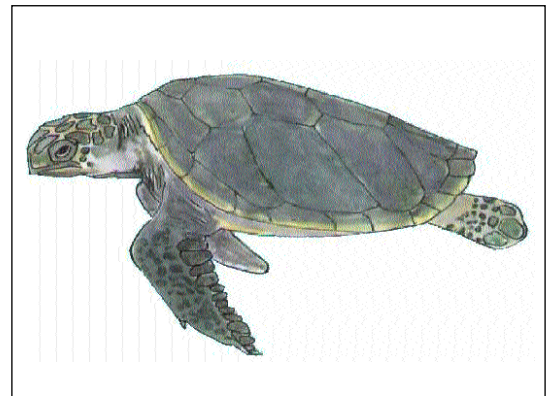




to nesting beaches. Nesting females return to the same area, believed to be in the region of where they were hatched. Courtship and mating take place in shallow waters near the nesting beach. Females often mate with more than one male. After mating, the males return to the feeding grounds.

Our **earthdive** partner UNEP-WCMC have developed a Marine Turtle Interactive Mapping System which provides a wealth of information on the various species, and it can be accessed [here](#)

The **Flatback Turtle** (*Natator depressus*) is endemic to the continental shelf of Australia. Although they feed around Papua New Guinea and Indonesia as well as within the Great Barrier Reef World Heritage Area, they nest only in Australia. They inhabit the subtidal soft-bottomed habitats of the continental shelf and feed primarily on jellyfish and benthic soft-bodied invertebrates such as soft corals and sea pens. The distinct low-domed flat carapace has upturned edges and is covered by a thin skin. The adult carapace can grow to 900cm. The head and flipper in adults is olive grey and their plastron is white, while newly hatched fatbacks are grey with a white plastron. This species is currently not listed as endangered by the IUCN, but it faces the same pressures that threaten other sea turtle species.



The **Green Turtle** (*Chelonia mydas*) can be found in warm tropical waters from New England to South Africa and in the seaweed-rich coral reefs and inshore seagrass pastures in tropical and subtropical areas of the Indo-Pacific region. When immature, green turtles are carnivorous with adults mostly herbivorous, feeding principally on seaweeds and seagrasses

Green turtles are the largest of the sea turtles with a highly domed carapace growing to approximately 100cm. The shell is typically smooth. The carapace colour varies from olive through shades of brown to black. Overlying this base colour are complete or broken lines of buff or reddish brown. The head is relatively small. The plastron is white or cream. The name 'green' turtle is thought to derive from the green coloured fatty flesh beneath the carapace.

The species is classified as endangered on the IUCN Red List

The Hawksbill Turtle (*Eretmochelys imbricata*) occurs in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. They are particularly fond of clear water coral reefs ecosystems, but may also be found in shallow rocky inland waters and mangrove-edged inlets and bays.

The hawksbill is one of the smaller species of sea turtle, growing to a maximum 90cm in carapace length and weighing up to 80kg. They have typical hard shells with unique features such as large thick, overlapping costal scutes (the shell plates which lie one row inwards from the edge of the carapace). The species name is reflected in the beak-like mouth. Its main identifying feature is the posterior edge of the carapace, which is serrated

The scutes are dark reddish-brown or black on a cream to amber background. Many hawksbills have barnacles attached to their shells. The plastron is generally a light cream to amber colour.





The diet of the hawksbill comprises of fish, gastropods, echinoderms, coelenterates, bryozoans, and in particular – and surprisingly - sponges. Very few vertebrates other than a few fish species are known to consume sponges, which contain spicules that would lacerate the lining of the alimentary tract of most animals.

The hawksbill is one of the most sought after species of marine turtles world wide due to its edible flesh and attractive shell used in the making of tortoiseshell jewellery, leading to the species being classified as endangered on the IUCN Red List



The **Leatherback Turtle** (*Dermochelys coriacea*) is possibly the most highly evolved and specialized of all the sea turtles. It is certainly the largest, with an average curved carapace length of 155cm and weighing up to 700 kg.

Leatherbacks are nomadic, pelagic creatures distributed worldwide in all tropical seas, possibly traveling between oceans. They are quite cold water tolerant and have frequently been observed in the temperate waters of the north Pacific and Atlantic oceans.



As the common name leatherback implies, this turtle lacks a hard shell. Instead, the deeply fluted and fusiform (spindle-shaped) shell and flippers are covered with soft skin. Colouring is dark gray to black with whitish or pinkish spots covering the shell and limbs. There is usually a large, often pinkish prominent spot on top of the head which is large, rounded and grades smoothly to the neck and shell. The front flippers are very large, measuring up to 300cm. from tip to tip.

The leatherback turtle is carnivorous and feeds mainly in the open ocean on jellyfish and other soft-bodied invertebrates.

The species is classified as critically endangered on the IUCN Red List.

The **Loggerhead Turtle** (*Caretta caretta*) is found in temperate and subtropical waters throughout most of the world, occurring in an enormous range from north to south. In the Western hemisphere they are found as far north as Newfoundland and as far south as Argentina, inhabiting subtidal and intertidal coral and rocky reefs and seagrass meadows in addition to deeper soft-bottomed habitats of the continental shelf.

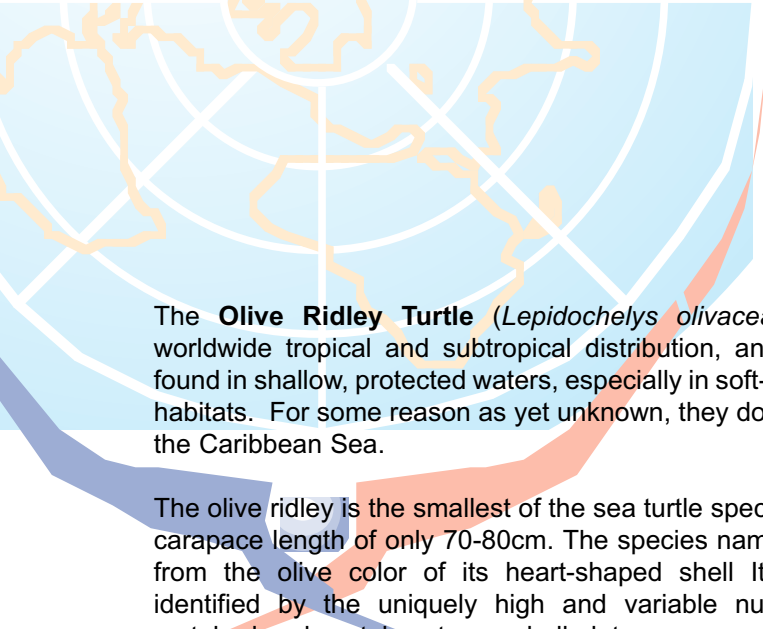


The head is very large with strong, heavy jaws. The carapace is heart-shaped and a reddish-brown and typically 82-105cm long. The plastron is yellowish-brown. The front flippers are short and thick with 2 claws, while the rear flippers can show 2 or 3 claws. Loggerheads are carnivorous, feeding on benthic gastropod and bivalve molluscs, crabs, sea urchins, shellfish and jellyfish.



The species is classified as endangered on the IUCN Red List





The **Olive Ridley Turtle** (*Lepidochelys olivacea*) has a worldwide tropical and subtropical distribution, and can be found in shallow, protected waters, especially in soft-bottomed habitats. For some reason as yet unknown, they do not enter the Caribbean Sea.

The olive ridley is the smallest of the sea turtle species with a carapace length of only 70-80cm. The species name derives from the olive color of its heart-shaped shell. It may be identified by the uniquely high and variable numbers of vertebral and costal scutes or shell plates.



Olive ridleys consume a variety of food including small shrimp, jellyfish, crabs, snails, fish, and in some populations, algae also forms part of the diet.

The species is classified as endangered on the IUCN Red List

3.5 Butterfly Fish (*Chaetodontidae*)

The butterflyfish family is a large and well known group of tropical species. They are mostly of small size with oval-shaped bodies which are deep and greatly compressed. The dorsal fin is continuous along the back and is not divided between the anterior spinous part and the spineless posterior portion. The tail may be rounded, truncated, or emarginated on its posterior border, but is never forked. The head bears a small mouth which contains flexible, brush-like or comb-like teeth. Within this family some members have a sharp spine on the lower back corner of the preopercle. These are true angel fishes, and with the presence of this spine can be distinguished and separated from true Butterfly Fishes, placing them in a separate family, *Pomacanthidae*.



Chaetodon ephippium

Butterflyfish are seen in various colors with bright and vivid hues of yellow, blue, red, orange, black and white. A few are of somber or muted colors, and many possess a dark stripe that runs through the eye. This family occurs in all tropical waters, but the largest number occurs in the tropical western Pacific and Indian Oceans. There are well over one hundred different species of butterflyfish, and many of them will be found throughout the region. When planning to dive and survey these delightful fish, check with your dive centre which species you are most likely to encounter. You will also find complete listings, descriptions and images for the area that you are diving in at the excellent www.fishbase.org web site.

One of the larger butterflyfish that can be found throughout the region is the Saddle Butterflyfish (*Chaetodon ephippium*). This species has an overall colour of yellowish grey with a large black spot bordered below by a broad white band on the back, and wavy blue lines on the lower sides. You are likely to encounter it in lagoons and seaward reefs to a depth of 30 m. It prefers coral-rich and clear water areas. They occur singly, in pairs or small groups. The maximum adult length is 30cm.

Note: Many species of fish and plants are known by different names in different locations. Where appropriate, we provide the recognised scientific name, but in the case of common names, for the sake of consistency, we have used the common names as they appear in the fishbase.org database as our default name.

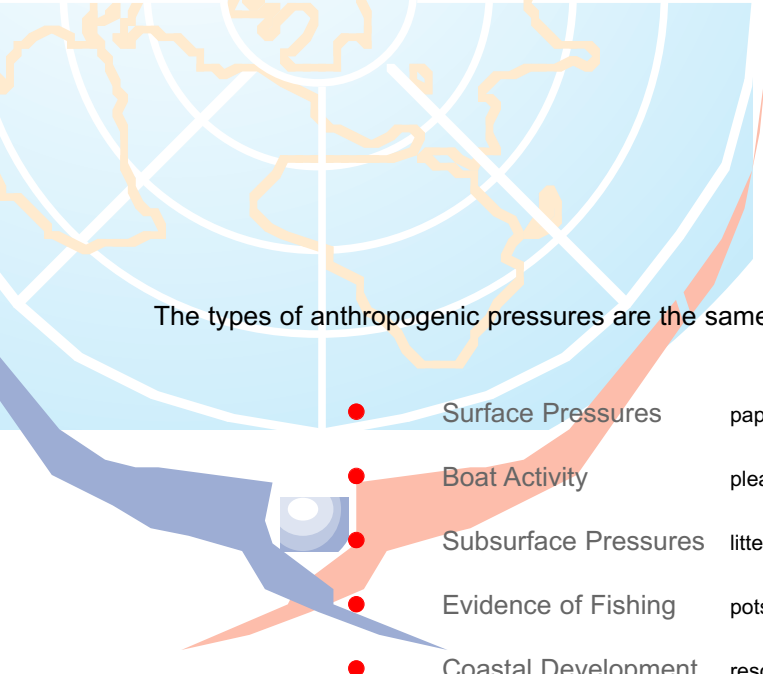
4.0 Anthropogenic Pressures

EARTHDIVE is recording five different types of anthropogenic pressures (effects resulting from the actions of humans). Collection of this data enables us to establish an ever-evolving **Global Snapshot** of our oceans.



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The types of anthropogenic pressures are the same for each region and are:

- Surface Pressures paper, wood, plastic and any other man-made debris
- Boat Activity pleasure, fishing, commercial
- Subsurface Pressures litter, sediment, physical damage
- Evidence of Fishing pots, traps, discarded nets, blast damage, cyanide damage, other etc.
- Coastal Development resorts, villages, towns, distance from the dive sites etc.

Please note any information you feel is relevant and record the data in the notes section for each impact in the Global Dive Log.

Thank you.

5.0 eCORD

EARTHDIVE asks all scuba divers to subscribe to the principles of **eCORD** - the **EARTHDIVE** Code of Responsible Diving - and to encourage others to practice them. **eCORD** is a straightforward 7 Point Plan which will help divers to limit the anthropogenic impact of recreational diving - while at the same time making their diving experiences more rewarding and enjoyable. Be sure to incorporate the 7 points in your dive planning!

1. Know your limits.

Every dive is different and every diver is different. Always ensure that you dive within the limits of your training and experience, whilst taking due account of the prevailing conditions. Take the opportunity to advance and extend your skills whenever that opportunity arises. In particular, buoyancy skills can become a little rusty after any prolonged absence from the water. If you can't get pool or confined water practice before your trip, get your buoyancy control checked out by a qualified instructor on your first dive! There are many national and international dive training organisations which offer a comprehensive range of courses and instructional material beyond basic skills level. Take advantage of them!

2. Be aware of the marine environment and dive with care.

Not surprisingly, many dive sites are located where the reefs and walls play host to the most beautiful corals, sponges and fish - fragile aquatic ecosystems! Starting with your point of entry, be aware of your surroundings: never enter the water where there are living corals, water plants or reeds. Once underwater, it only takes one unguarded moment - a careless kick with a fin, an outstretched hand, a dragging gauge or octopus - to destroy part of this fragile ecosystem. Even fin kicks too close to the reef or sand can have an adverse effect - so dive with the utmost care. Photographers in particular need to take greater care as they strive for that best-yet shot! Don't let your dive become an adverse anthropogenic impact! And remember that these rules apply just as much to 'hard' dive sites - such as wrecks, which have become the home of diverse marine life - as well as fresh-water and other sites.

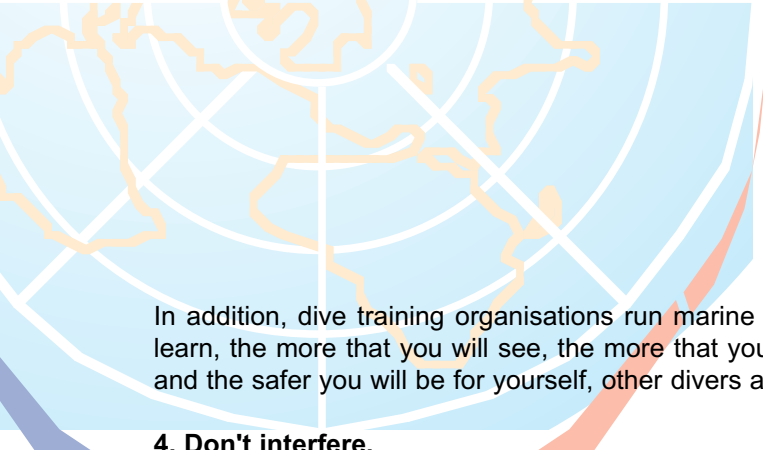
3. Understand and respect marine flora and fauna.

A large part of the joy of diving is in learning more about the plants and animals who live in this unique underwater environment. In order to survive and thrive, many living creatures disguise themselves to look like plants and inanimate objects, or develop defence mechanisms such as stings. Some even do both! (Have you seen a stonefish lately?) The **EARTHDIVE** briefing packs (available by download) provide information about indicator species for the region in which you are planning to dive.



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In addition, dive training organisations run marine naturalist and identification courses. The more that you learn, the more that you will see, the more that you will derive pleasure from your underwater experience - and the safer you will be for yourself, other divers and the marine environment!

4. Don't interfere.

First and foremost, be an observer in the underwater environment. As a general rule, look don't touch. Remember that polyps can be destroyed by even the gentlest contact. Never stand on coral even if it looks solid and robust.

Always resist the temptation to feed fish and discourage others from doing so. You may interfere with their normal feeding habits, damage their health and encourage aggressive behaviour. Leave only your bubbles!

5. Take only what you need.

The marine environment is a valuable source of food for mankind and it is important that it remains so into the future. If you are among those divers who enjoy taking food from the sea, observe some simple rules:

- Obtain any necessary permits or licenses.
- Comply with all relevant fish and game regulations. These are designed to protect and preserve fish stocks, the environment and other users.
- Only take what you can eat. If you catch it and can't eat it, put it back.
- Never kill for the sake of 'sport'.
- Avoid spear fishing in areas populated by other divers or visitors to the area, or where you might cause collateral damage.

Don't be tempted to collect shells, corals or other mementos of your dive. If you want a souvenir, take a photograph!

6. Observe and report.

As an **EARTHDIVE** member, you will be in a unique position to monitor and report on the health, biodiversity and any obvious damage to dive sites using the **EARTHDIVE** Global Dive Log. In addition, we would encourage you to report anything unusual to the appropriate local marine and environmental authorities, or if this is difficult, get your dive centre to do it for you. They have a vested interest in a healthy marine environment, and will normally be more than willing to help. Always be on the lookout for physical damage, fish stock depletion, pollution and other environmental disturbances. If the dive operation itself is causing damage -say by anchoring to the reef - then let them know how you feel in no uncertain terms!

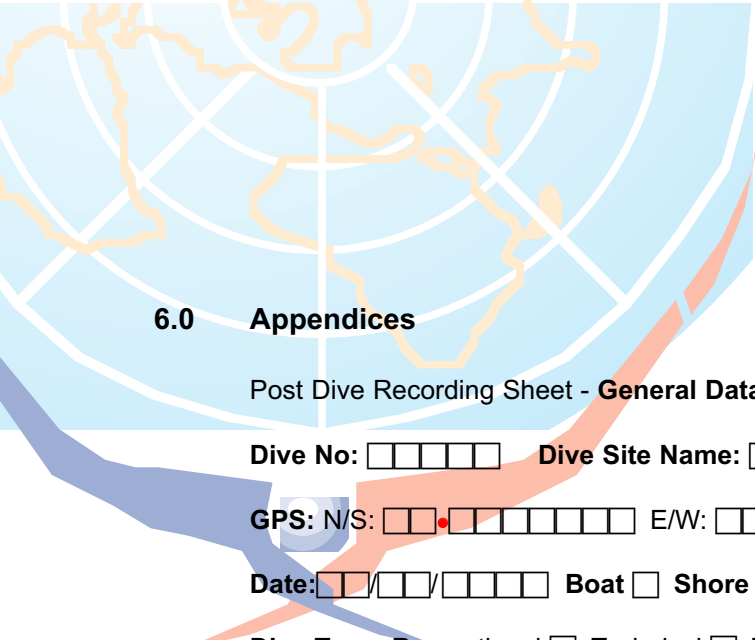
7. Get involved.

No matter where you are diving or snorkelling, be it at home or abroad, there will be at least one (and often many more) marine conservation bodies who are active in the area. Don't be afraid to approach them for information, to offer help, or just to find out what they have to offer. You will receive an enthusiastic welcome! They will provide you with lots of opportunities to contribute to marine conservation.



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6.0 Appendices

Post Dive Recording Sheet - **General Data** (complete/add/delete/tick as applicable)

Dive No: Dive Site Name:

GPS: N/S: E/W: (Decimal Degrees up to 7 decimal points)

Date: / / Boat Shore Water Type: Salt / Brackish / Fresh

Dive Type: Recreational Technical Training Drift Search Wreck Drift Night Other

Time In: : : Time Out: : : (24 hour clock) Dive Time: : (hr:mins)

Air/Nitrox Start: End: (psi or bar) Max Depth (ft/m)

Visibility: ft/m Temperatures: water: °C / °F air: °C / °F

Current: None Light Medium Strong (tick)

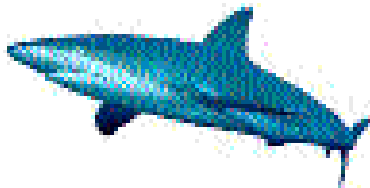
Surface Conditions: Cloudy Sunny Partly Cloudy Rain Variable other

IF DIVING WITH A CLUB/DIVE CENTRE/LIVEBOARD OR RESORT, WERE YOU GIVEN AN ENVIRONMENTAL BRIEFING: YES NO

Please record any other information you normally record immediately following a dive. Add this data to the **earthdive** website via your control panel as soon as possible. **Thank you**

Post Dive Recording Sheet - **Indicator Species**

Important Note: If you allocated some time to looking for one of the indicator species, but didn't find any, please make sure that you record a **0 (zero)** count in the appropriate box, and record how much time you spent looking for the indicator.



All Sharks

How many Sharks did you see? (tick box and/or record actual number)

0 1 - 5 6 - 20 20 - 50 51 - 250 >250

Actual Number (write actual number)

How long were you looking for this indicator? (minutes)

Add your additional information here. In what type of habitat did you see this indicator? Can you record its species? What was it doing? At what depth did you see it/them?

Additional Information:



All Groupers (*Serranidae*)

How many Groupers did you see? (tick box and/or record actual number)

0 1 - 5 6 - 20 20 - 50 51 - 250 >250

Actual Number (write actual number)

How long were you looking for this indicator? (minutes)

Add your additional information here. In what type of habitat did you see this indicator? Can you record its species? What was it doing? At what depth did you see it/them?

Additional Information:



Crown of Thorns Sea Star (*Acanthaster planci*)

How many Crown of Thorns did you see? (tick box and/or record actual number)

0 1 - 5 6 - 20 20 - 50 51 - 250 >250

Actual Number (write actual number)

How long were you looking for this indicator? (minutes)

Add your additional information here. In what type of habitat did you see this indicator? At what depth did you see it/them?

Additional Information:





All Marine Turtles

How many Turtles did you see? (tick box and/or record actual number)

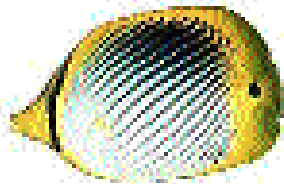
0 1 - 5 6 - 20 20 - 50 51 - 250 >250

Actual Number (write actual number)

How long were you looking for this indicator? (minutes)

Add your additional information here. In what type of habitat did you see this indicator? Can you record its species? What was it doing? At what depth did you see it/them?

Additional Information:



Butterfly Fish (*Chaetodontidae*)

How many Butterfly Fish did you see? (tick box and/or record actual number)

0 1 - 5 6 - 20 20 - 50 51 - 250 >250

Actual Number (write actual number)

How long were you looking for this indicator? (minutes)

Add your additional information here. In what type of habitat did you see this indicator? Can you record its species? What was it doing? At what depth did you see it/them?

Additional Information:



Post Dive Recording Sheet - **Anthropogenic Pressures**



Surface Pressures

Did you see any Surface Litter? (tick box)

Yes No Dont Know

If yes please record any details (plastic, wood, paper, other etc.) Please record quantity and any other relevant information.



Boat Activity

Did you see any Boat Activity? (tick box)

Yes No Dont Know

If yes please record any details (i.e fishing boats, pleasure boats, commercial vessels any other etc)

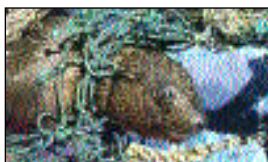


Subsurface Pressures

Did you see any Surface Litter? (tick box)

Yes No Dont Know

If yes please record any details (litter, sediment, physical damage, coral bleaching other etc).

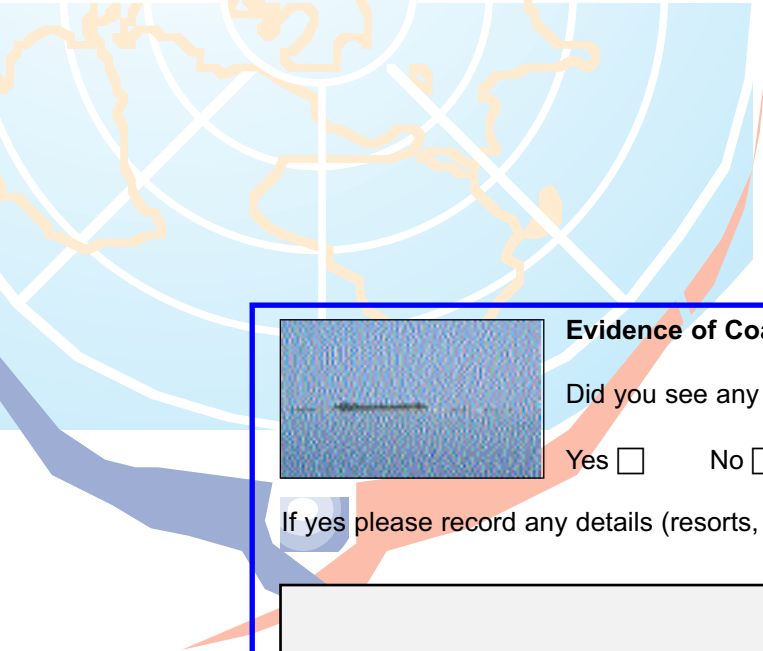


Evidence of Fishing

Did you see any Surface Litter? (tick box)

Yes No Dont Know

If yes please record any details (pots, traps, discarded nets, blast damage, cyanide damage, other etc).



Evidence of Coastal Development

Did you see any evidence of Coastal Development? (tick box)

Yes No Dont Know

If yes please record any details (resorts, villages, towns, distance form the dives site etc).

Evidence of the illegal trade in endangered species

Any observations you make below and record in the Global Dive Log will be passed onto **TRAFFIC**, the world's wildlife trade monitoring network.

TRAFFIC works to ensure that the trade in wild plants and animals is not a threat to the conservation of nature. It has offices covering most parts of the world and works in close co-operation with the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). **TRAFFIC** is a joint programme of WWF and IUCN-The World Conservation Union.

Evidence of the illegal trade in endangered species

Did you find any evidence at any time during your holiday/dive trip of the illegal trade of endangered species. (tick box)

Yes No Dont Know

If yes please record any details (the species, sale location, and any other available information). Please refer to the **TRAFFIC** Guide for more information concerning species identification, local laws, and contact information of **TRAFFIC** to report offences.



© Elizabeth Fleming
Turtle shell ornaments on display

TRAFFIC

