Cousteau Divers Caribbean Dive Log

Cousteau Divers is worldwide community of divers united to become active agents of the study and preservation of marine life, inspired by Jacques Cousteau and his amazing life achievements. When Cousteau invented scuba diving as we know it today in 1943, he opened the eyes of millions of people to the beauty, and fragility, of the underwater world. With great knowledge comes great responsibility.

Today, divers are the only people in the world who witness the state of the oceans on a daily basis. We are uniting to form the front lines of a global movement to help protect them.

In 1970, Jacques Cousteau and the crew of Calypso have been on the banks of Hood Island for several days observing and shooting the amazing marine iguanas. Calypso's crew most vivid moments are the times when their camp is calmly at rest. That is when the golden Galápagos sea lions (Zalophus wollebaeki) come, to scratch, lie about, yawn and sleep on the sand, just two paces from the tents. Their adventure on one of the smallest and most unusual spots in the Galápagos is related in the Cousteau's film « Dragons of Galapagos ».

« In the Galapagos, the animals flee neither Man nor each another. Hence, in this area of the world, perhaps the only one, Nature has accomplished a state of complete disarmament. No weapons, no predators, no conflict, and fear becomes an unknown. Nature seems to prove to us that peace by disarmament is not a utopia."

The Cousteau Divers program is structured around three major axes: Science, Community and Multimedia. Dive into our program on www.cousteaudivers.org, and share your geo-tagged underwater images with the rest of the world, allowing us all to witness the state of our oceans and to compare them with Cousteau archive images.

Cousteau Divers is establishing diver observation programs in different regions around the world, and you will find dive log methods for the Caribbean, Mediterranean, Red Sea and South-East Asia regions as well.

The following manual will help you understand and complete the Cousteau Dive Log. Your observations could provide valuable information on the status of our coastal seas. The Cousteau Diver program aims to capture this information in a simple and entertaining way, and provide the vehicle through which recreational divers can contribute towards monitoring the health and wealth of the marine life in our oceans.

Cousteau Divers train themselves to record their observations after their dives on the Dive Log and upload them later on the website www.cousteaudivers.org.

The Cousteau Divers training is also offered through accredited Cousteau Dive Centers all over the world. The accreditation program for dive centers involves the provision of specialist training for the dive centers to enable them to run the Cousteau Divers training course, as well as the use of training tools to help students progress in reporting their observations.

Cousteau Dive Centers and divemasters serve as permanent observers of their dive sites. They monitor the evolution of additional parameters, such as salinity, pH and oxygen concentrations. Cousteau Dive centers are also encouraged and assisted in having their dive sites declared no-take zones, catering for the natural ecosystem to develop and enrich over the years.

Guide to the Cousteau Divers Log

The Cousteau Divers - Dive Log

The Cousteau Divers - Dive Log allows you to record your personal observations underwater during your dive. Dive operators can also use the Dive Log to record the observations of dive clients by working as team on your dive sites. The observations recorded on the Dive Log can then be entered into the online form on the Cousteau Divers website the next time you have access to the internet.

How do I complete the Cousteau Divers - Dive Log?

The Cousteau Divers - Dive Log is divided into three main sections in which to capture information about the dive, the site and focal species / groups. The guidance notes below explain how to complete each section of the Dive Log. All information is meant to be collected as soon as possible after the dive.

As you will see, you can collect the observations of other people who came on the same dive, gathering as much information as possible on the dive site.

What will happen to the information collected by Cousteau Divers?

The Dive Log data entered into the website is automatically analyzed and a simplified version displayed on the website. The data collected by Cousteau Divers is also made accessible to scientists, local managers of Marine Protected Areas, local authorities and non-governmental organizations (NGOs) working in the region to help with their research and environmental monitoring. Scientists are able to request datasets through an online request form. This allows Cousteau Divers to track where the data is going, who is using the data, and how it is being used. Scientists interested in this data have the opportunity to create a specific profile on the website, and will be kept informed in real-time as the data come in.

About the Dive

On this section of the Cousteau Divers - Dive Log you will record the basic information about the dive (country, geographic location, dive rating, maximum depth, and depth of observation).

- **Photographs**: Tick if you took photographs during the dive / snorkel (see notes below) and will be uploading them on www.cousteaudivers.org

- **Video**: Tick if you recorded video during the dive / snorkel (see notes below) and will be uploading them on www.cousteaudivers.org

How do I prepare images for uploading onto the Cousteau Diver Website?

A photograph (or video) can speak a thousand words! The types of photographs or videos that would be most interesting for scientists would include general shots (e.g. using a standard or wide-angle lens) that capture the characteristics of the site or close-up shots (e.g. using a macro or a standard lens with macro setting on your camera) that capture representative, unique or unusual species. If you spot something that causes you concern you can also submit images of impacts at the site.

When preparing to upload your images (photographs or videos) onto the Cousteau Diver website try be selective. You only need to upload the images that best illustrate the characteristics of the site (e.g. landscapes, habitats) or species of interest (e.g. fish and other marine life). Tag the photographs as accurately as possible, including country, date, location and species identified as you upload them onto the Cousteau Diver website.

- **Dive Site**: Record the name of the dive site or the nearest location if there is no given dive site name.

- **Latitude / Longitude**: It is very important that you locate your observations with as much accuracy as possible. Ideally, record the GPS coordinates yourself or ask your dive center. Record the Latitude / Longitude using the WGS-84 (World Geodectic System-84) in degrees and decimal minutes. For example, the coordinates 37.6732°N and 2.3567°E are in decimal degrees. The coordinates for the same location in degrees and decimal minutes would be 37°40.3920'N and 2°21.4020'E.

If you can't get the exact coordinates for the dive site, ask your dive master to point out the site location on a map AND note the name of the dive site.

- **No. of Divers**: Record the number of divers on the dive that contributed observations to the Dive Log. Don't be shy! And don't hesitate to ask your fellow divers what they saw during the dive.

- **Dive Site Rating**:

  - *Landscape*: Rate the underwater landscapes at the site using a scale of 1 to 5, where 1 is a site with an unremarkable landscape and 5 is a site with amazing scenery. If completing the survey with clients ask them to provide you with the rating.

  - *Marine life*: Rate the marine life at the site using a scale of 1 to 5, where 1 is a site with poor marine life and 5 is a site with an abundance of marine life. If completing the survey with clients ask them to provide you with the rating.

About the Site

On this section of the Cousteau Divers -Dive Log you will record information on the characteristics of the dive site and the conditions at the site.

- **Site Conditions**: On this sub-section of the Cousteau Divers - Dive Log you will record information about the conditions at the dive site on the day of the dive. This information provides an indication about the type of site. The conditions on the day of the dive can also affect the ability of the Cousteau Diver to record information and may help to explain unusual observations. You can record this information at the start or the end of the dive.

Circle the symbol that best represents the conditions on the day of your dive.

- **Seabed Composition**: On this sub-section of the Cousteau Divers -Dive Log you record information about the physical structure of the seabed in terms of different components: coral reef, solid rock / bedrock, boulders, cobbles, gravel, sand and mud.

During your dive, observe the substrate. Some habitats may be entirely covered by biological organisms so you need to be careful and try to determine what substrate these organisms are growing on (you will record the biological cover on the next part of the form). Try to identify which is the dominant type (i.e. is >50 % of the seabed composed of one type, such as sand or rock). If the main focus of the dive is a wreck then you can indicate the wreck as dominant.

The structure and composition of the seabed provides an indication of both the complexity of the substrate and the stability of the site, both of which are important determinants of the type of marine life. Different types of substrate support different types of animal and plant communities. Substrates such as rock or large boulders provide a stable habitat, as they are rarely moved by wave action or currents, on which diverse communities can develop over a long period of time.

More mobile substrates like muds, sands, gravels and smaller rubble may be subject to more regular disturbances, and this can affect the type of organisms able to colonize the habitat and the

communities that develop over the long term. The structure and composition of the substrate together give an impression of the complexity of the substrate.

Tick the box if the given substrate is present and mark a cross if it is the dominant substrate.

Note: Boulders are >25cm in diameter, Cobbles are 6-25cm, Gravel is 0.2cm-5cm, Sand is smaller than 0.2cm in diameter. For the Mud type, no grains are visible.

- **Seabed Cover**: On this section of the Cousteau Divers - Dive Log you will capture information on the biological organisms living on the seabed (benthic organisms). You will record the presence of the different types of benthic organism found at the site, and indicate which of these provides the dominant cover (e.g. if >50 % of the seabed is covered in seagrass, then this is the dominant cover).

Tick the corresponding box if that substrate is present, and mark a cross if the substrate provides the dominant cover of the dive.

- **Algae**: There is a huge diversity of marine algae found in the Galapagos Islands. There are three broad categories as described below.

Importance: Algae are primary producers and an important food and energy source for some groups of animals (such as fish and sea urchins). The 'microhabitats' created by turf and erect algae are also important to many small animals such as worms and crustaceans (crabs, shrimp).

Threats: Threats to these communities include physical impacts due to fishing and recreational divers, pollution, and invasive species. Coralline algae are particularly vulnerable because they grow slowly so it takes time for these communities to recover if they are damaged. Climate change poses another threat as warming sea temperatures and ocean acidification may impact calcification rates.

- *Turf algae*: Turf algae is also often known as filamentous algae, and it is typically not much more than 1 cm in length. Turf algae can form dense carpets that may be found growing on other habitats, such as crustacean or mollusk beds, or on algal beds. They can create microhabitats of importance for a wide variety of species, including fish and urchins and other groups that feed off these algae.

- *Frondose algae*: There is a huge variety of different forms of erect or frondose algae. These may include red, green and brown algae such as Sargassum and kelp.

- *Coralline algae*: Coralline algae is the common name for a number of different red algae species from the Corallinaceae family. These algae are usually more of a pinkish-red color and they characteristically have a hard skeleton made from calcium carbonate. Globally, there are many different species and some of these form calcium carbonate constructions, which provide a habitat for a host of other species including polychaetes, cnidarians, mollusks, sponges, bryozoans, foraminferans and crustaceans. Coralline algae are sensitive to water temperature, nutrients and other environmental conditions.

• **Benthic animals**: This section only refers to non-mobile animals that grow attached to the seabed.

There are numerous different types of benthic animals that might be encountered in different habitats, including sponges, tunicates, anemones, barnacles, mollusks and hard and soft corals (including gorgonians). There are a few of these groups that are bio-constructors and may form biogenic reefs, such as corals, polychaete worms, barnacles and mollusks, amongst others.

Importance: Different groups of benthic animals are important for different reasons. Some are important as food for other organisms while other groups that are capable of creating reef-like structures provide habitats for other organisms and increase diversity.

Threats: These types of organisms may be damaged by physical impacts due to fishing, or other disturbance, pollution and sedimentation from land-run and rivers, and other impacts (including recreational divers). Some groups may also be threatened by climate related threats due to warming sea temperatures and ocean acidification.

- *Hard corals*: Hard corals are animals that are related to sea anemones, with the important difference that they lay down a skeleton of calcium carbonate (limestone) to provide themselves with support. Most true reef building corals contain small single-celled algae (zooxanthellae) that live inside their tissues. These algae create energy from sunlight and this is transferred to the host coral. The algae also contribute towards the corals color. If the coral is exposed to high seawater temperatures or other stressors they may lose their algae. This process is known as 'coral bleaching' because the coral appears 'pale' or white as the calcium carbonate skeleton becomes visible through the animals tissue. There are approximately 32 reef-building coral species in the Galapagos Islands as well as many different solitary hard coral species.

- *Soft corals, sea fans and black corals*: There are numerous different types of soft corals, which grow in a number of very distinctive forms, from branching and tree-like to encrusting, and are often brightly colored yellows, red, oranges and purples, and a wide range of colony shapes. Soft corals are also known as octocorals because they have eight tentacles around their mouths instead of the six found in true hard corals. Soft corals are related to hard corals, and there are a small number of species that do form a hard skeleton. However, most soft corals just have a network of hard calcium carbonate spicules that help to strengthen the body wall instead of a solid skeleton, resulting in a relatively flexible structure, but they are still easily damaged.

- *Sponges*: Sponges are primitive filter-feeding invertebrates that may be found on all types of seabed from the lower shore to great depths. They are composed of a body with a cavity but they lack any major organs. There are many different species of sponge but they are notoriously difficult to identify, not least because they can have different shapes depending the exposure of a site. In exposed locations these animals may form flat or rounded structures, whereas in more sheltered locations they may create larger structures and develop plant-like fronds.

- *Benthic animals (other):* Use this tick box to indicate the presence of other benthic animals that are not hard or soft corals, or sponges.

- *Bare*: Areas where there are no visible organisms growing on the seabed would be categorized as bare substrate. Areas of exposed mud, sand, gravel or pebbles may prevent the settlement and survival of organisms due the mobility of the substrate. While these bare areas of substrate may appear devoid of life they can often accommodate different types of organisms that can burrow into the sediment.

- **Human Impacts:** On this section of the Dive Log you will record the presence of human activities and impacts. The evidence of human impacts may include rubbish, fishing equipment, lost dive equipment or other visible impacts. Record the presence of the impact if one or two items are seen, or record the impact as abundant if more than two examples are seen at the site.

Focal Species – GALAPAGOS ISLANDS

On this section of the Cousteau Divers - Dive Log, you will record the species that you observe during the dive. There are four parts: fish, invertebrates, algae and other species. The species listed are characteristic of the region, and may include endemic species, exotic (non-native) species, flagship species, keystones, targets, vulnerable and bio-indicators of climate change or other impacts. The fifth section on this part of the form is for recording other observations from the surface.

Tick the box if present or mark a cross if abundant.

Fish (Galapagos Islands)

Bacalao *(Mycteroperca olfax)*

The Bacalao (*Mycteroperca olfax*) is a large grouper with a maximum length of 120cm. It occurs at depths of 5m down to about 40m and is found living among rock walls, underwater lava ridges and other vertical rock formations; juveniles are found in shallow sandy lagoons. This species is found only around the Isla del Coco off Costa Rica and the Galapagos Islands. It is a popular food fish and is heavily exploited by the artisanal fishery. It is considered to be 'Vulnerable' on the IUCN Red List.

Other Groupers (*Family Serranidae*)

Groupers (Family Serranidae) are predatory fish that feed on other fish, and invertebrates such as crabs and octopus. There are over 25 species in the Galapagos Islands, which range in size as adults from less than 30cm to over 1m. They are found in all habitats, but many species prefer rocky habitats. Young groupers may inhabit shallower depths, whereas older individuals may be found in deeper water, often near cliffs, caves and overhangs. The Pacific Creole Fish (*Paranthias colonus*) is probably the most common fish around the Galapagos Islands and can form huge aggregations in open water or above rocks. Grouper are favored food fish and other important species in the local fisheries include *Epinephelus mystacinus* (Mero) and *Paralabrax albomaculatus* (Camotillo), which is listed as 'Endangered' on the IUCN Red List.

Butterflyfishes (*Family Chaetodontidae*)

The Butterflyfishes (Family Chaetodontidae) are one of the archetypal families of coral reef fishes, being conspicuous and brightly colored. There are 9 species of buttterflyfish in the Galapagos Islands. Butterflyfishes are used as indicator species for studies of coral reef health and diversity because they occupy a diversity of different ecological niches. For example, their feeding habits vary from corallivores (can only eat live coral) through to generalists (feeding on anything from small worms to algae) and planktivores (feeding on plankton).

Snappers (*Family Lutjanidae*)

Snappers (Family Lutjanidae) are another group of fish caught in the local fisheries in the Galapagos Islands. There are approximately 8 different species, although not all are both common and widespread. Size of adult fishes varies between species, from as little as 30cm to over 1m (in the case the Pacific Dog Snapper *Lutjanus novemfasciatus*).

Parrotfish (*Family Scaridae*)

Parrotfish (Family Scaridae) are both common and widespread throughout shallow tropical seas. They are named parrotfish because of their bright colors, and the beak-like fused teeth that are a prominent feature. Parrotfish change sex from female to male during the course of their lives, with the smaller, younger females (called the 'initial phase') generally being quite drab in color, and the older (or 'terminal phase') males being vividly colored. The color differences between the sexes are so pronounced that inexperienced divers may easily think they are two separate species. Parrotfish are grazers, scraping rocky and coral surfaces with their fused teeth to remove algae, and in some cases large adults will leave very pronounced scrape marks on living corals, or even bite off small pieces of coral. There are 6 different species of parrotfish in the Galapagos Islands.

Jacks and Pompanos *(Family Carangidae*)

Jacks and Pompanos (Family Carangidae) are another group of fish caught in the local fisheries in the Galapagos Islands. There are approximately 18 different species, although not all are both common and widespread. They tend to be fast swimming and are found in the waters above the reef and in the open sea, where they feed on fish and invertebrates. Size of adult fishes varies between species, from as little as 30cm to over 2m (in the case of the Yellowtail Amberjack *Seriola lalandi*).

Grunts (*Family Haemulidae)*

Grunts (Family Haemulidae) tend to be common around the Galapagos Islands. There are approximately 12 species of which 3 species are only found in the Galapagos Islands: the White Salema (*Xenichthys agassizi*) and the Blackstriped Salema (*Xenocys jessiae*), which are quite common and the Galapagos Grunt (*Orthopristis forbesi*), which is rare. Other common species are the Grey Grunt (*Haemulon scudderii*) and the Burrito Grunt (*Anisotremus interruptus*). Grunts tend to form large schools above rocky reefs, sandy areas and slopes.

Scorpion fish *(Family Scorpaenidae)*

Scorpion fish (Family Scorpaenidae) are solitary and sedentary species found on rocky substrates. They tend to be carnivores and feed on fishes, crustaceans and mollusks. There are approximately 6 species of scorpion fish in the Galapagos Islands, some of which are caught in the local fisheries. This fish

is venomous, but the venom is heat instable and stings can be treated by running as hot water as one can tolerate on the affected area.

King Angelfish *(Holacanthus passer)*

The King Angelfish (*Holacanthus passer*) is brightly colored and can grow up to 35cm in length, although they are commonly only around 15cm. The adults have blue bodies with iridescent-blue-rimmed fins and a yellow dorsal fin. Juveniles are mainly yellow, with the same blue-rimmed fins and blue striping towards the end of their bodies, and an orange mask around the eye. They live at depths of 4-30m and feed on algae, plankton, invertebrates and sponges. They are a popular aquarium fish and therefore may be collected for the international aquarium trade.

Pacific Seahorse *(Hippocampus ingens)*

The Pacific Seahorse (*Hippocampus ingens*) is one of the largest seahorses and adults can reach a maximum length of 30cm. They live in depths of 3-18m and are often found amongst sea fans and black corals where they are seen to curl their tail around the branches. The male carries the eggs in a brood pouch underneath the tail. This species is of commercial importance for the international aquarium trade, the traditional medicinal trades and as curios and is also susceptible to decline resulting from degradation of habitat from coastal development, tourism and fisheries. It is listed as 'Vulnerable' on the IUCN Red List.

Galapagos Garden Eel *(Heteroconger klausewitzi)*

Galapagos Garden Eels (*Heteroconger klausewitzi*) may grow up to 70cm in length although usually only the head and front part of the body is visible. They are light to dark brown in color with a line of white spots along the sides of their body and a transparent dorsal fin. They live in depths of 10-30m and are found in large colonies in sandy areas where they feed on plankton. This species is only found in the Galapagos Islands.

Barracuda *(Family Sphyraenidae)*

There are 3 species of Barracuda (Family Sphyraenidae) in the Galapagos islands, the smaller Pelican and Mexican Barracuda (*Sphyraena ensis* and *S. idiastes*) and the larger Great Barracuda (*S. barracuda*), which can be up to 2m long. They are often seen at or near the surface and may be solitary or in a small group.

Sunfish *(Family Molidae)*

Sunfish (Family Molidae) are large unusual-looking fish. They completely lack all bones in their tail, and most of their skeleton is made of cartilage. Their body has no scales and is covered with extremely thick, elastic skin. They can grow to be over 3m in length. They are found on slopes close to deep water

where they come in for shelter and for seeking cleaner fishes and are often seen drifting at the surface. They are usually shy. There are 3 different species of Sunfish in the Galapagos Islands, the Ocean Sunfish (*Mola mola*), the Sharptail Mola (*Masturus lanceolatus*) and the Slender Sunfish (*Ranzania laevis*).

Requiem Sharks *(Family Carcharhinidae)*

There are around 12 species of requiem sharks (Family Carcharhinidae) found around the Galapagos Islands. The most likely to be encountered by divers is the Whitetip Reef Shark (*Triaenodon obesus*) and the Galapagos Shark (*Carcharinus galapagensis*) which is often seen in loose groups. Other requiem sharks include the Tiger Shark (*Galeocerdo cuvier*), the Oceanic White Tip (*Carcharinus longimanus*) and the Silky Shark (*Carcharinus falciformis*). Shark populations around the world have collapsed in the last 20 years due to fishing pressure.

Hammerhead Sharks *(Family Sphyrnidae)*

There are 4 different species of Hammerhead Sharks (Family Sphyrnidae) found around the Galapagos Islands. The Scalloped Hammerhead Shark (*Sphyrna lewini*) is the most common and may be seen forming large schools.

Other Sharks

There are a number of other sharks which may be seen around the Galapagos Islands. These include the world's largest fish, the Whale Shark (*Rhincodon typus*), the Shortfin Mako Shark (*Isurus oxyrinchus*), which is listed as 'Vulnerable' on the IUCN Red List and smaller sharks such as Horn Sharks, Catsharks and Houndsharks.

Manta Ray *(Manta birostris)*

The large oceanic species, the Giant Manta (*Manta birostris)* is found in the waters around the Galapagos Islands, particularly around islands such as Wolf and Darwin.

Eagle Rays *(Family Myliobatidae)*

There are many other different species of rays in the Galapagos Islands, including Devil Rays, Eagle Rays and Cownose Rays. Devil Rays tend to be pelagic although may also be seen in coastal waters. There are 3 species of Devil Ray in the Galapagos Islands. Eagle Rays are coastal species, found to depths of 100 m. Four species of Eagle Ray have been recorded in the Galapagos Islands; the most common is the Spotted Eagle Ray (*Aetobatus narinari*). Cownose Rays are semi-pelagic and found inshore and in deep water, in bays and lagoons and offshore banks. There is one species of Cownose Ray in the Galapagos Islands, the Pacific Cownose Rays (*Rhinoptera steindachneri*).

Stingrays *(Family Dasyatidae)*

Stingrays (Family Dasyatidae) are mostly demersal and found in coastal waters to depths of 480m; there are 6 species in the Galapagos Islands. The most common species are the Whiptail and Diamond Stingrays (*Dasyatis brevis* and *D. dipterura*) and the Round Ribbontial Ray or Black-blotched Ray as it is also known (*Taeniura meyeni*); this species is listed as 'Vulnerable' on the IUCN Red List.

Other Species

There is space on this part of the form record the scientific names of the other species of fish that you observe, if you are confident of their identification.

Invertebrates (Galapagos Islands)

Slipper lobster *(Scyllarides astori)*

Galapagos Slipper lobsters (*Scyllarides astori*) are found on platforms, crevices, and on vertical walls. The decline in catches of spiny lobster has resulted in an increase in catch and demand for slipper lobsters.

Spiny lobster

There are two species of spiny lobster that occur in the Galapagos Islands, the Red Spiny Lobster *Palinurus penicillatus* and the Green or Blue Lobster *P. gracilis.* Both are fished for food, with over-exploitation being a problem around many islands.

Sea cucumbers

Sea cucumbers are echinoderms, the group that also includes sea urchins and starfish. Sea cucumbers are elongated and soft-bodied, without any projecting arms. They feed by using tentacles around the mouth, at one end of the long body, to collect food particles from the substrate, or which are floating in the water. Color of the different species varies from very dark brown or black through pale brown to cream. Some species are very abundant in shallow sandy areas, such as reef flats, while others may be seen at much greater depths. There are numerous sea cucumber species in the Galapagos Islands, of which *Isostichopus fuscus* is heavily exploited because it is regarded as a delicacy in parts of Asia.

Starfish

There are many different species of starfish or sea stars in the Galapagos Islands. Starfish are echinoderms, and they have a flattened body with five or sometimes more radiating arms (or rays). The mouth is on the underside along with the tube-feet, which allow the sea star to move along the seabed. Some sea star are voracious predators and they can have significant impact on benthic community structure. Some of the starfish likely to be encountered by divers in the Galapagos Islands include 'ordinary' star-shaped sea stars such as *Luidia*, as well as more unusual types such as cushion stars (for

example the Chocolate Chip Star *Nidorellia armata*) and sun stars (for example *Heliaster cumingi*, which is only found in the Galapagos Islands).

Sea urchins

Sea urchins are generally spherical, within a chalky shell-like skeleton covered in mobile spines. The mouth of the urchin is on the underside and the anus is located on the apex of the shell. Sea urchins are grazers and they feed by scraping the fine algal film that forms on the surface substrate. As with other grazers, sea urchins help to create clean patches on the seabed, and space for new benthic organisms to settle. Sea urchins are preyed upon mainly by fish. If the fish predators are overfished then sea urchin populations can increase rapidly, resulting in overgrazing, which can be problematic in some habitats (e.g. kelp). Similarly, a lack of sea urchins can also be problematic in certain habitats. There are a number of different sea urchin species in the Galapagos Islands, the most common is the slate pencil urchin *Eucidaris galapagensis*. The abundance of this species has increased dramatically since the strong El Niño Southern Oscillation events in 1982/83 and 1997/98.

Nudibranch

Nudibranchs are a type of gastropod (snail-like) mollusk, but they lack a shell entirely. These typically small invertebrates range between 2 cm and 6 cm. They have a slug-like body with a pair of tentacles on the head and a ring of feathery gills on the back, and sometimes they have additional appendages along the back. What they lack in size they make up for in coloring, as they are usually brightly colored. There a number of different species in the Galapagos Islands including the Blue Striped Sea Slug *Tambja mullineri* which is only found in the Galapagos.

Hard Corals *(Pavona spp.)*

The hard coral *Pavona* spp. are a common group of hard reef-building corals in the Galapagos Islands, which may occasionally form patch reefs. There are at least 12 different species and they can form encrusting plates, columns or hemispherical colonies. They all have small flower-shaped corallites and are usually brown in color. The corals in the Galapagos Islands suffered mortality as a result of coral bleaching following the strong El Niño Southern Oscillation events in 1982/83 and 1997/98.

Hard Corals *(Pocillopora spp.)*

Cauliflower corals (*Pocillopora* spp.) are one of the most common hard reef-building corals in the Galapagos Islands and can form patch reefs in some areas. There are at least 10 different species, but they all tend to form clumps of thick branches with wart-like growths on their surface. The corals in the Galapagos Islands suffered mortality as a result of coral bleaching following the strong El Niño Southern Oscillation events in 1982/83 and 1997/98.

Hard Corals *(Porites lobata)*

Porites lobata is a hard coral, which forms hemispherical colonies and has a smooth surface with tiny corallites that are almost invisible to the naked eye. They are usually cream or pale brown, but may

be bright blue or purple in shallow water. The corals in the Galapagos Islands suffered mortality as a result of coral bleaching following the strong El Niño Southern Oscillation events in 1982/83 and 1997/98.

Galapagos Black Coral *(Antipathes galapagensis)*

Black corals are soft corals, which tend to occur in deeper water. They are called black corals because when they are dried, the internal skeleton has a black color. The Galapagos Black Coral (*Antipathes galapagensis*) is actually yellow in color and forms large bushes. It was harvested for jewellery during the 1970s.

Cup Corals *(Tubastrea spp.)*

Cup corals are corals, which produce a hard calcium carbonate skeleton but do not form reefs. They have large corallites, of 0.5-1cm in diameter and are brightly colored. They do not host the symbiotic algae, zooxanthellae, and feed by extending their tentacles at night to catch plankton. There are 4 species in the Galapagos Islands, the most common of which are the orange cup coral (*Tubastrea coccinea*) and the pink cup coral (*T. tagusensis*). The former is found on rocky walls and overhangs, while the latter tends to be found in areas of upwelling.

Other Species

There is space on this part of the form record the scientific names of the other species of invertebrates that you observe, if you are confident of their identification.

Algal Species (Galapagos Islands)

Galapagos Kelp *(Eisenia galapagensis)*

Kelp are large seaweeds belonging to the brown macroalgae. Galapagos Kelp (*Eisenia galapagensis*) is easy to recognize, in part because it has a maximum size of at least 85cm frond length and because it is the only kelp species found around the Galapagos Islands. The species used to be found in many different sites across the central and western archipelago, but is now only known from western Fernandina and south-western Isabela Islands. It occurs in depths of 12-60m. It has declined in abundance over the past thirty years, probably due to El Niño. It is listed as 'Vulnerable' on the IUCN Red List.

Sargassum spp.

Sargassum is a large brown macroalgae and there are approximately 12 different species in the Galapagos Islands including at least 2 species which are found only in the Galapagos Islands. They are threatened by climate change and an increase in grazing sea urchins linked to the El Niño Southern Oscillation and overfishing.

Surface Observation (Galapagos Islands)

Whales and Dolphins

There are approximately 28 species of cetaceans thought to occur around the Galapagos Islands. Of these, the most commonly encountered species include baleen whales such as the Humpback Whale (*Megaptera novaeangliae*), Minke Whale (*Balaenoptera acutorostrata*), Sei Whale (*B. borealis*), Fin Whale (*B. physalus*) and Bryde's Whale (*B. edeni*) and toothed whales such as the Short-finned Pilot Whale (*Globicephala macrorhyncus*), Sperm Whale (*Physeter macrocephalus*), Killer Whales (*Orcinus orca*) and False Killer Whales (*Pseudorca crassidens*); beaked whales may also occasionally be spotted. There are about 7 species of dolphin, of which the resident Common Dolphin (*Delphinus delphis*) and Bottlenose Dolphin (*Tursiops truncatus*) are most commonly seen.

Sea Lions

The Galapagos Sea Lions (*Zalophus wollebaeki)* are found throughout the Galapagos Islands and colonies are usually found on gently sloping sandy and rocky beaches. The population has declined since 1978, which may be due to repeated strong El Niño events, which result in starvation. The species is listed as 'Endangered' on the IUCN Red List. Vagrant South American Sea Lions (*Otaria flavescens*) have also been recorded in the Galapagos Islands on one or two occasions.

Galapagos Fur Seals *(Arctocephalus galapaoensis)*

Galapagos Fur Seals (Arctocephalus galapagoensis) are observed throughout the Galapagos Islands and tend to haul-out on rocky coasts with large boulders and ledges that provide shade. The breeding season lasts from mid-August to mid-November and most breeding colonies are found in the western and northern parts of the Archipelago, close to productive upwelling areas offshore. The species is listed as 'Endangered' on the IUCN Red List.

Galapagos Penguin *(Spheniscus mendiculus)*

The Galapagos Penguin (*Spheniscus mendiculus*) is found only in the Galapagos Islands, where the majority of the population is found around Isabela and Fernandina Islands. It is the most northerly breeding penguin species. The population underwent dramatic declines following the El Niño Southern Oscillation in 1982/83 and 1997/98 due to declines in the availability of shoaling fish. The species is listed as 'Endangered' on the IUCN Red List.

Sea turtles

The Galapagos Islands are important for two species of sea turtle: Green Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Eretmochelys imbricate*), which are common in the surrounding waters, with the former nesting on sandy beaches. Green Turtles are listed as 'Endangered' on the IUCN Red List and Hawksbill Turtles are listed as 'Critically Endangered'.

Galapagos Marine Iguana *(Amblyrhynchus cristatus)*

The Galapagos Marine Iguana (*Amblyrhynchus cristatus*) is found only in the Galapagos Islands and occurs on 10 different islands, where they form large colonies. It is the worlds' only marine lizard species. They feed on marine algae and can dive down to depths of 12m. El Niño causes periodic dramatic mortality. The species is listed as 'Vulnerable' on the IUCN Red List.

Algal bloom

An 'algal bloom' occurs when there is a large accumulation of small algae (phytoplankton), macroalgae and occasionally heterotrophic protists in the water. There are many species of phytoplankton that can form blooms. Some species can cause the water to change color, and cause 'red tides', 'brown tides', or 'green tides'. Other species produce toxins that are poisonous to fish (and humans if they consume the fish) and these are called 'harmful algal blooms (HABs)'. Sometimes create a scum or foam on the sea surface, which can also cover beaches. Algal blooms can occur naturally in response to seasonal changes in the availability of nutrients in the water that favor cells. They can also occur as a result of nutrient enriched run-off from the land, with high concentrations of nitrates, phosphates, from human waste water or from agriculture (fertilizers). When the bloom ends, the algae die and sink to the seabed. The decomposition of the algae removes oxygen from the water and can cause 'eutrophication' and result in the death of other organisms living on the seabed or in the water column.

Jellyfish bloom

Several species of jellyfish occur naturally in the Galapagos. Often these may be seen as individuals and rarely in groups. Over the past 10 years, there has been an increase in the frequency of reports of 'jellyfish blooms', when there are swarms of jellyfish in the water at the same time. Jellyfish blooms can present a nuisance for swimmers, and pose a potential health hazard when certain toxic species are involved. Such blooms also cause problems for fishermen, as they clog nets thereby deterring fish and consume fish larvae. Jellyfish in large numbers can also clog the inlets underwater pipes. The increased frequency of jellyfish blooms, and the synchrony of such events in other locations, such as along the eastern Pacific coast of USA and South America, can indicate a potential phase shift. The cause of these blooms is uncertain and may be linked to overfishing, coastal habitat degradation, contaminated run-off and climate change, or a combination of these factors.

Marine litter

Marine litter is a global problem. Man made synthetic materials whether they float, sink or remain suspended in the sea, not only look unsightly, but can pose a threat to many species of wildlife. It is estimated that 8 million items of marine litter enter the oceans every day, from the land or thrown overboard from ships. Another estimate is that there are over 13,000 pieces of plastic litter floating for every square kilometres of ocean surface.

Don't forget to upload your divelogs on www.cousteaudivers.org!

Citation

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