

THE FORMATION AND TYPES OF CORAL REEFS IN INSULAR SOUTHEAST ASIA AND THEIR INHABITANTS

by

Todd M. Neville

April 30, 1999

The teaching module enclosed is designed for a junior-high level general science course. The following pages of this teaching module contain information on the marine biodiversity of Southeast Asia, mainly concentrating on Indonesia and the Philippines.

The module has been designed with the 12-14 year old in mind. This module has been designed from the perspective of introducing students to the following concepts:

- basic geological formation of the coral reefs in Southeast Asia;
- basic concepts about the Southeast Asian monsoon and currents within the western Pacific which cause warmer waters in the region; brief introduction to the biological diversity of these particular reefs;
- the ways human activity has affected these areas and biological conservation. Photos of various reefs are in the book cited at the end of this module by Carnon and Arneson, and the teacher can make slides or pass pictures around to illustrate this module. This module is organized on a step-by-step basis for easy understanding and delivery.

I. Step I: Brief introduction to the Geography Using a World Map

The emphasis should be on where Southeast Asia is in relation to Hawaii and the United States.

II. Step II: Brief Introduction to the Topics to be Discussed in Further detail

Insular Southeast Asia (S.E.A.) is a group of islands located in the Western Pacific. This area is known for having some of the warmest waters on the planet. Insular S.E.A. is geologically active; it is still being formed by a number of volcanoes located in the region. The warm, shallow waters of S.E.A. reefs are home to the highest marine biodiversity in the world. This is an area where scientists are 'discovering' new species daily. Undescribed species may be seen by snorkelers just off the beach. The ocean environment of S.E.A. contains coral reefs, seagrass beds, algal flats, and mangrove forests. These areas contain a diversity of life only rivaled by the tropical forests of this part of the world.

III. Step III: Brief introduction to the Geological Formation of S.E.A.

The marine life which exists in the present day shallow waters of S.E.A. mostly evolved from the fauna

in the Philippines and Indonesian that survived the conditions of the last glacial period, 17,000 years ago. There were two significant changes in the marine tropics of S.E.A. First, sea surface temperatures decreased. Secondly, and most importantly, was the decrease in the sea level of S.E.A. by 300 – 400 feet. The lowering of sea level changed the nature of seawaters throughout the region. In current times, the main diversity in S.E.A. lies in the Indonesian-southern Philippines region. This area is one of the most unique in the Pacific Ocean.

IV. Step IV: Explanations of the Currents of the Western Pacific that Affect S.E.A. and the Winds that Control Them

The seasonal monsoons drive the currents of the region and, along with equatorial sunlight, maintain the warm water temperatures in the region.

The monsoons in S.E.A. last for half the year on the western side of the mountain ranges and half the year on the east. A monsoon is a windstorm that brings with it heavy rains to S.E.A. The southeast tradewinds of the Southern Hemisphere combine with the northeast tradewinds of the Northern Hemisphere to blow surface waters towards the equator, across the seas that circle S.E.A. Water moves east through the Straits of Malacca, between the Malay Peninsula and Western Indonesia, turning north between Kalimantan and Sulawesi. The currents on the north islands of S.E.A., in contrast, are complicated and poorly understood.

V. Step V: Explanations of the Types of S.E.A. Reefs and Basic Formation of those Types

Some examples of S.E.A. reefs are patch reefs, fringing reefs, barrier reefs, and atoll reefs. Patch reefs exist in shallow waters of S.E.A. on continental shelves. Fringing reefs hug the coastline of Insular S.E.A. Barrier reefs exist at the offshore continental margins. Atoll reefs vary in type and size. True atoll reefs rise out of the deep water and are made up of a ring of reef and low islands. Sometimes patch reefs exist with atoll reefs as secondary reefs. Atoll reefs range in size from as much as 500 sq. miles to less than a mile. The theory on coral atoll formation was first described by Charles Darwin and is still widely accepted today. Coral atolls, according to Darwin, are built upon the remnants of a subsiding volcano and coral growth has kept pace with this subsidence over millions of years to produce the structure which we see today. An atoll reef goes through stages of fringing reef, barrier reef, and finally, a truly atoll reef as the volcano submerges.

VI. Step VI: Explanation of Seagrass Beds and Mangrove Forests Existing in Indonesia and the Philippines

Seagrass beds provide a habitat ideal for many invertebrates of S.E.A. There is shelter and cover provided by dense blades of plants. Seagrass beds provide a food source for many marine animals in the region. The mangrove forest is another ecosystem that exists in the marine areas of S.E.A. Mangroves are an intermediate area between land and sea. Mangroves are tropical forests that occur within tidal zones along coastlines and river deltas. They predominate during times of high tide and are home to many varieties of plants and animals.

VII. Step VII: Different Invertebrate Species that Makes up the Coral Reefs in Indonesia and the Philippines

A. Sponges

Sponges are the oldest group of multicellular organisms, first appearing 500 million years ago. Many varieties can be found throughout the Philippines and Indonesia. In Indonesia, the number of different species is over 1,000. They are very interesting and colorful creatures. Sponges have no muscles or nerves; therefore, these animals do not move around – they are *sedentary*. If touched by humans, sponges have been known to cause skin irritations.

B. Marine Worms

Flatworms are one of the littlest known inhabitants of tropical marine S.E.A. reefs. They come in many exotic colors and forms. They are beautiful as they ‘glide’ through the warm waters of S.E.A.

C. Mollusks

Students who have collected shells will be familiar with mollusks: they make those shells. Not all mollusks have shells; some have lost them, such as the octopus. Mollusks are a soft mass of tissue with a muscular *foot* – used for locomotion. Octopods and squid move by jet propulsion. This group contains about 35,000 species, many of which are fished for commercially. Oysters are mollusks that produce pearls, which are, of course, very valuable. Many use *crypsis* – coloration that allows an animal to blend into its environment.

Step VIII: Brief Discussion of the ‘State’ of the S.E.A. Reefs and Conservation

Intense logging has caused silt to accumulate in the shoreline reefs of S.E.A. This silt ‘chokes’ the reefs and eventually kills them. The reefs of S.E.A. are some of the largest reefs in the world and special attention must be taken to preserve these ecosystems. Many fishermen use dynamite and cyanide, the latter being a very toxic poison to collect fish for aquariums.

These fish are quite beautiful; but in collecting them, fishermen damage reefs to the point where they cannot recover. When they inject cyanide into the reef, it anesthetizes and puts the fish to sleep for easy collection. A fisherman will then break apart the reef to get at creatures that hide in the crevices of the reef. Dynamite fishing simply stuns the fish for easy collection. Most of these fish never see the aquariums that wish to purchase them because they have been so badly handled during collection. This low rate of survival causes the Southeast Asian fisherman to have to collect an increased number of fish to make up for the ones that die. Simply using nets would curb this low survival rate but takes the fisherman much more time, so they normally do not choose to collect this way.

The governments of S.E.A., especially the Philippines, have realized that the reefs of the area can be a renewable resource for a long time if used in different ways. The advent of SCUBA (self-contained underwater breathing apparatus) diving has

made these once inaccessible areas a hot commodity for Philippine business because of an increase in tourism. More money can be made for a longer period of time if these reefs are kept alive for tourists to come and enjoy. Realizing this, the Philippine government has taken steps to preserve these areas of biodiversity by setting up reef preserves. This strategy is commendable, but will not save the reefs if logging and siltation of near-shore marine waters persist at the scale it currently does in the region.

Step IX: Ask Students Questions during the Lecture about All Topics, Find Out What They Know, What They Have Seen and How They Think These Problems Should be Solved.

Administer a short quiz by asking students to identify the ecosystems and the few animals described in this module. I think it would be good if they could tell a sponge from a mollusk and a mangrove forest from a reef by looking at slides. The quiz should entail an essay on the types of reefs in S.E.A. and the geologic formation of those reefs.

This module will be helpful in discussing the reefs of S.E.A. with your students. Children from 12 – 14 years old are really interested in the ocean and marine organisms. Your students will not be any different.

References

All information including all of the color pictures enclosed can be found in:

Colin, P.L. and C. Arneson (1995). Tropical Pacific Invertebrates: A Field Guide to the Marine Invertebrates Occurring on Tropical Pacific Coral Reefs, Seagrass Beds and Mangroves.