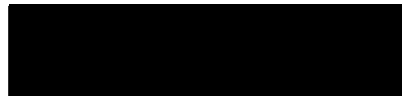


**Learning About Coral Reefs of Hawai`i
Through Educational Brochures**

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ABSTRACT:

Coral Reefs are one of the most beautiful, diverse, and intricate ecosystems on the Earth. Despite their aesthetic beauty, biological diversity, and ecological intricacy, coral reefs are highly vulnerable to human disturbance and destruction. Many people do not realize that there are many living organisms in and on the reef that can easily be harmed. In order to help educate people, especially tourists, about the uniqueness of the coral reef ecosystem in Hawai`i, I have developed three brochures. These brochures on corals, invertebrates, and fish are designed to be learning tools. The brochures not only teach what organisms look like, but also how the animals can be protected. The actual criteria of the brochures, their use, and their benefits will be discussed.

INTRODUCTION:

Coral reefs are known as one of the world's most diverse and unique ecosystems on the Earth (Holliday, 1989). They are also said to be one of the most endangered ecosystems on the Earth (Weber, 1993). Coral reefs are subject to a great deal of stresses, both natural and anthropogenic.

Over a period of time reefs are able to structurally rebuild and restore themselves after natural occurrences, such as hurricanes and tropical storms (Wilkinson, 1993). But, when anthropogenic influences reach the reef, the organisms are not able to recover as easily. Reefs need a specific environment to thrive. Some of these factors include temperature, sun-light, salinity, and water circulation (Wallace, 1995). Each of these factors can be altered anthropogenically. Global warming is one current environmental issue which affects the temperature of the ocean. This of course is related to anthropogenic stress. It is suggested that increase in climate changes combined with other anthropogenic stresses will increase the rate of reef decline (Wilkinson, 1993). Other human factors which affect the coral reef environment are fishing and over-exploitation which have a tendency to shift the natural food web, thus causing shifts in the ecology of the reef (Butler et al., 1993). Other important factors include pollution and tourism (Weber, 1993).

The Hawaiian Islands host about 50,000-70,000 divers a year, and are in the top five most desirable diving destinations for

tourists (Holliday, 1989). Clumsy diving and snorkeling can cause damage to the reef by bumping or stepping on coral (Richardson, 1994).

The following work is based on a years worth of preparation and research to help educate tourists on the coral reef ecosystem.

METHODS:

The purpose of this research was to develop educational brochures about coral reef ecosystems in Hawai`i.

In order to develop the brochures an extensive amount of research was conducted by reading journals, articles, and books that deal with the coral reef ecosystem and all the organisms that inhabit it.

I also gathered existing brochures from various hotels and organizations around the islands of Hawai`i. This gave me ideas for the type of material that should be placed in the brochure, as well as, ideas for format and illustrations. Some of these brochures included, Hawaiian Sea Turtles, Manele Bay Tide Pool Guide, Marine Life Conservation Districts in Hawai`i, and Corals: Law's of Hawai`i.

The brochures were able to be printed up with the help of the University of Hawai`i at Hilo Graphic Arts Department.

RESULTS:

The information collected was divided into three separate brochures, 1) Corals of Hawai`i, 2) Invertebrates of Hawai`i and, 3) Hawaiian Reef Fish.

The first brochure that was developed was the Corals of Hawai`i. The inside cover of the brochure demonstrates that corals are made up of many tiny organisms known as polyps, and each polyp consist of tentacles, mouth, gut, and skeleton, as shown in Figure 1. The inside cover also explains that there are two types of corals known as hard and soft.

On the inside of the brochure, six common hard corals of Hawai`i were chosen to be identified (Table 1). For each of the species, an illustration was created and also a short descriptive paragraph was written, including the use of both scientific and common names (Figure 2).

Also on the inside, one species of soft coral was identified, *Tubastraea coccinea*. This species also has an illustration and description (Figure 2).

The first leaf on the back of the brochure is devoted to the requirements for coral growth (Figure 3). These include sunlight, wave energy, temperature, and salinity. Also, symbiotic zooxanthellae are discussed because they are an integral part of hard coral health, as discussed in depth by Bequette, 1994.

The last leaf on the coral brochure mentions safety tips for snorkelers or divers, such as not bumping into coral or breaking it. Lastly, some of the Hawai`i State Laws on coral are

mentioned, such as it is illegal to break or damage coral intentionally, or take it from the water (Figure 4).

The second brochure developed was on invertebrate organisms on the reef. These organisms were divided into three sections according to phyla 1) Mollusca. 2) Echinodermata and, 3) Annelida.

The mollusk section has five Hawaiian species named and described (Table 2). There is an introduction talking in general about mollusks, emphasizing their many shapes, sizes, and color. It also mentions that mollusks are the largest group of invertebrates in Hawai'i, in terms of number of species (Figure 5).

Secondly, the echinoderm section has nine described species (Table 3). The first part refers to sea urchins and explains that they are the most commonly seen organisms on Hawaiian reefs, and that urchins are easily recognized by their spines. The second part refers to the sea cucumbers and their many colors and patterns. Also, each section has illustrations and descriptions (Figure 6).

Lastly, one species of annelid was described and illustrated, *Spirobranchus giganteus* or the christmas tree worm (Figure 6).

Also on the invertebrates brochure, as in the coral, safety tips are written so to prevent injury to the person, as well as, the organism.

The last of the brochures is on Hawaiian Reef Fish. Twenty different species of fish were chosen (Table 4). Each species of fish has an illustration, however, the descriptions were deleted. Descriptions were deleted to prevent clutter. Also, there are many good books already available, which describe the many species of reef fish. Some of these include, Underwater Guide to Hawaiian Reef Fishes, by John Randall, Coral Reefs in the South Pacific, by Michael King, and A Guide to Hawaiian Marine Life, by Marjori Awai et al. As in the other two brochures safety tips are included in this brochure as well.

DISCUSSION:

These brochures were developed to help educate tourists about the delicate state of the coral reef ecosystem. The reef is aesthetically beautiful, as well as, very diverse and complex. This needs to be understood in order to be preserved.

I believe educational brochures are the most effective way to educate people about the coral reef ecosystem. Many people do not realize that coral is very fragile, and its branchlets can be easily broken off, which can cause damage to the swimmer and to the coral. The coral brochure will make tourists aware of this.

Also, people do now know that urchin spines can break and become lodged in the skin. The invertebrate brochure will teach them how to treat this. They will also become aware of which species of sea urchins are venomous. Lastly, they will learn which species of fish are dangerous from the fish brochure.

Other educational materials need to be developed to keep this awareness going on. The more tourists know, and are able to understand, the more they will respect the coral reef environment and help to preserve it.

Table 1
Common Corals of Hawai'i

Scientific Name	Common Name
<i>Porites lobata</i>	lobe coral
<i>Porites compressa</i>	finger coral
<i>Pocillopora meandrina</i>	cauliflower coral
<i>Pocillopora damicornis</i>	lace coral
<i>Pavona varians</i>	brain coral
<i>Montipora verrucosa</i>	rice coral

Table 2
Mollusks Identified

Scientific Name	Common Name
<i>Cellana sandwicensis</i>	limpet
<i>Nerita picea</i>	pipipi
<i>Littorina pintado</i>	periwinkle
<i>Isognomon californicum</i>	oyster
<i>Acanthochiton viridis</i>	chiton

Table 3
Echinoderms Identified

Scientific Name	Common Name
<i>Echinometra mathaei</i>	rock boring urchin
<i>Echinometra oblonga</i>	black rock boring urchin
<i>Hetrocentrotus mammillatus</i>	slate pencil urchin
<i>Colobocentrotus atratus</i>	shingle urchin
<i>Echinothrix calamaris</i>	banded urchin
<i>Tripneustes gratilla</i>	collector urchin
<i>Holothuria atra</i>	black sea cucumber
<i>Actinopyga mauritiana</i>	speckled sea cucumber
<i>Ophiocoma pica</i>	brittle star

Table 4
Hawaiian Reef Fish

Threadfin Butterflyfish	Hawaiian Dascyllus
Longnose Butterflyfish	Saddle Wrasse
Fourspot Butterflyfish	Yellowstripe Goatfish
Ornate Butterflyfish	Hawaiian Sergeant
Raccoon Butterflyfish	Spotted Trunkfish
Multiband Butterflyfish	Reef Triggerfish
Lined Butterflyfish	Lagoon Triggerfish
Moorish Idol	Convict Tang
Bullethead Parrotfish	Yellow Tang
Spectacled Parrotfish	Trumpetfish

What is a Coral?

Corals are unique organisms which are made up of colonies of little animals known as polyps. These organisms belong to a much larger group known as Coelenterates.

A single coral can have hundreds of these tiny polyps, each consisting of a tentacle, mouth, gut, and skeleton.



There are two main types of coral, known as hard and soft coral. Hard corals secrete a limestone or chalk, which in turn hardens around the polyp, thus giving it its hard texture. These hard corals are the main building blocks of the reef.

The soft corals also have polyps which form colonies, but, unlike hard corals, they do not secrete limestone, and they tend to have a feathery appearance.

Figure 1

Common Hard Corals of Hawai'i



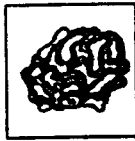
Porites lobata - lobe coral

This is a massive form which has a yellow-green tint or sometimes brown coloring. It tends to be more rounded in shape.



Porites compressa - finger coral

The easy to spot finger like branches makes this coral a unique attraction to the reef. It has a light gray coloration.



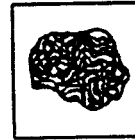
Pocillopora meandrina - cauliflower coral

As the name suggests, this coral looks like a head of cauliflower and is off-white in appearance.



Pocillopora damicornis - lace coral

This coral is easy to spot because of its delicate lace-like features, which are actually tiny little branches. However, don't let the beauty of it fool you, this coral can be very abrasive and sharp, so try not to rub against it.



Pisona varians - false brain coral

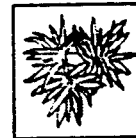
A common encrusting coral, this species tends to form plates with a tannish appearance.



Montipora verrucosa - rice coral

Rice coral is very distinguishable from other corals. The name may be misleading, it does not look like rice at all. This coral is stacked on top of each other and has a dark brownish color with the tip fringed in white.

Common Non-Reef Building Coral



Tubastraea coccinea - tube coral

This coral is found in shallower water, commonly in tide pools. The living tissue is a brilliant orange, which makes it very easy to spot.

Figure 2

More about Corals...

Corals are delicate animals which require a specific environment in order to grow. First of all, corals need a certain temperature to thrive, this is around 70° F.

Corals also need a great amount of sunlight. Living inside hard corals are little plant like animals known as zooxanthellae. These organisms supply nutrients to the corals, mainly carbohydrates, to help them grow. They also give coral their fabulous coloring. Since zooxanthellae are photosynthetic organisms they require sunlight to sustain life.

In relation to the need of sunlight, corals need clear waters to thrive. If too much sediment or pollution enters the reef it can smother the corals and block out sunlight and clog the polyps.

Corals also need salt levels (salinity) that are similar to that of the open ocean. If too much or too little salt enters the reef, the coral will die.

One last environmental condition that corals need is high wave energy or currents. This helps to keep the reef clear of sediment, helps to regulate salinity, and helps to bring food to the coral polyps.

Figure 3

There are a few safety tips and general guidelines that should be followed when you are observing the reefs:

1. Corals may look harmless, however, they are very abrasive, so it is possible that contact with coral may cause cuts and scrapes. Coral will not grow inside your cut, but bacteria will, so clean cuts and scrapes properly so infection does not occur.
2. Corals are also very fragile organisms which can break off easily, this results in killing the animal. So please be careful when swimming or diving. Stepping on, kicking, or bumping into coral will damage it, so do not be a clumsy observer, watch where you are going and respect the coral and its environment.
3. Also as stated before, pollution can cause damage to the reef. Please do not litter and pick up all trash before you leave.
4. One final reminder, it is against the law in the state of Hawai'i to break off coral, or to take it from the water, so please leave the coral to its natural habitat.

HAVE FUN AND BE RESPONSIBLE !



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HILO

This brochure authored and researched by
Amy L. Baynes University of Hawaii at Hilo as
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Figure 4

Common Mollusks of Hawai'i

The phylum Mollusca are a group of organisms that are very diverse. In Hawai'i, mollusks are one of the largest groups of organisms. They have very different shapes, sizes, and colors.

A common term in Hawaiian used to refer to mollusks is pupu.



Cellana sandwicensis
- limpet

These organisms are most easily found in intertidal zones clinging to lava rocks.

Nerita picea
-pipipi



These are rather small organisms which are also found on lava rocks. They are very deep black in color, and very abundant.

Littorina pinctada
-periwinkle



These tiny little organisms, which resemble tiny turbans, live in the splash zone on rocks.



Isognomon californicum
-oyster

The common oyster consists of two shells, and has a light yellow or beige tint. These are found in shallow water, usually beneath stones.

Acanthochiton viridis
-chiton



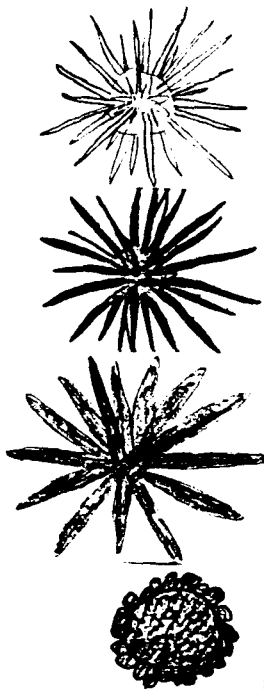
A chiton is a unique organism that consists of eight plates, with a light gray color. They are shy organisms, so look under rocks for them.

Figure 5

Common Echinoderms of Hawai'i

class Echinoidea

Commonly known as the sea urchins, echinoidea are the most common marine organism in Hawai'i. They are all recognizable by having spines on their surface.



Echinometra mathaei
-rock boring urchin

Very common in Hawai'i waters. It has a light tone, and as the name implies they can be found between rocks and crevices.

Echinometra oblonga
-black rock boring

Similar to the urchin above, this one can also be found between rocks, but has a black coloration.

Hetrocentrotus mammillatus
-slate pencil urchin

This urchin is very easy to recognize. It is characterized by its long, thick, red spines.

Colobocentrotus atratus
-shingle urchin

This urchin is named for its shingle like appearance. These tiny plates act as protection. They also have very short, blunt spines.



Echinothrix calamaris
-banded urchin

This urchin is green in color with white bands on its long, thin spines.



Tripneustes gratilla
-collector urchin

Very bulbous in shape. Its spines are very tiny and short, giving it an almost fur like appearance.

class Holothuroidea

Known as sea cucumbers many species live in Hawai'i. They may have many colors or patterns.

Holothuria atra
-black sea cucumber



Found laying on the bottom, usually in sand, they can blend in so it makes them hard to see.

Actinopyga mauritiana
-speckled sea cucumber



This cucumber is tannish in color, and usually has spots covering its surface.

class Ophuroidea

Ophiocoma pica
-brittle star



Can be found hiding under rocks. It has a very fuzzy appearance.

Common Annelid

Spirobranchus giganteus
-christmas tree worm



Usually live on coral. They may have a range of colors, and their shape resembles a Christmas tree.

Figure 6

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