Marine Conservation and Coral Reef Research in Mexico

Training Manual

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Welcome !

Welcome to GVI's Mexico Marine Training Manual. We're very excited you'll be joining us out in the field very soon but we need you to get to work first! This document is meant to brief you a bit on what to expect on the expedition in terms of the science training. The information below will take you through the training schedule to give you an idea of what to expect, but most importantly, it will help you get started on the foundation of the expedition- learning all of the fish or coral species in the region.

Plan to have fun, meet a lot of great people, and learn new skills but above all, prepare to work hard. This is a research expedition and GVI and our local project partners use the collected data to work towards sustainable development and other resource management schemes, so it is essential that we train you up to 100%. Thus, while we understand you may be busy with work/school/travel etc., the more you can learn pre-expedition will put you a step ahead and get you monitoring that much faster.

About the Mesoamerican Barrier Reef

The Mesoamerican Barrier Reef System (MBRS), the second largest barrier reef in the world, extends from Isla Contoy on the North of the Yucatan Peninsula, Mexico, through Belize and Guatemala to the Bay

Islands of Honduras and is home to an immense amount of fish and coral biodiversity.

This unique reef system, largest in the Northern Hemisphere, offers a range of benefits. Just before a hurricane makes its way to land, the reef serves as a means to dissipate the enormous energy of the waves, thus protecting the coast from erosion and the general impact. Working side by side with the lagoon and mangrove ecosystems, the 3 systems are important to maintain good water quality. As you'll see very soon, the reef is essential as feeding and breeding grounds for all types of aquatic life, which is what brings divers and other tourists to experience the reef, generating incredible revenue via tourism and consequently providing an array of employment opportunities.

And this is why we're here - to aid in the protection of a resource not only beautiful and full of vibrant, colourful life, but to learn more about, create environmental awareness and promote sustainability of this very important resource. Ready to get started?!

Training Schedule

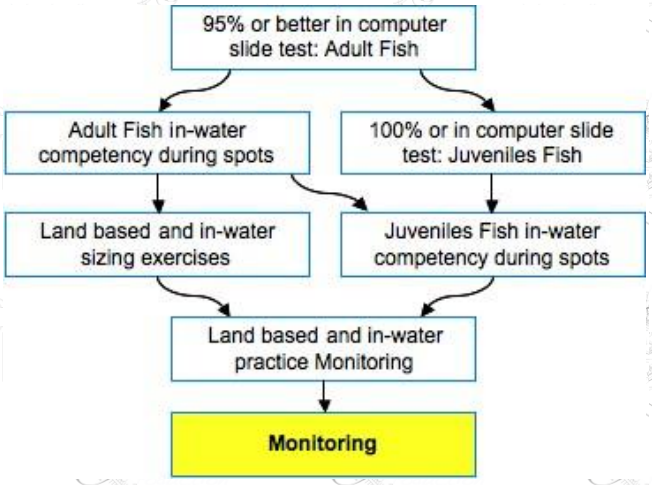
The best way for the staff to train and assess your fish or coral knowledge is by what we call "spot dives." Once basic dive training is completed at the beginning of the expedition, each diving day you will receive 1-2 spot dives or snorkels. At first the dive leader will bring a slate and point to different species, briefly describing the important characteristics. When you become more confident, eventually you will bring the slate and ID the species being pointed out. After a few dives, this may seem repetitive, but please keep in mind that we need to see that your ID-ing ability is consistent as well as accurate and underwater, you will most definitely notice that species are not always easy to ID and often don't appear exactly as they do in the books. In addition, behaviour and abundance are factors that can help you ID a species so, we'll be visiting a range of sites and depths to familiarize you with the fish or coral you may see in some places but

not others.

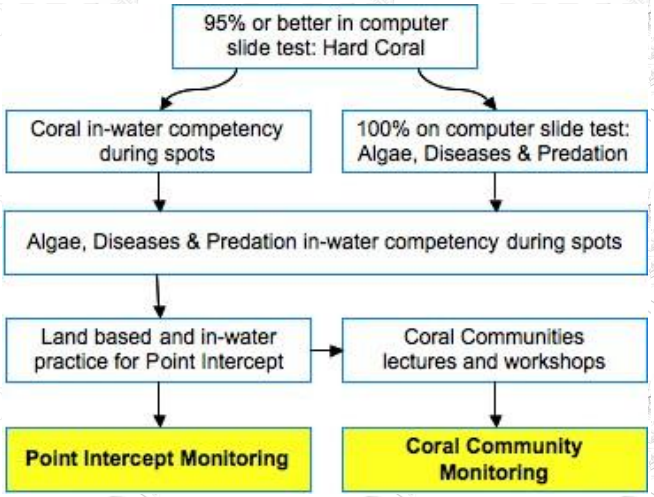
While we require you to receive a mark of 95% or greater on the computer tests, we suggest you attempt the first computer test by the end of day 3. This is meant to assess your progress and help you to focus your studying on possible weaknesses. Thus, there are no real tests, rather assessments. Furthermore, after each spot dive we'll do a post-dive briefing to recap what was seen and how you did, as well as a once-weekly feedback session to go over your dive and science training progress.

The checklists on the following page will give you a general idea of what to expect in regards to the science training and what you need to accomplish before monitoring. A more detailed schedule with timeline will be on base.

Fish Monitoring Checklist



Coral Monitoring Checklist



Species List

By now you've been assigned the responsibility to learn either fish or coral. There are a lot of species to learn but there are some helpful ways to learn and remember them. The GVI Mexico pre-expedition training website was specifically created to prepare you before your arrival. Whether you need to learn fish or coral, you'll find invaluable family and individual species descriptions, photos, and quizzes to test your knowledge. Check it out at: http://www.gvi.co.uk/resources/mexico-training

** Please keep in mind that this website is a work in progress as we continually add new species and/or photos creating the most comprehensive training tool as possible. The photos have been taken by staff and past Expedition Members so the species will appear as you will see them in the water, not as the perfect image found in the Humann books.

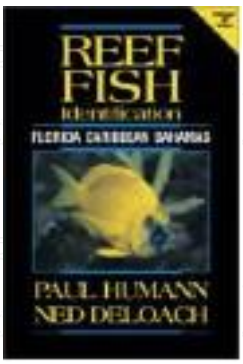
Appendix 1 has the adult and juvenile fish species list fish species list - Yes, there are a lot of fish to learn but that's due to the great biodiversity! You only need to learn the common names and hopefully the additional included information about fish in general will help you get started in recognizing the characteristics that make up the fish families and furthermore, the distinguishing features of individual species, making it easier to learn their names. If you are coming only for 4 weeks you will only have to learn the juvenile fish list. If you are coming for 8 or 12 weeks, then you only need to learn the adult forms (of the species listed below) to start with, and not

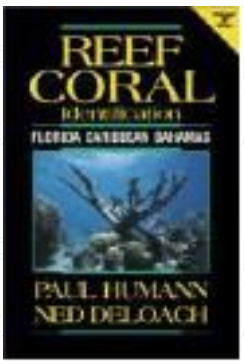
the juveniles (there will be time for them along with some additional adult species once you get to base). To start with, you only need to learn the adult forms (of the species listed below) and not the juveniles (there will be time for them along with some additional adult species once you get to base).

Appendix 2 has the coral species list - There are only 51 species but you need to learn their Latin names. This may seem daunting but don't fret, there are some easy tricks to remember the names of many of them. Included as well is additional general information about corals that should help to get you started recognizing the important and defining characteristics of both coral families and individual species.

So once you've learned your species, the learning doesn't stop there! Depending on whether you are doing fish or coral, you will need to learn a select few juvenile fish species, or some algae and other select invertebrates, as well as some other factors used to assess coral health. Don't worry about this now. What is essential is to prepare yourself with a good solid base, which is learning the coral or adult fish species, and everything else following will fall into place.

Necessary Training Materials





Humann, P. & Deloach, N.Reef Fish Identification
Humann, P. & Deloach, NReef Coral Identification

Also check out the training resources website we have created to help you out: http://www.gvi.co.uk/resources/mexico-training

Flashcards - A great way to study! Make your own or use the ones on base, we have loads!

Check around the web for additional photos to help you see as many versions of the species as possible. The computers on base are chockfull of photos so don't forget to check those out when you arrive.

Ready to Monitor?

There are different methodologies on base that allow us to assess the health of the reef.

One of the methods we use to assess the bleaching in corals is CoralWatch, which main tool is the Coral Health Chart. This was created by a non-profit organization (CoralWatch) built on a research project at the University of Queensland in Brisbane, Australia. The divers use a chart with different samples of colours and brightness that represent the different stages of bleaching or recovery. This methodology is followed worldwide. Check out their website at: www.coralwatch.org

Every time you go on a dive or snorkel you will be looking for mega fauna species, we record all the incidental sightings of sharks, marine mammals, sea turtles, eels, rays, etc. in order to create a database with species that are indicators of the health of the reef and the biodiversity around the area. You will have to learn to estimate sizes and identify the species that are included on the list. Don't worry just yet; you will be given a lecture on how to do this when you get to base.

We are starting an exciting new protocol to map coastal habitats. This new methodology will be implemented to characterize the coastal habitats in the Sian Ka'an Biosphere Reserve. Geo positioned transects from the coastal line to 20m depths are used every 200m. The team of divers have a quadrant that has a camera attached, they move along the transect taking pictures as well as recording the benthic composition. Thi is a very new method and we are still working on perfecting it hence your help will be great to continue improving.

Another method employed for the underwater visual census work are those outlined in the Mesoamerican Barrier Reef System manual (Almada-Villela et al., 2003- can be found on base), but to summarise GVI uses three separate methods for buddy pairs. You still have a ways to go before you're ready to monitor but the following will give you an idea what it's all about.

Buddy method 1 - Surveys of corals, algae and other sessile organisms. At each monitoring station 5 replicate 30m transects lines are deployed randomly within 100m of the GPS point. The transect line is

laid across the reef surface at a constant depth, usually perpendicular to the reef slope.

For each buddy pair that surveys the coral, one diver will measure the percentage cover of sessile organisms and substrate along the 30m transect, recording the nature of the substrate or organism directly below every 25cm point along the transect. This monitoring strategy is classified as Point Intercept (PI).

The second diver of the buddy pair will collect data on the characterisation of the coral under the transect line, classified as Coral Communities (CC). This involves identifying to species level each coral colony larger than 10cm in diameter directly under the transect. Mortality, disease, predation and bleaching are also noted (to be discussed once you get to base).

Buddy method 2 - Belt transect counts for coral reef fish. At each monitoring site 8 replicate 30m transects lines are deployed randomly within 100m of the GPS point. The transect line is laid just above the reef surface in a straight line along the depth contours.

The first diver is responsible for swimming slowly along the transect line identifying, counting and estimating the sizes of target fish species* within a two meter wide belt while the second diver records any Long Spine Sea Urchins and Banded Coral Shrimp found along the transect line. The buddy pair then waits for three minutes at the end of the transect line before proceeding. The second diver swims slowly back along the transect surveying a 1m wide belt and identifying and counting the presence of newly settled juvenile fish of the target species.

*Target fish species are those that were chosen by the creators of the MBRS synoptic monitoring programme because they are the species found to best represent the health of the reef as they represent all levels of the food chain. This is the list of adult fish below that you will need to know before you're ready to monitor. So why learn ALL the fish in the area (don't worry about this now, you will be given the rest of the fish species on base when you're ready)? The Rover monitor (described below) accounts for all species, especially considering that some fish are more shy than others and are unlikely to cross your transect.

Buddy Method 3 - Coral Rover and Fish Rover diver At each monitoring site a third buddy pair monitors in an expanding square formation for 30 minutes within approximately 100m from the GPS point.

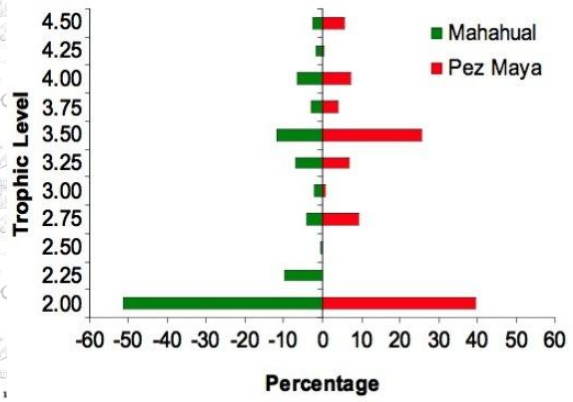
One diver quantifies all adult fish species identified using their training and knowledge of fish behaviour and habits while the other diver conducts a census of all the coral species.

But not all the work is done in the water, we also have weekly beach cleans where we collect the rubbish that washes up on our beach and classify it into different categories depending on their source. A team of volunteers goes out to do the clean and fills in a format that is sent to our partners for analysis.

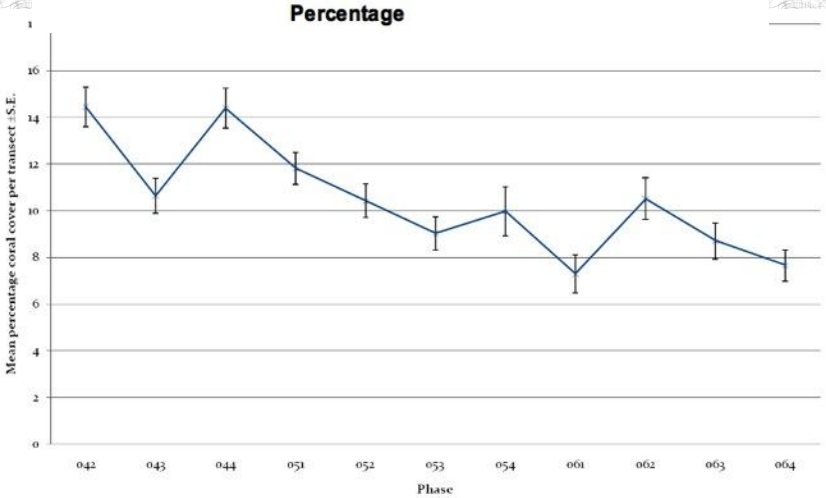
As well, we have daily birding transects where we identify the bird species around the area. A team of 3-4 volunteers goes out with a staff member armed with binoculars and books to identify the species around base.

Data Collection

During your expedition, a staff member will go over data recently collected as the quarterly report is prepared. At the end of your stay, a presentation will be available to review the data you helped to collect and the floor open to analyze the data. The following graphs are just a glimpse at what some of the data has shown us.



By showing the trophic levels from the fish in the adult fish surveys, these can be monitored to see if fishing pressures, etc. are affecting the structure of the community. Below, mean percentage coral cover per transect has greatly declined over the 2.5+ years noted here.



Our Partners

GVI Mexico strives to train expedition members to an exceptionally high standard and together with GVI's partners Amigos de Sian Ka'an (ASK) and Comisión Nacional de Áreas Naturales Protegidas (CONANP), aim to use the data collated to aid decision makers in coastal zone management.

We are doing projects that our local partners would like to do but do not have the manpower, the logistical resources, the finances, or all 3 to undertake. As a monitoring programme the MBRS is a large scale, long term monitoring protocol, requiring all of the above. By training and using volunteers, we greatly help them collect the data they need to promote conservation (creation of reserves, zonation schemes, etc.).

Final Thoughts

We're really looking forward to having you out here. The GVI staff are very passionate about conservation and aiding in the sustainable development and protection of the incredible resource that is soon to be your "backyard." If it wasn't for Expedition Members like you, our local partners' effort to protect the reef wouldn't benefit from the collection of consistent and abundant data so we're already very grateful.

Remember, the more preparation you can do before arriving will get you monitoring faster. Any

additional questions about the science training, please feel free to send us an email and we'll get back to you as quickly as possible. Finally, don't forget to bring an open mind and be ready to work hard but walk away with an incredible set of new skills. See you soon!

Appendix 1 - General Fish Information & Species List

An Introduction to Fish

Fish are the most abundant and conspicuous large organisms that are encountered on a reef. The coral reefs encompassing the MBRS are home to a huge variety of fishes. In addition, there are many pelagic (live in the open sea) species which visit the reefs in search of food, and a number of migratory species which you may also see. As you look over the reef you will notice a huge array of differences in the anatomy, colours and markings, morphologies, habitats, schooling and general behaviour of fish. This document introduces some of the defining factors that have controlled the evolution of fish within these ecosystems and describes their resulting behavioural ecology.

Fish identification quizzes

For those of you who have been allocated fish to study you can start testing yourself on your identification skills using these short quizzes on the following websites. You can either use the fish species list you have been sent or you can download it here. It contains all of the species of fish you need to know in order to take part in the Mesoamerican Barrier Reef survey work in the Caribbean.

- http://www.pbcrrt.org/PBFQ_01.shtml
  23 quizzes, 10 questions in each.
- http://www.fishid.com/cgi-bin/quiz.cgi?action=init
  10 quizzes, 10 questions

Because the above websites are for general public use, there are some species included in these quizzes that are not found in the areas of the reef where you will be surveying. If some of these species appear in the quiz that you don't recognise once you have been through the list a few times and you are fairly confident about your identification skills then don't worry about it – it is a species that you do not have to know. Don't forget to check out the GVI training resources website created specifically for your expedition: http://www.gvi.co.uk/resources/mexico-training

Habitat

One reason for the high diversity of species on the reef is the great range of habitats that exist there. Coral reefs not only include coral but also areas of sand, various caves and crevices, areas of algae and of course deep to shallow reef zonation. Within these habitats, there are differences in conditions which diverse reef fish

require, for example areas of darkness, shelter, limited or enhanced light, food availability and refuge. Due to factors such as predation and unpredictability, populations never become so big that they undergo competitive exclusion due to food, resource and competition limitations.

Adaptations, lifestyles and schooling

Fish families each have their own set of adaptations to suit their lifestyles. This can be seen in their colour, anatomy and general behaviour. Reef-dwellers, for example parrotfish (Scaridae) have powerful jaws, fused teeth or beaks. These are used to scrape algae and polyps from coral and rocks, their bodies have a large mass and swim using their pectoral fins in a rowing motion. Parrotfish are usually seen solitary or in small family groups, they are generally slow, but when disturbed they can dart away from danger, a fast burst over a short distance.

Benthic or bottom dwellers can have a different appearance as well, they use the lack of movement to their advantage. They conceal or camouflage themselves against the substrate and use it to avoid predators or so unsuspecting prey are oblivious to the waiting threat where the fish are ready to ambush. The ability to blend in with the background is called crypsis. Fish do this by several methods, some physically change colour e.g. Peacock Flounder (*Bothus lunatus*), and others allow other organisms to colonize on them e.g. Ocellated

Frogfish (*Antennarius ocellatus*). As these fish do not swim great distances and spend most of their lives stationary, this allows them to have more unusual morphologies, sometimes making them nothing like the common fish shape.

Pelagic fish such as jacks (Carangidae) need a completely new set of adaptations again, they are predators, they need to be swift and streamlined for attacks, and usually they have deeply forked tails which are very strong, enabling them to swim fast. Usually they school, living mainly in the open sea rather than directly on the reef. They come in to search for food of small fish and crustaceans but they can be masters of pandemonium. Packs ranging from 6-20 jacks can be seen terrorizing the reefs. Seconds before the hunters appear, schooling reef fishes tighten ranks and begin to swirl while solitary fish inch toward shelters. At times the jacks make only a few quick

passes, but at other times they come flying in toward the reef, cutting fast and with authority.

Fish that swim in schools can be grouped in two different ways, polarized and non-polarized. Polarized schools have a very defined structure where all the fish point in the same direction and have a clear leader for example *Sphyraena barracuda* (Great Barracuda). Non-polarized schools swim in loose aggregations in all directions, for example *Acanthurus coeruleus* (Blue Tang).

Reef fish do not migrate and many smaller species such as damselfish (Pomacentridae) are territorial. They swim around their territory and compulsively attack everything that comes near their personal pieces of reef, including divers. There is good reason for this aggressive nature: the reef is full of algae-eating parrotfish and surgeonfish (Acanthuridae) that are continuously attacking the damselfishes' well-kept lawns.

Appearance on the reef

Most dives upon the reef are conducted during the day, when the majority of species are visible. At night, however, these diurnal fish seek shelter in the reef and are replaced by a smaller number of nocturnal species which are rarely seen during the day when larger predators come in and attack. Since some diurnal species are ecologically similar to certain nocturnal species, cardinal (Apogonidae), for example, replace damselfish, this is another way of permitting a greater number of species to exist on the reef without competing directly.

Feeding and Defense

Carnivores constitute 50-70% of the reef species. The majority don't hunt for specific food but are more likely to be opportunistic. They feed upon different prey through their life stages, as their changing morphology restricts them from feeding on certain species. However, there are some specialised carnivores just as there are a number of true scavenger fish.

Herbivores and coral grazers make up the next largest group of fishes (about 15% of the species) and the most important of these are the families Scaridae and Acanthuridae. The remainder of fish are

generally classed as omnivores or multivores and include representatives from nearly all families of fishes on the reef (Pomacentridae, Chaetodontidae, Pomicanthidae, Monocanthidae, Ostraciontidae, and Tetradontidae).

A side effect of the feeding of some fish, such as grunts (Haemulidae), is to enhance the nutrition and growth of corals. Schools of certain fish, which rest by day in coral heads, feed at night on seagrass beds and then return and defecate material rich in nitrogen and phosphorus into the coral heads. This results in faster coral growth.

Given that most fish on the reef are unspecialised carnivores, it is easy to understand why most invertebrate organisms are hidden from view. There are however some invertebrates that cannot hide e.g. sea cucumbers and have evolved mechanisms to deter potential predators. The most common deterrent is a toxin or poison. Tropical sea cucumbers produce toxic substances that can kill fish and in addition have viscous, sticky strands (cuvierian organs), which can be extruded to literally tie up any potential predator.

The development of distasteful or toxic substances is not limited to invertebrates. Many reef fish also produce toxic substances. These may take the form of venom associated with various spines or of poisonous material simply extruded onto the body surface (crinotoxin) or the flesh or internal organs may be toxic. Truly venemous fish are rare on reefs and are confined mainly to the stonefish (Synanceiidae) and scorpionfish (Scorpaenidae) but a large number of fish have toxic secretions on their outer surfaces, including the abundant parrotfish, wrasse (Labridae) and surgeonfish. One explanation for the prevalence of these is that they deter predation by abundant carnivores.

Cleaning Symbiosis

Symbiosis refers to a close interrelationship between two species. There are three primary types of symbiosis: mutualism – 2 species forming an alliance for the well-being of both, commensalism – one species benefits while the other is unharmed by the association, and parasitism – one species benefits at the expense of a host species.

Many species, particularly groupers, are plagued by an assortment of external parasites, so small they can hardly be seen. These parasites

are mainly isopods and copepods armed with razor-edged mandibles that burrow into the tissue around the eyes and nostrils, under scales and even invade the tender lining of gills and mouths. To keep their infestations under control, client fishes spend significant amounts of time at sites known as cleaning stations, where they often assume stationary trancelike poses while parasite-eating fishes and shrimps dine on their pests. In the process, the cleaners also remove dead or injured skin and mucous and sometimes even take a bite of healthy tissue. Four primary cleaning organisms occur in the tropical western Atlantic: gobies in the genus Gobiosoma; juvenile Spanish Hogfish, *Bodianus rufus;* initial phase Bluehead Wrasse, *Thalassoma bifasciatum* and Pederson Cleaner Shrimp, *Periclimenes pedersoni*.

A mutualistic relationship exists between the Orangespotted Goby, *Nes Longus*, and a snapping shrimp from genus Alpheus. The nearly blind shrimps excavate burrows in shallow mud or sandy bottoms near mangroves or along the sloping edges of canals. However, whilst above ground they become easy prey for hungry carnivores hunting the sand. Gobies are also prey in the open. They have good eyesight and so can detect predators but need a place to hide. To adapt, the blurry-eyed shrimps and the homeless gobies join forces for their mutual benefit.

Large, segmented isopods from the family Cymothoidae attach to the heads or internal gill structures of several common reef fish species. Cymothoids attach to the skin with seven pairs of hooklike legs and benignly scavenge specks of floating food. Their long-term association with their host cause only minor skin discolouration, scale erosion or, at worst, slight bone deformities.

Reproduction

There are several ways that fish species breed. One is pelagic spawning (broadcast breeding). Usually at sunset, the parental fish release hundred’s of free-floating gametes into the watercolumn, these mix and disperse where they are carried further afield by the ocean’s currents. Usually this happens amongst male and female pairs but it can be seen in larger groups, hence increasing genetic variation. Benthic laying usually happens at sunrise. A lively courtship precedes the female laying her eggs in nests prepared, tended and guarded by the males.

Internal fertilisation or live bearing is less common, for example in

sharks and seahorses, and is rarely seen.

Wrasse, parrotfish and seabass are sequential hermaphrodites i.e. they have the ability to change sex. They do this to maintain the desired sex ration under varying social and environmental conditions. This process is irreversible, nearly all fish which do this will be protogynous hermaphrodites, this is where females change into males when they reach a certain size, age or when social situations, such as the loss of the harem's dominant male. These fish exist in small family groups and have a "supermale," the main reproductive male in the group which is brightly coloured, and with it are smaller duller juvenile male and females. A few species are protandrous hermaphrodites, where males turn into females, for example the Common Snook, *Centropomus undecimalis*. Factors triggering this are unknown.

Conclusion

Fishes are the most abundant and conspicuous large organisms that are encountered on a reef. The variety of fish groups display a huge array of differences in:

- anatomy
- morphologies
- colours
- habitats
- markings
- life behaviour

Through studying these aspects of fish population dynamics, it becomes clear that individual species have developed the anatomy and behaviour best suited to the niche within the ecosystem that they occupy. The anatomy of a particular fish species gives an indication of its behaviour, and similarly, the behaviour of a fish species gives a strong indication of its anatomical features. The physical, biological and chemical factors that have controlled a species' evolution within this ecosystem describe the resulting behavioural ecology and anatomy of that species.

Fish Identification

In order to identify different fish species it is important to understand the colours, markings and anatomical differences that distinguish the fish from similar appearing species. In most cases, these features are readily apparent to divers, but occasionally they are quite subtle.

Fish Anatomy

Fins – Fin rays are joined together by a membrane. They can be: Stiff and spiny or soft and flexible. They vary in size, shape and colour depending on their species and their function.

- Shape and size determines mode of swimming; constantly fast/slow, stop/start or bursts
- Stiffness determines mode of swimming: strong-propulsion (pelagic e.g. jacks); soft-manoeuvrability (swim and feed round coral heads e.g. butterflyfish).

Dorsal – Some species have spiny fin rays towards front. Can be multiple, distinct or set apart. Can appear fused together extending along the dorsal surface.

Tail/Caudal – A major propulsive surface. Varies in size and shape, may be rounded, squared off or flattened. If forked – each part called a lobe can be asymmetric.

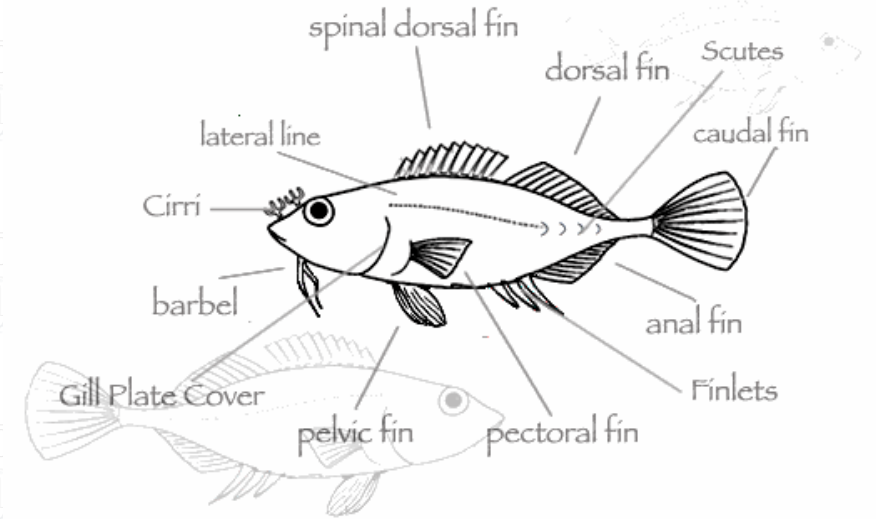
Anal – Begins at anal opening and varies in extent towards caudal fin. Some cases dorsal, caudal and anal fins fuse e.g. eels.

Paired pelvic and pectoral fins - One on either side of fish. Location and size varies with species. Pectorals midway upside of body, major propulsive appendage of most reef fish.

Mouth – Vary in size, shape and orientation. Pointing up or down. The extent in which fish can extend their jaws varies with species.

Forehead – Shape and size varies with species. Cirri – Found on the forehead/nape, a fleshy, branched appendages usually in pairs appears on many bottom dwellers.

Gill



Cover/Operculum – Covers gills breathing apparatus.

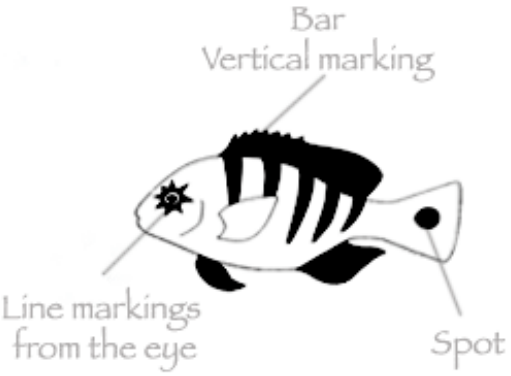
Lateral line – A sensory groove running along lateral surface on either side of body. Can be visually distinctive, often curved as it runs from near pectoral fins to caudal fin.

Caudal Peduncle – Narrow part between body and tail. Dorsal surface known as saddle sometimes has blotch type marking association with it.

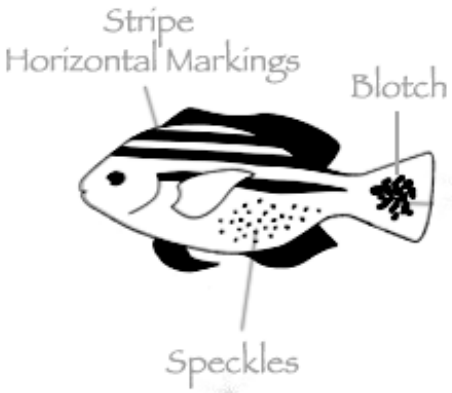
Finlets/scutes – Found towards tail especially in fast swimming pelagic fish. **Finlets** look like small, stiff triangular fins on both dorsal and ventral surface. **Scutes** are large scales or bony plates along the body towards the caudal peduncle. Thought to assist efficiency of swimming in fast, pelagic species.

Markings – Body markings can be visually obvious, highly varied in shape, size, colour, location and a combination of all these factors.

Lines – Vary in numbers and thickness, partial or whole coverage.
Bars – vertical
Stripes – horizontal
Bands – diagonal

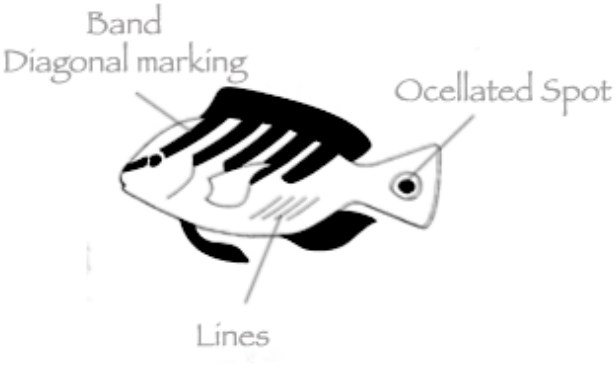


Spots – A well defined circular mark
Ocellated spot – spot surrounded by ring of another colour
Blotch – ill-defined/ irregular mark
Speckless – fine spots



Markings around eye – Can be a specific colour, may radiate outwards in specific pattern, eye can be disguised by a similar coloured line going through it.

Colour – The colours of many species vary considerably from individual to individual. Many fish also have an ability to pale, darken, and change colour. Because of this the colour is rarely used for identification.



The Fish List

- **Family:** *Pomacanthidae*
  Angelfish

  Centropyge argi
  Cherubfish

  Holacanthus ciliaris
  Queen Angelfish

  Holacanthus tricolor
  Rock Beauty

  Pomacanthus paru
  French Angelfish

  Pomacanthus arcuatus
  Grey Angelfish

- **Family:** *Chaetodontidae*
  Butterflyfish

  Chaetodon striatus
  Banded Butterflyfish

  Chaetodon capistratus
  Four Eye Butterflyfish

  Chaetodon ocellatus
  Spotfin Butterflyfish

  Chaetodon sedentarius
  Reef Butterflyfish

  Chaetodon aculeatus
  Longsnout Butterflyfish

- **Family:** *Acanthuridae*
  Surgeonfish

  Acanthurus coeruleus
  Blue Tang

  Acanthurus bahianus
  Ocean surgeonfish

  Acanthurus chirurgus
  Doctor fish

- **Family:** *Sphyraenidae*
  Barracuda

  Sphyraena barracuda
  Great Barracuda

- **Family:** *Haemulidae*
  Grunt

  Haemulon flavolineatum
  French Grunt

  Haemulon striatum
  Striped Grunt

  Haemulon chrysargyreum
  Smallmouth Grunt

  Haemulon sciurus
  Blue Striped Grunt

  Haemulon carbonarium
  Caeser Grunt

  Haemulon aurolineatum
  Tomtate

  Haemulon melanurum
  Cottonwick

  Haemulon macrostomum
  Spanish Grunt

  Haemulon parra
  Sailors Choice

  Haemulon album
  White Margate

  Anisotremus virginicus
  Porkfish

  Anisotremus surinamensis
  Black Margate

- **Family:** *Lutjanidae*
  Snapper

  Lutjanus analis
  Mutton Snapper

  Lutjanus griseus
  Grey Snapper

  Lutjanus cyanopterus
  Cubera Snapper

  Lutjanus jocu
  Dog Snapper

  Lutjanus mahogoni
  Mahogany Snapper

  Lutjanus apodus
  Schoolmaster

  Lutjanus synagris
  Lane snapper

  Ocyurus chrysurus
  Yellowtail snapper

- **Family:** *Pomacentridae*
  Chromis/Damselfish

  Microspathodon chrysurus
  Yellowtailed Damselfish

- **Family:** *Serranidae*
  Grouper/Seabass

  Epinephelus itajara
  Goliath Grouper

  Epinephelus striatus
  Nassau Grouper

  Cephalopholis cruentatus
  Graysby

  Epinephelus adscensionis
  Rock Hind

  Cephalopholis fulvus
  Coney

  Epinephelus guttatus
  Red Hind

  Mycteroperca venenosa
  Yellowfin Grouper

  Mycteroperca bonaci
  Black Grouper

  Mycteroperca tigris
  Tiger Grouper

  Mycteroperca interstitialis
  Yellowmouth Grouper

- **Family:** *Scaridae*
  Parrotfish

  Scarus coeruleus
  Blue Parrotfish

  Scarus coelestinus
  Midnight Parrotfish

  Scarus guacamaia
  Rainbow Parrotfish

  Scarus vetula
  Queen Parrotfish

Scarus taeniopterus
Princess Parrotfish

Scarus inserti
Striped Parrotfish

Sparisoma aurofrenatum
Redband Parrotfish

Sparisoma chrysopterum
Redtail Parrotfish

Sparisoma rubripinne
Yellowtail Parrotfish

Sparisoma atomarium
Greenblotch Parrotfish

Sparisoma radians
Buchtooth Parrotfish

Sparisoma viride
Stoplight Parrotfish

- **Family:** *Labridae*
  Hogfish, Razorfish/ Wrasse

  Lachnolaimus maximus
  Hogfish

  Bodianus rufus
  Spanish Hogfish

- **Family: Triggerfish and Filefish Balistidae**

  Balistes vetula
  Queen Triggerfish

  Balistes capriscus
  Gray Triggerfish

  Melichtys niger
  Black Durgon

- **Family:** *Monacanthidae*
  Filefishes

  Aluterus scriptus
  Scrawled Filefish

  Cantherhines pullus
  Orangespotted Filefish

  Cantherhines macrocerus
  Whitespotted Filefish

- **Family:** *Carangidae*
  Jacks

  Caranx ruber
  Bar Jack

Family: Acanthuridae
Surgeonfish

Family: Chaetodontidae
Butterflyfish

Family: Grammatidae

Family: Labridae

Bodianus rufus
Spanish hogfish

Halichoeres bivittatus
Slipperydick

Family: Pomacentridae

Chromis cyanea
Blue chromis

Stegastes adustus
Dusky damselfish

Family: Scaridae

Scarus iserti
Striped parrotfish

Scarus taeniopterus

Acanthurus coeruleus
Blue tang

Chaetodon capistratus
Four eye butterflyfish

Gramma loreto

Halichoeres garnoti
Yellowhead wrasse

Halichoeres maculipinna
Clown wrase

Thalassoma bifasciatum

Stegastes diencaeus
Longfin damselfish

Stegastes leucostictus
Beaugregory

Stegastes partitus
Princess parrotfish

Sparisoma atomarium
Greenblotch parrotfish

Sparisoma aurofrenatum

Acanthurus bahianus
Ocean surgeonfish

Chaetodon striatus
Banded butterflyfish

Fairy basslet

Bluehead wrasse

Halichoeres pictus
Rainbow wrasse

Bicolour damselfish

Stegastes planifrons
Threespot damselfish

Stegastes variabilis
Cocoa damselfish

Redband parrotfish

Sparisoma viride
Stoplight parrotfish

Appendix 2 - General Coral Information and Species List

An Introduction to Coral

Within the corals present on a reef, scientists have grouped them into two main groups: hard corals and soft corals. The hard corals are mostly reef building corals, which make up the main structure of the reef. The overall groups consists of 2 Classes, Hydrozoa and Anthozoa. Within Anthozoa, there are two subclasses containing hard corals, Subclass Hexacorallia and Subclass Ceriantipatharia, Order Antipatharia. The following describes the main characteristics of these groups for identification purposes.

Useful websites

http://coralpedia.bio.warwick.ac.uk: This is a link to Warwick University's new coral archive (Caribbean only). For a free interactive CD, please contact the university directly.

http://www.gvi.co.uk/resources/mexico-training :Don't forget to check out the GVI online training website created specifically for your expedition.

Hydrozoa (Hydrocorals)

Hydrocorals are calcified hydroid colonies; the most recognized family is the Milliporidae.

Millepora alcicornis – This species forms a multiple branch structure where the branches appear cylindrical and usually expand in a single plane. They can encrust over other species such as gorgonians and take on their shape. They are commonly found in most marine environments from shallow to deep water but are less common in shallow surge zones.

Millepora complanata – This species forms upright blades or plates that extend from an encrusting base and contribute more to the reef than *Millepora alcicornis*. The outer edges of the blades are uneven and appear to have separated wide branches. They are a mustard colour with a white edge. From afar the coral appears smooth, similar to the stony corals but at close range it appears fuzzy. This is the colony's tiny, hair-like polyps which extend through thousands of pinhole-sized pores. They are distinctive in having 2 kinds of polyps those used for feeding (gastrozooids) and those, which have a sensory or defensive (dactylozooids) function.

They have powerful batteries of stinging cells (nematocysts) on the tentacles of the tiny polyps, which they use to paralyse and immobilize their prey. If a diver brushes against them with bare skin it can cause an itching irritation, which can be soothed using vinegar, this immobilizes unspent nematocysts. The feeding polyps appear stout and are encircled by 5-9 sensory/stinging polyps.

Anthozoa – Subclass: Hexacorallia

In the subclass hexacorallia there are 6 orders: anemones, zoanthids, corallimorphs, tube- dwelling anemones, black corals and stony corals (scleractinia).

Hexacorallian – These corals have smooth tentacles in multiples of 6; their polyps are generally smooth and tubular. They are commonly called stony or hard corals and are the basic building blocks, which make up the reef (corallum). This subclass secretes calcium carbonate; forming calyx cups (corallites) within which the soft delicate polyps live protected. Generally corallites are constructed in a circular pattern; occasionally they are uneven, oval, and Y-shaped or join to form elongated valleys and ridges. These corallites join together to make larger colonies which vary in size depending on the species and can grow into fantastic table corals. The corallites are associated with each other through thin connective tissue where the outer surface is alive. The corals increase in size by asexual budding where successive generations overgrow one another. Around the top surface of the coral polyp are vertical infolds where calcium carbonate is deposited which forms thin upright, radiating plates or ridges called septa. The number and structure of these septa can be used for identification purposes. The polyps of these corals are usually retracted during the day and are released during the night where they filter feed for plankton, and give a difference in appearance. The central axis of a corallite is called the columella below the polyp mouth. The hexacorals feed predominantly through the symbiosis with microscopic single celled algae called zooxanthellae. Zooxanthellae play a vital role in the polyps' ability to produce calcium carbonate. When water temperatures rise outside the normal boundaries or in other times of stress, for example hurricanes, these algae are expelled from the coral. The pigmentation of the coral is supplied by the algae and thus the corals lose their

colours, leaving them a white appearance. Without the zooxanthellae, growth is severely restricted.

As they are an algae, zooxanthellae need to be in a well-lit location to function properly, and this is one of the main reasons why corals compete for space on the shallow reef. Corals fight for space in a number of ways, and some are more aggressive than others. They may simply overgrow or shade each other, but they also use chemical warfare. Some develop special "sweeper" tentacles that have an extra long reach and are usually employed at night. Others have internal threads (mesenteric filaments), which are extruded and actually digest neighbouring coral tissue. The result of all this is a whitish, dead band that separates adjacent coral colonies.

The corals, which contribute large amounts of calcium carbonate to the reef, are called hermatypic (reef-building corals). These live within a narrow temperature range (70-85°F, 21-29 °C), although more resilient species can live between 61-97°F (16-36°C). Ahermatypic corals are usually small, occasionally solitary and without substantial skeletons. They do not have zooxanthellae, so in this case their own pigments become prominent.

Anthozoa – Subclass: Ceriantipatharia – Order: Antipatharia

Antipatharians – These black corals are thought to be deep dwellers, but some species can be found in a safe scuba diving depth. These corals secrete a hard black protein that becomes extremely hard during a tanning process. The material is laid down in concentric layers forming branched or wire-like structures creating the overall skeleton. If the skeleton were to be cut in half it would look like the growth rings of a tree. Some species have tiny branchlets called pinnules. Black corals do not have corallites, so the polyps live on the surface of the skeleton sometimes wider spaced, so can be distinguished easier where as other species may have branches tightly packed giving a bushy tangled barbed wire appearance. Each polyp has 6 small non-retractable tentacles, but can expand and contract a little. Black corals are often used by jewellers and sold as a semi precious material; this has lead to overharvesting leading some species to be threatened. There were once great forests of black coral in Grand Cayman and Cozumel, but it would now take over 100

years to re-establish themselves should harvesting cease.

The Coral List (Phylum: Cnidaria)

- **Class: Hydrozoa (Hydrocorals)**
- **Family: Milliporidae (pg 17)**

  Millepora alcicornis
  Millepora complanata
- **Famiy:Stylasteridae (pg 21)**

  Stylaster roseus
- **Class: Anthozoa**
  Subclass: Hexacorallia
  Order: Scleractinia
  Suborder: Astrocoeniina
- **Family: Acroporidae (pg 91)**

  Acropora cervicornis
  Acropora palmata
  Acropora prolifera
- **Family – Pocilloporidae (pg 103)**

  Madracis mirabilis

  Madracis spp.
- **Family – Astrocoeniinae (pg 111)**

  Stephanocoenia intersepts
- **Suborder: Fungiida**
- **Family: Poritidae (pg 95)**

  Porites porites
  Porites furcata
  Porites divaricata
  Porites astreoides
- **Family: Agariciidae (pg 135)**

  Helioceris cucullata
  Agaricia fragilis
  Agaricia lamarcki
  Agaricia undata
  Agaricia agaricites
  Agaricia tenuifolia
  Agaricia grahamae
- **Family:Siderastreidae (pg123)**

  Siderastrea siderea
  Siderastrea radians

- **Suborder: Faviina**
- **Family: Meandrinidae**

Dendrogyra cylindrus (pg 97)
Dichocoenia stokesii (pg 119)
Meandrina meandrites (pg129)

- **Family: Oculinidae (pg 103)**

Oculina varicosa

- **Family: Faviidae (pg 113+)**

Montastrea annularis
Montastrea faveolata
Montastrea franksi
Montastrea cavernosa
Solenastrea bournoni
Solenastrea hyades
Favia fragum
Diploria strigosa
Diploria clivosa
Diploria labyrinthiformis
Manicina areolata
Colpophyllia natans

- **Suborder: Caryophylliida**
- **Family – Caryophylliidae (pg 163)**

Eusmilia fastigiana

- **Family: Mussidae (p P148+)**

Mycetophyllia lamarckiana
Mycetophyllia aliciae
Mycetophyllia ferox
Mycetophyllia reesi
Isophyllia sinuosa
Isophyllastrea rigida
Scolymia sp.
Mussa angulosa

- **Class: Anthozoa**
- **Subclass: Ceriantipatharia**
- **Order: Antipatharia**

Antipathes n. sp. (pg 179)
Cirrhipathes (Stichopathes) leutkeni (pg 187)

Appendix 3 – Introduction to Marine Plants and Algae

There is a huge diversity of plants on the reef; there are two main groups, which are the Marine Flowering Plants and Algae. Marine plants and algae (primarily phytoplankton) are essential components of the marine ecosystem and can often be overlooked. Nearly all of them live in the sea, and they are depended on by many species as the primary producers as the base of the food chain. The following information is only a brief summary since you will be learning about the algae more in-depth when you arrive to base.

These plants take energy from sunlight and nutrients from the water or substrate producing food and oxygen via photosynthesis that is used either directly or indirectly by other organisms to sustain life. Herbivores feed on the plants and algae directly and then indirectly up the food chain by subsequent predators. This process also oxygenates the water. Marine plants and algae are dependent on light availability so are limited to intertidal areas and depths; just over 100ft (30m). A few species grow deeper, and in the extremely clear water of the Caribbean some species can be found at surprising depths. There are over 600 species reported in the western tropical Atlantic.

Occasionally calcareous algae rather than corals form the main bulk of shallow reefs, occurring as pinkish-coloured nodules or sheets, which build up in solid layers. Algal reefs flourish, especially in very wave-swept areas where corals have difficulty in surviving for example in Bermuda. On deep reefs, where coral growth tails off, calcareous algae are responsible for most of the reef building. These are very obvious on many of the drop-offs in the Caribbean.

Distribution

Seagrasses grow in protected areas of lagoon consisting of sandy, silty or rubble substratum. It accounts for a large proportion of primary productivity of waters. Green algae comprise an important component of the tropical seagrass ecosystem especially algae such as: Caulerpa, Udotea, Codium, Acetabularia, Avrainvillea, and

Halimeda. They can grow as epiphytes. Brown algae are equally important especially Padina and Sargassum.

Red algae become increasingly more abundant on back reefs and then onwards down the zonation having their own preferred locations depending on the condition.

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