Ocean Activity Workbook

UNIHI-SEAGRANT-MR-82-01

JUNE 1982

UNIVERSITY OF HAWAII SEA GRANT COLLEGE PROGRAM

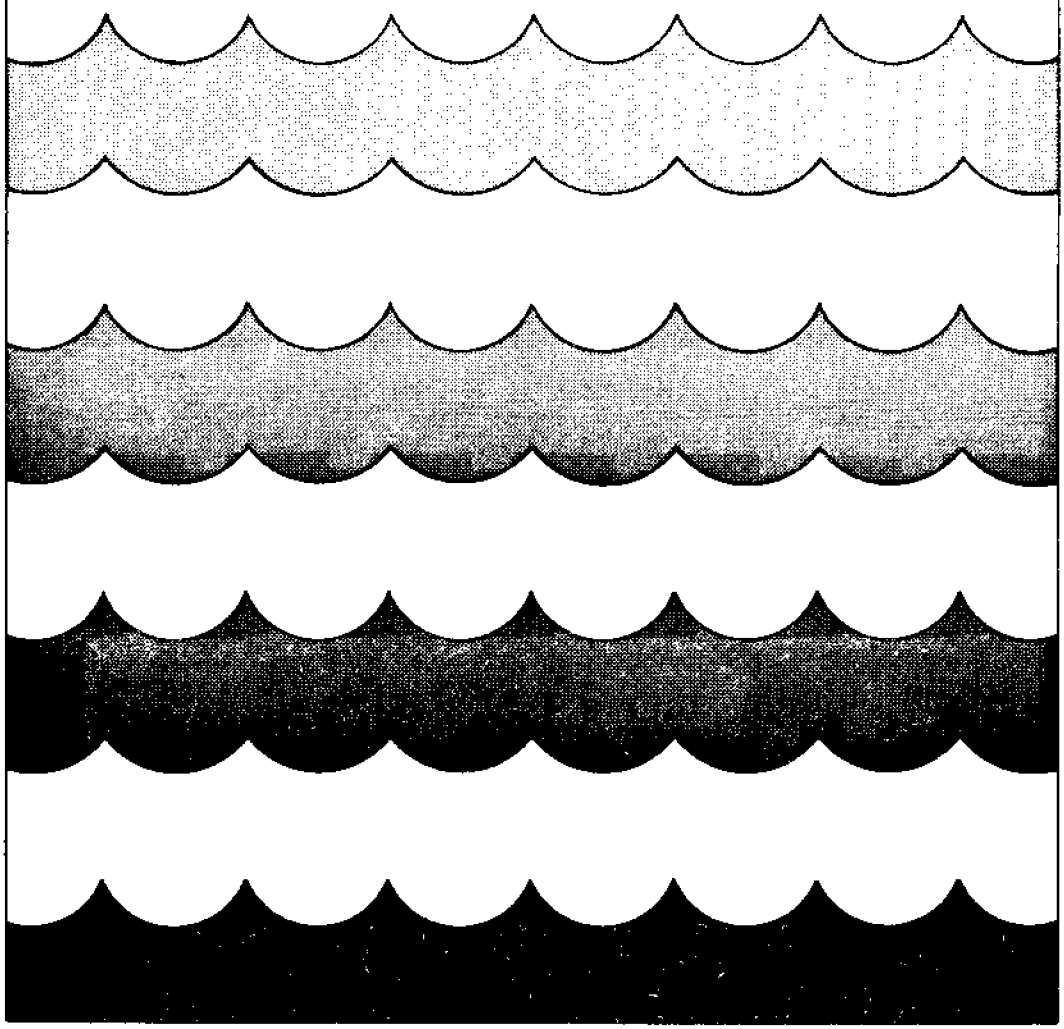


Table of Contents

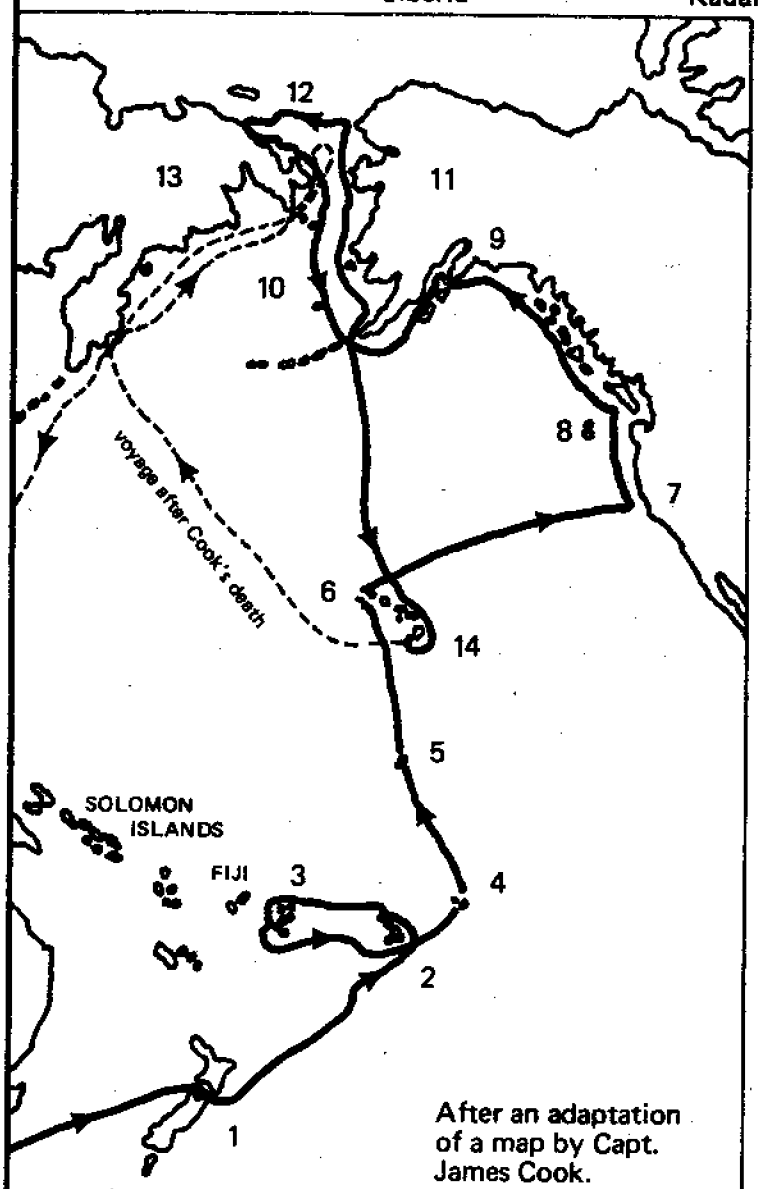
Cook's Voyage

Below is a map of the Pacific Ocean and the route of Captain Cook's third voyage. It was on this voyage that he discovered Hawaii.

DIRECTIONS: Fill in the **Map Key** using the names from the **List of Places** (below). (Answers on page 31)

LIST OF PLACES:

Christmas Island	Cook Inlet	Hawaii	Cook Islands
Tahiti	Friendly Islands	Alaska	Bering Sea
Vancouver Island	New Zealand	New Albion	Arctic Ice
Siberia	Kauai		



After an adaptation of a map by Capt. James Cook.

Map Key

1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
2. _ _ _ _ _ Islands
3. _ _ _ _ _ _ _ _ _ _ Islands
4. _ _ _ _ _ _
5. C h r i s t m a s Island
6. _ _ _ _ _
7. _ _ _ _ _ _ _ _ _ _ _ _
8. _ _ _ _ _ _ _ _ _ Island
9. _ _ _ _ _ _ _ _ _ _ _ _
10. _ _ _ _ _ _ Sea
11. _ _ _ _ _ _
12. _ _ _ _ _ _ _ _ _
13. _ _ _ _ _ _ _
14. _ _ _ _ _ _

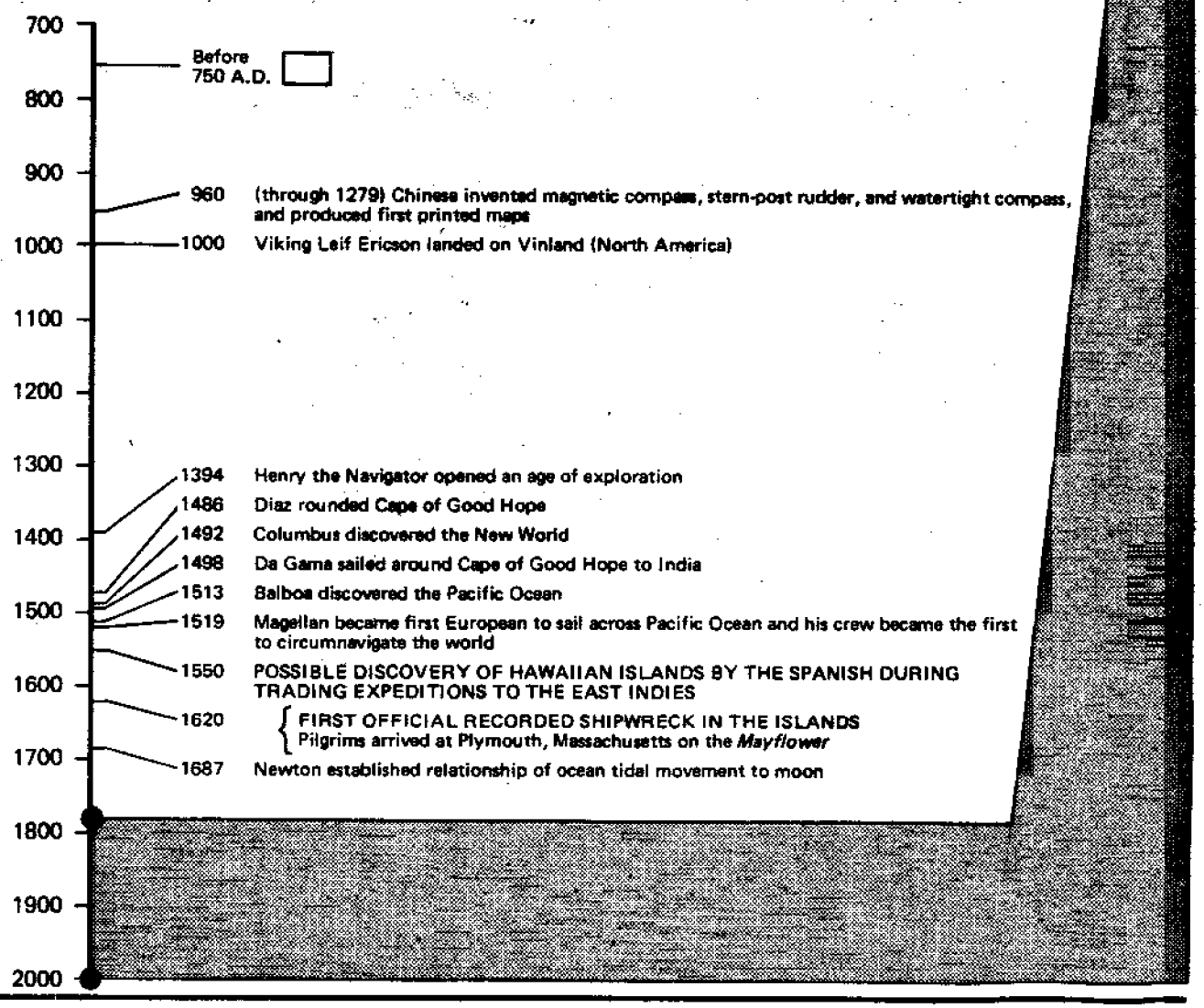
4 Maritime History of Hawaii and the World

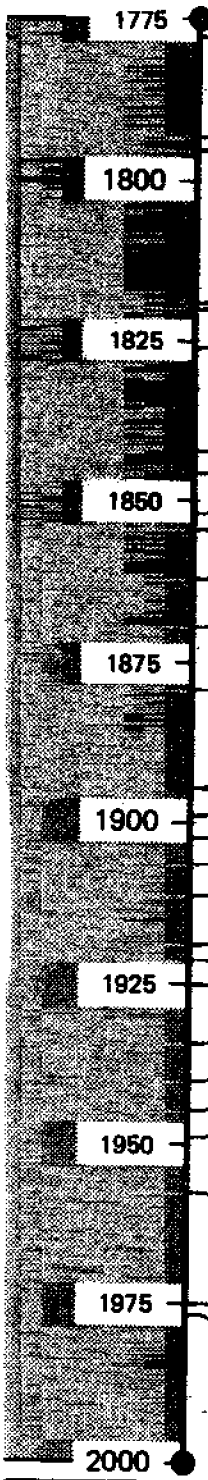
This is a short maritime history of Hawaii and the world. On page 5 the timeline is enlarged so details of events that happened between 1775 and the present can be shown.

DIRECTIONS: Place the missing events in the timeline where there are ☐. Use the letters in the list below. (Answers on page 31)

LIST OF EVENTS:

A. Aloha Tower built
B. Cook discovered the Hawaiian Islands
C. OTEC in operation
D. Peak year for Hawaii whaling industry with arrival of 596 whalers in Hawaiian ports
E. Pearl Harbor attacked. *Arizona* exploded and sank.
F. Arrival of first missionaries
G. Early Polynesians settled in Hawaii
H. *Falls of Clyde* built





1775 First American submarine built

1776 Congress adopted the Declaration of Independence

1778 [ ]

1789 Washington elected first President of the U.S.

1792 VANCOUVER, BRITISH EXPLORER, BROUGHT FIRST LIVESTOCK AND CITRUS FRUITS TO HAWAII

1819 KAMEHAMEHA I, FIRST HAWAIIAN KING TO UNITE ALL THE ISLANDS, DIED AT AGE 60
KAPU SYSTEM OVERTHROWN
FIRST WHALING VESSELS KILLED A WHALE OFF THE COAST OF HAWAII

1820 [ ]
KAMEHAMEHA II (LIHOLIHO) PURCHASED *CLEOPATRA'S BARGE* FOR $90,000 AND RENAMED HER *HAAHEO O HAWAII*

1826 MOSQUITOES INTRODUCED AT LAHAINA

1840 FIRST LIGHTHOUSE IN HAWAII CONSTRUCTED AT LAHAINA

1846 [ ]

1851 HAWAII PARTICIPATED DIRECTLY IN WHALING INDUSTRY WITH THE KING OWNING A FLEET OF 19 SHIPS

1853 *AKAMAI* FIRST STEAMSHIP THAT OFFERED INTERISLAND SERVICE

1860 Lincoln elected President of U.S.

1869 First transcontinental railroad completed

1878 FIRST TELEPHONE INTRODUCED TO HAWAII IN HAIKU, MAUI [ ]

1891 HAWAIIAN ELECTRIC CO. (HECO) STARTED SERVICE ON OAHU

1899 NAKASUGI, THE FATHER OF COMMERCIAL FISHING IN HAWAII, ARRIVED IN HONOLULU WITH THE FIRST SAMPAN

1903 Wright Brothers tested a successful airplane

1908 Henry Ford produced first Model T car

1900s (BEFORE 1912) FIRST FISH AUCTION HELD IN HONOLULU

1914 Panama Canal officially opened

1917 HAWAIIAN TUNA PACKERS BEGAN OPERATIONS

1925 [ ]

1936 FIRST TRANSPACIFIC PASSENGER AIR SERVICE TO HAWAII

1941 [ ]

1946 WORST TSUNAMI IN HAWAIIAN HISTORY

1949 WORST MARITIME STRIKE IN HAWAIIAN HISTORY (178 DAYS)

1959 HAWAII BECAME 50th STATE

1975 [ ]
INTERISLAND HYDROFOIL SERVICE BEGAN

1976 *HOKULEA* BEGAN HISTORIC 6,000-MILE VOYAGE TO TAHITI

6 Solar Energy from the Sea—OTEC

The world's oceans, especially near the Equator, are like your hot water tank at home. The sun's energy, stored in the warm ocean surface, could be tapped someday by a process called OTEC—ocean thermal energy conversion. The idea was first suggested 100 years ago by a Frenchman, Arsene d'Arsonval. His student, George Claude, actually tested OTEC plants in the 1930s. However, for forty years, not much more was done until the 1970s when everyone worried about the "energy crisis." Today, energy planners think OTEC could be an important source of energy in the future.

OTEC works like a modern power plant. In the Kahe plant, water is turned into steam in a boiler by burning oil. The steam turns a turbine which runs a generator to produce electricity. Then the steam is changed back into water in a condenser which uses cold seawater to cool the steam.

In an OTEC plant, a fluid such as ammonia is "boiled" by using heat from warm ocean water in an evaporator (same as the boiler in the Kahe plant); the ammonia vapor is then run through a turbine to run the generator. The vapor is returned to liquid ammonia by using very cold seawater (40°F) in a condenser. The cold seawater comes from about one-half mile deep.

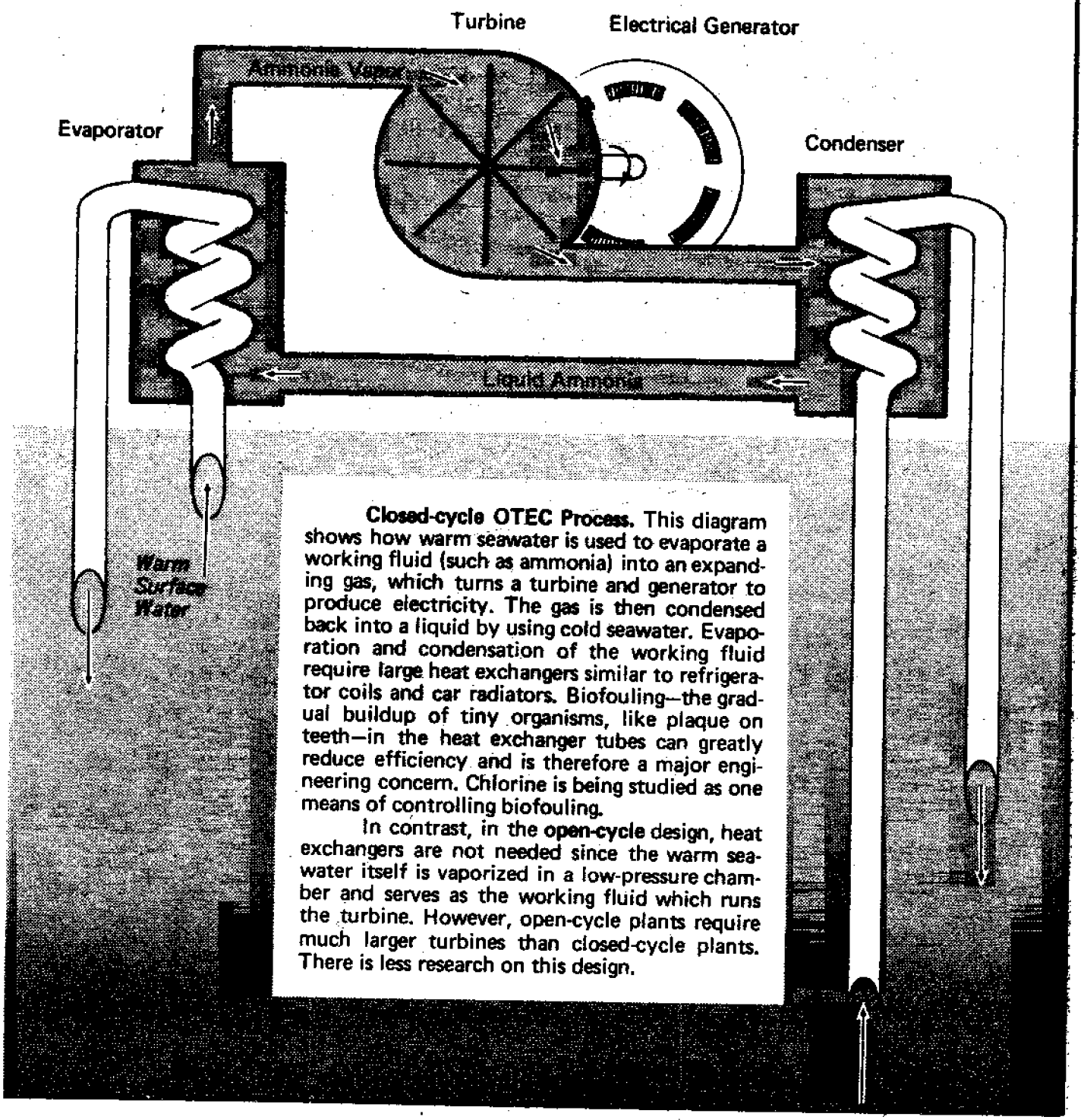
There is no question that the world is slowly running out of oil. Some energy experts believe the "oil age" will die out in another 30 years or so—within one generation. The question: what will Hawaii turn to after oil? Coal? Nuclear? Solar?

There are many choices of renewable energy sources for Hawaii: wind, biomass, photovoltaic cells, solar heaters. OTEC is one possibility that could some day provide much of our electricity and other energy needs. One medium-sized plant could provide electricity for about 4,000 people. OTEC could be used to produce methanol or ammonia as substitute for gasoline. The cold water from an OTEC plant could be recycled for producing fish and other seafood. Because of its potential, researchers in the United States, Japan, France, and other countries have spent millions of dollars on OTEC development. Hawaii helped lead the way with its Mini-OTEC project off Keahole Point in 1979. In 1981, Japanese firms built a pilot plant on the Pacific island of Nauru. Designs of two pilot plants are now being studied for the Kahe area.

Before OTEC takes off, however, a number of technical, economic, and environmental questions will have to be studied further—for example, how offshore fishing would be affected by the large amounts of seawater discharged by an OTEC plant. OTEC is expensive; a medium-sized plant could cost $200 million or more. OTEC's major advantage is that the "fuel," warm ocean water, is "free" and available day and night, year-round—not like in solar heaters which work only when the sun is shining.

OTEC will not solve all the nation's energy problems—but could make a big difference for islands like Hawaii and Guam. OTEC could take the place of expensive oil for generating electricity. This could free Pacific islands from importing most of their energy.

For more information on OTEC, write for *Solar Energy from the Sea*, a 4-page brochure, from UH Sea Grant Publications, 1000 Pope Road, Room 200, Honolulu, HI 96822. Please enclose $.25 to cover postage and handling.



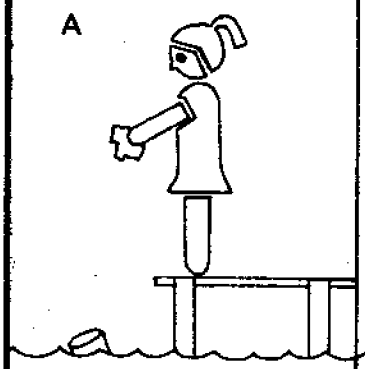
Closed-cycle OTEC Process. This diagram shows how warm seawater is used to evaporate a working fluid (such as ammonia) into an expanding gas, which turns a turbine and generator to produce electricity. The gas is then condensed back into a liquid by using cold seawater. Evaporation and condensation of the working fluid require large heat exchangers similar to refrigerator coils and car radiators. Biofouling—the gradual buildup of tiny organisms, like plaque on teeth—in the heat exchanger tubes can greatly reduce efficiency and is therefore a major engineering concern. Chlorine is being studied as one means of controlling biofouling.

In contrast, in the **open-cycle** design, heat exchangers are not needed since the warm seawater itself is vaporized in a low-pressure chamber and serves as the working fluid which runs the turbine. However, open-cycle plants require much larger turbines than closed-cycle plants. There is less research on this design.

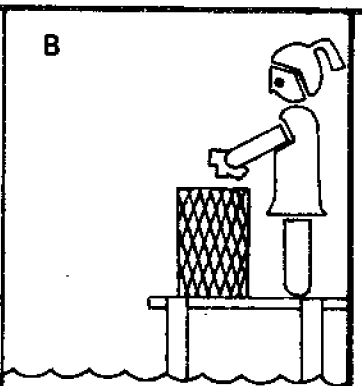
8 Shoreline Conservation

What is meant when the word conservation is applied to our seashore? It means the careful use of our shoreline resources. It means obeying rules to help keep plants and animals alive. It means taking only what you need and not more. What can **you** do to help conserve our resources? In the six sets of drawings below, which posters best show things you can do to help? Write A or B in the boxes below each set. (Answers on page 31)

A

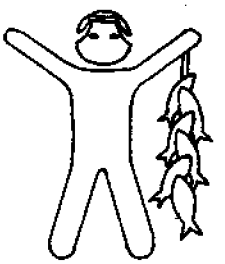


B

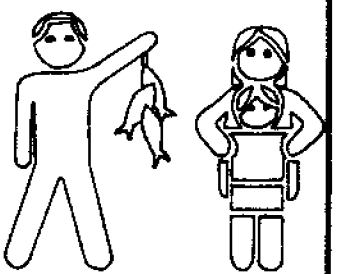


1) Put litter in its place!

A



B



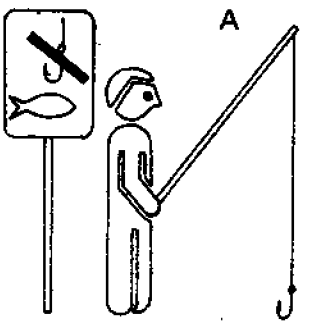
2) Catch only what you need!

A

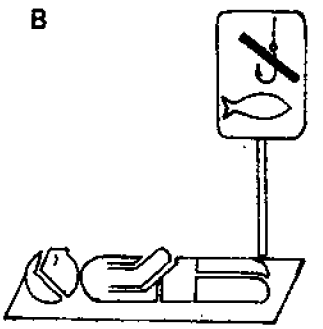
B

3) Do not collect everything in sight!

A

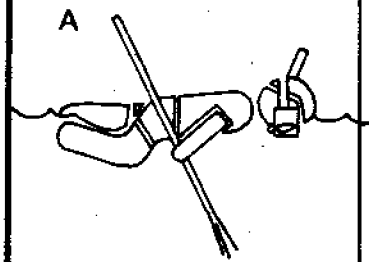


B



4) Follow posted conservation signs!

A



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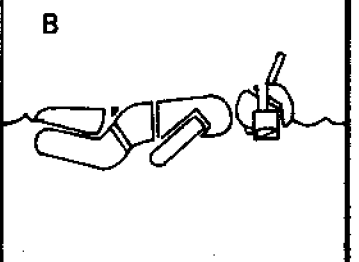
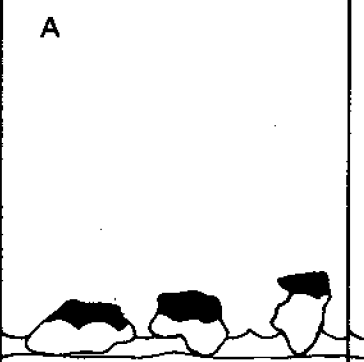
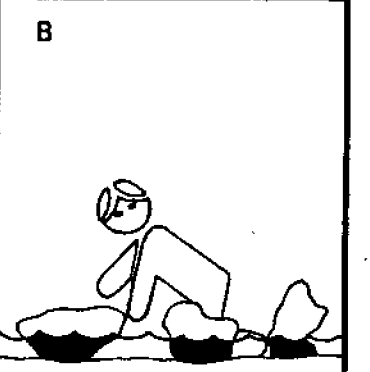


5) Do not spear lobsters out of season!

A



B

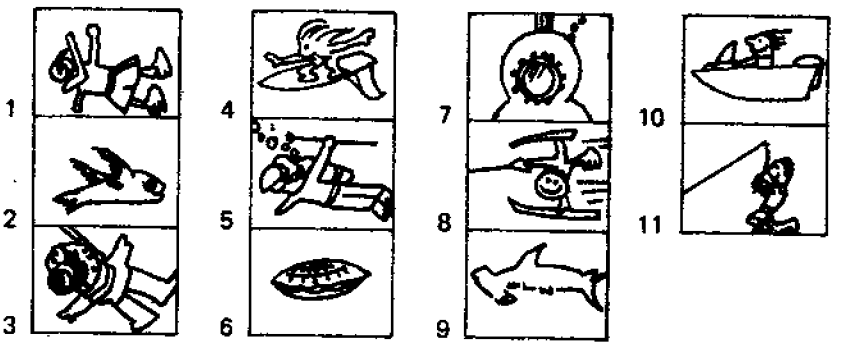


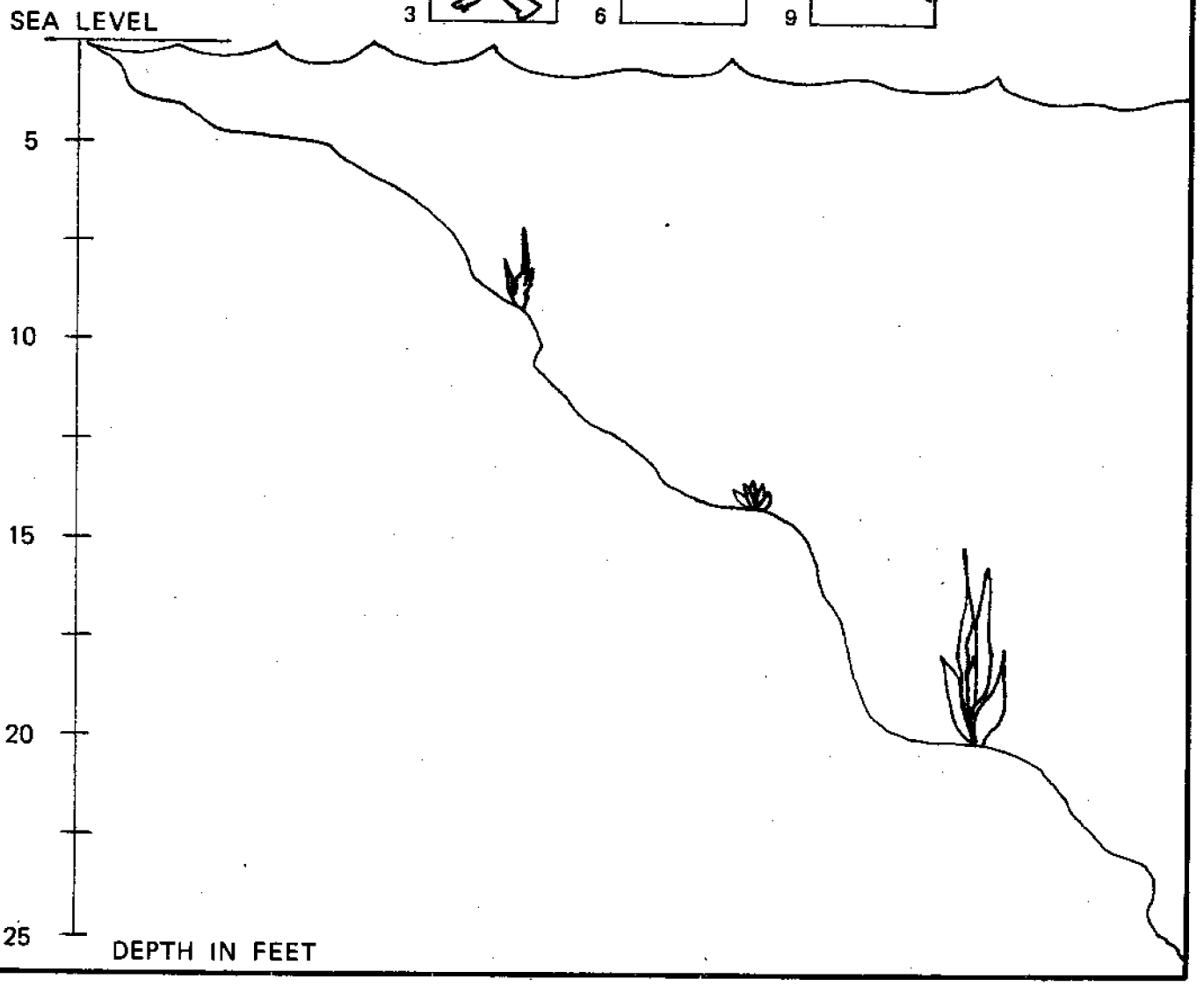
6) Replace overturned rocks!

Recreation

Draw in recreational activities that can be carried on at different depths of the ocean. See cartoon key below.

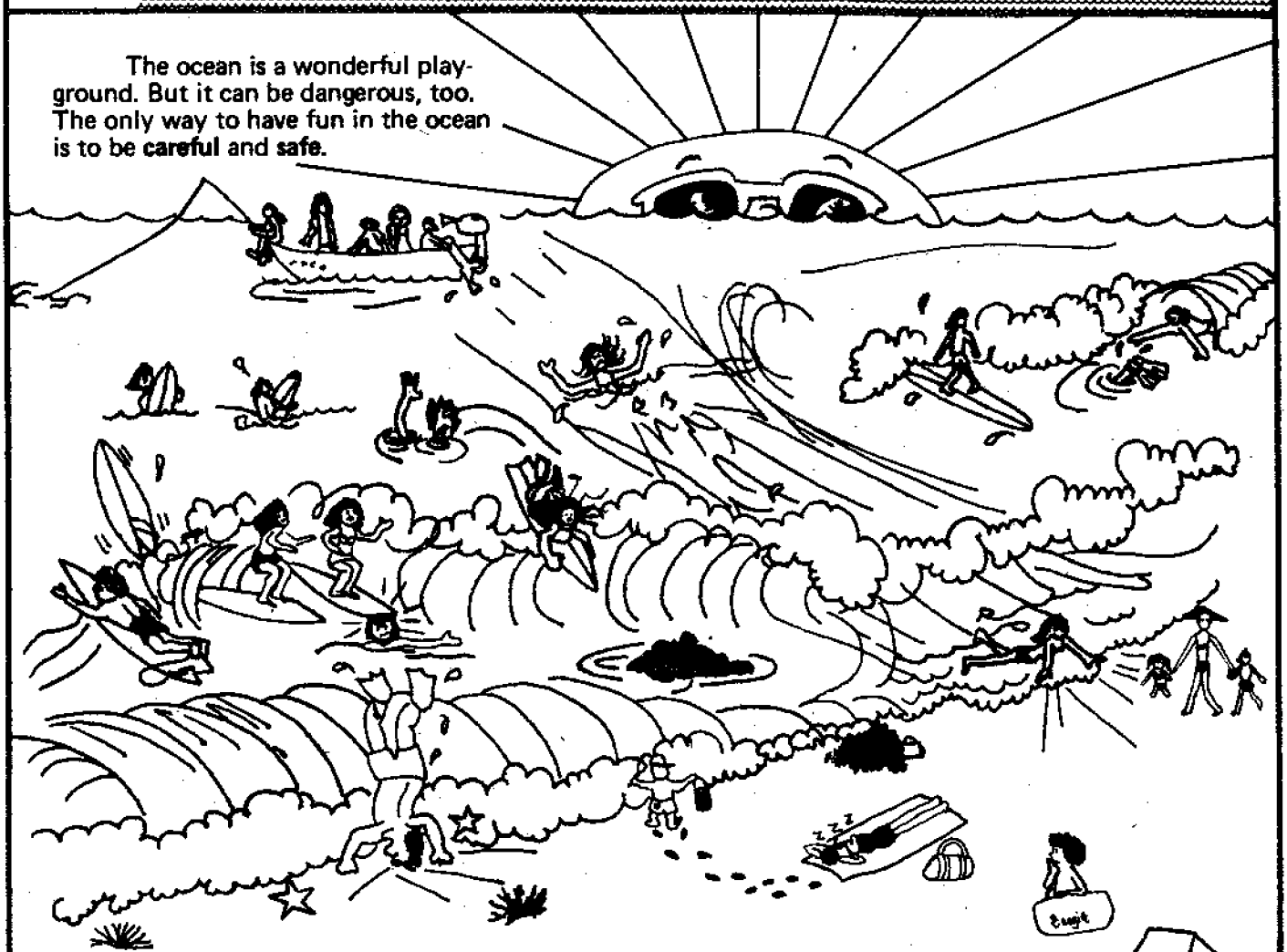
KEY





10 There are Many Ways to Have Fun in the Ocean

The ocean is a wonderful playground. But it can be dangerous, too. The only way to have fun in the ocean is to be **careful** and **safe.**



Here are some **safe** things to do.
Draw a **green** line from each safe act to its picture.

*asking the lifeguard about the water
*wearing a surfboard leash
*supervising children
*diving under a breaking wave
*surfing ahead of the curl, not straight in to shore
*staying out of the water if the waves look too big for you

Here are some **ocean dangers.**
Draw a **red** line from each danger to its picture.

*unsupervised child
*swimmer caught in rip
*loose surfboard
*going "over the falls"
*crowded waves
*rocks

Next time you go to the beach, look out for these dangers—and find new ones of your own!

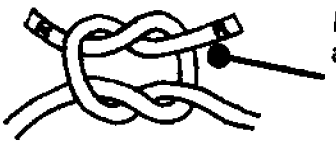
Knots

Overhand:

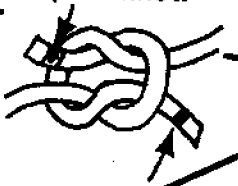
Figure-8:

an "end-of-the-line" knot

Square knot:



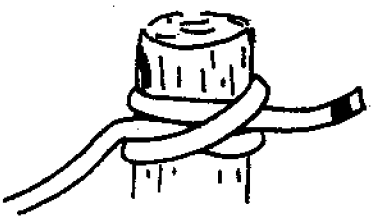
Note: this is **not** a square knot!



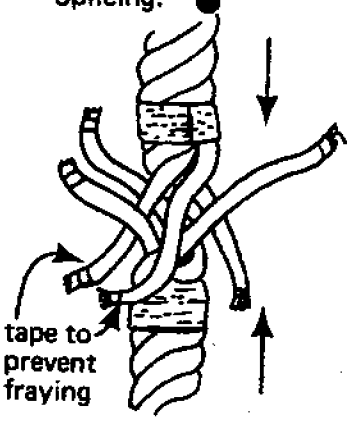
Note: a square knot will reduce the strength of the line joined by 50%, a bowline by 30-40% and a splice by only 10%.

Bowline:

Clove hitch:

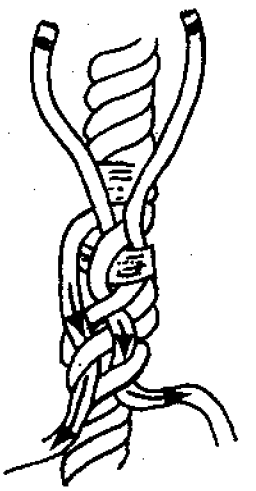


Splicing:



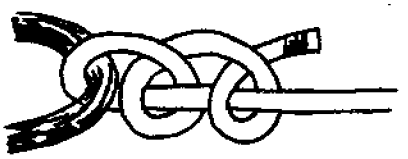
tape to prevent fraying

1) "Marry" the two ends to be spliced

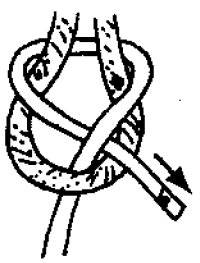


2) Weave the ends in and out of the partially unlayed line

2 half-hitches:



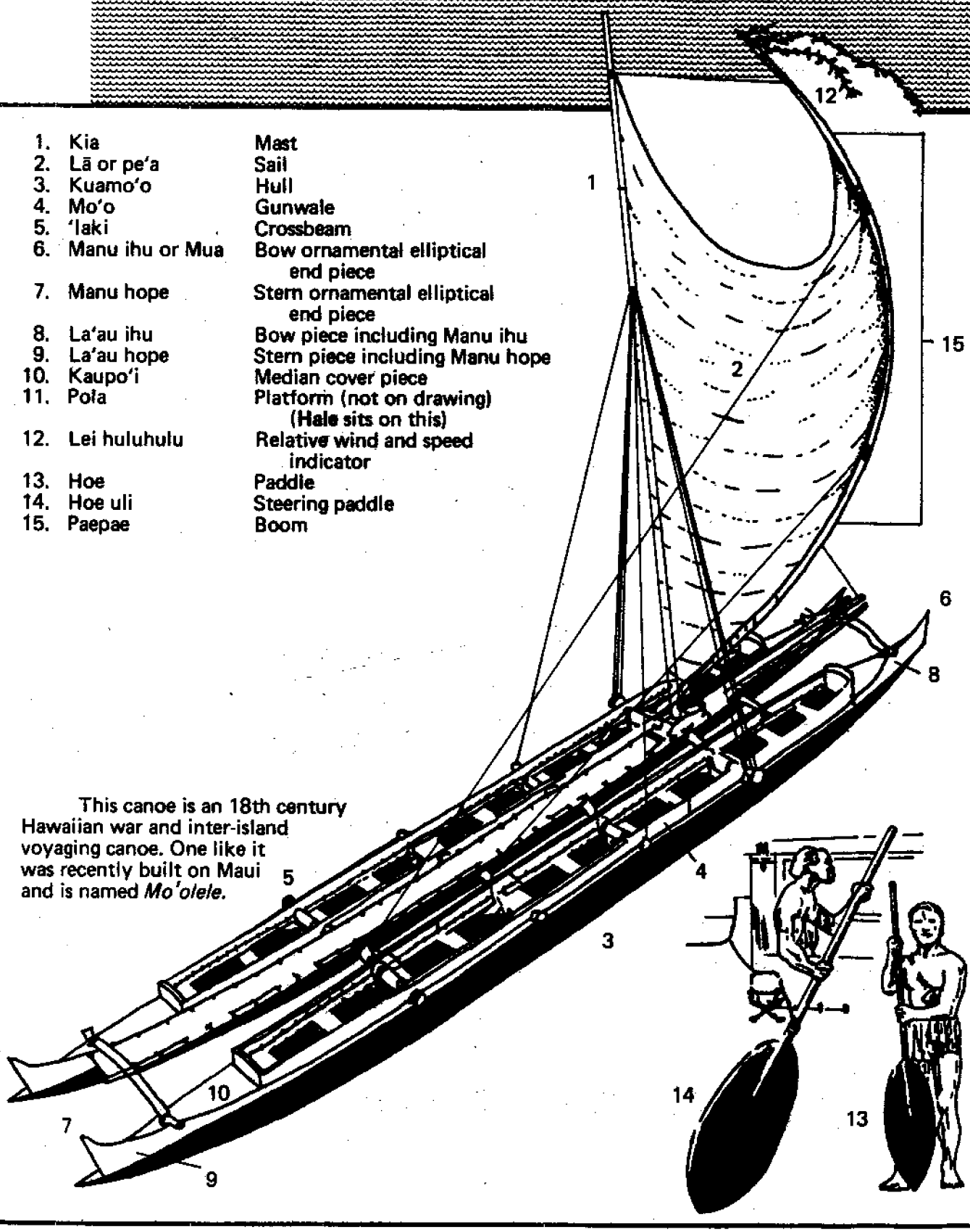
Sheet bend: start with a loop



12

Wa'a Kaulua

1.	Kia	Mast
2.	Lā or pe'a	Sail
3.	Kuamo'o	Hull
4.	Mo'o	Gunwale
5.	'Iaki	Crossbeam
6.	Manu ihu or Mua	Bow ornamental elliptical end piece
7.	Manu hope	Stern ornamental elliptical end piece
8.	La'au ihu	Bow piece including Manu ihu
9.	La'au hope	Stern piece including Manu hope
10.	Kaupo'i	Median cover piece
11.	Poła	Platform (not on drawing) (Hale sits on this)
12.	Lei huluhulu	Relative wind and speed indicator
13.	Hoe	Paddle
14.	Hoe uli	Steering paddle
15.	Paepae	Boom

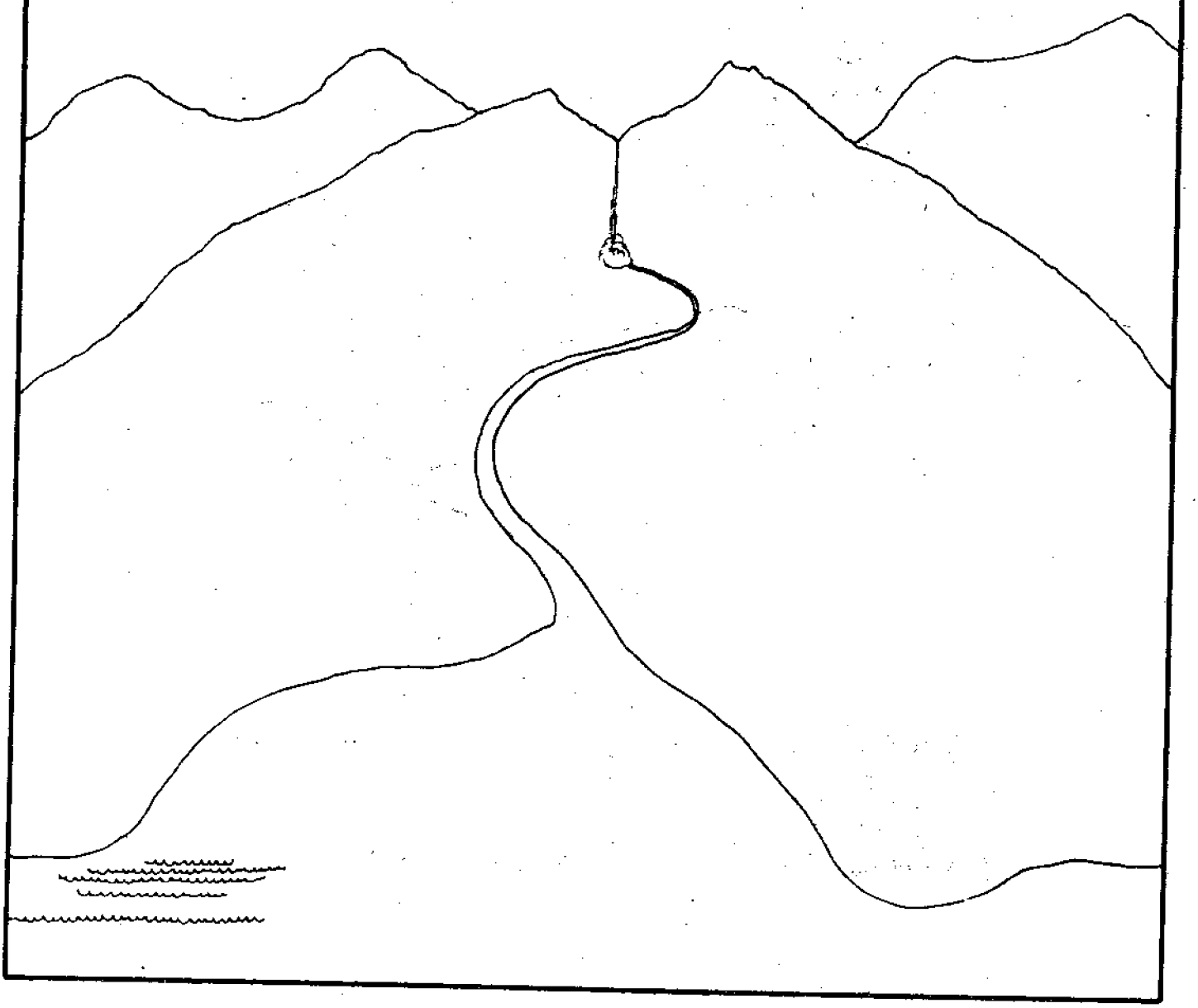


This canoe is an 18th century Hawaiian war and inter-island voyaging canoe. One like it was recently built on Maui and is named *Mo'olele.*

Ahupua'a

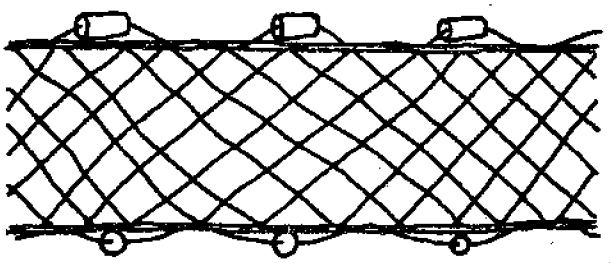
This is a picture of an ahupua'a* on Oahu before people came to live in it. What did people add to the ahupua'a? Imagine that you are on a boat at sea. Fill in this ahupua'a so that it looks like a typical valley in which people live today.

*Land section, usually extending from the upland to the sea.

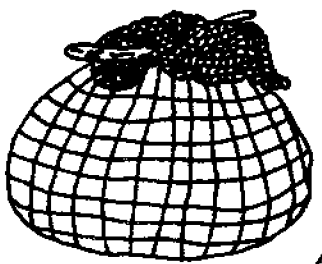


14 Fishing in Old Hawaii

Draw a line connecting the animal with the proper fishing tool.

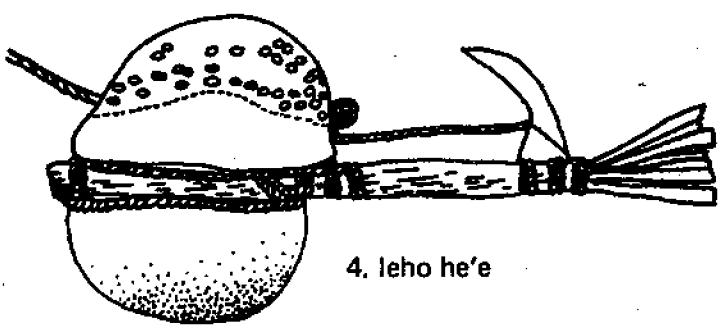


1. ʻupena kuʻu



2. hīnaʻi

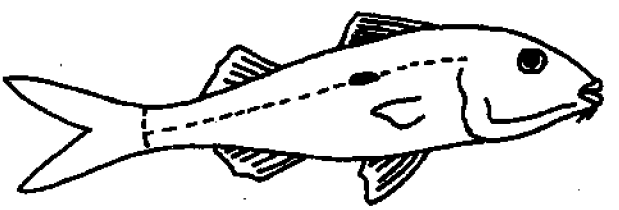
3. ʻoiʻa



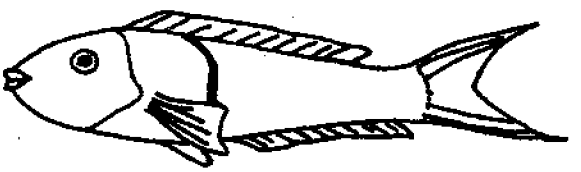
4. leho heʻe

a. heʻe

b. ʻōpū hue



c. weke ʻāʻā



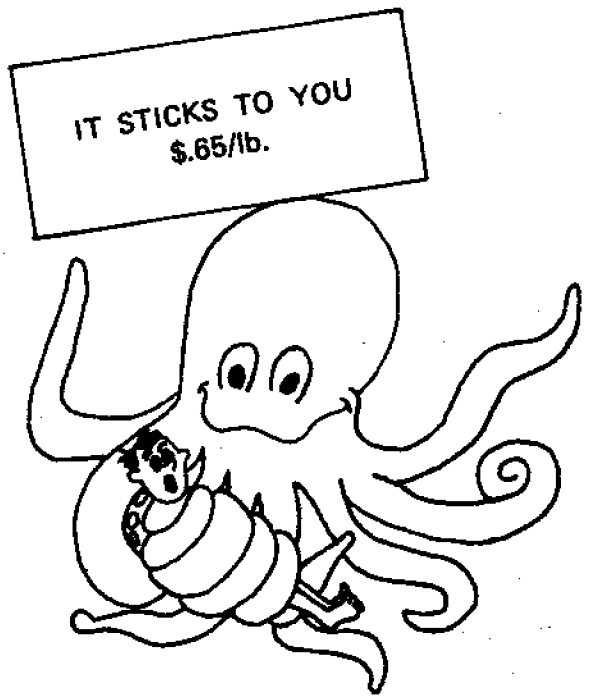
d. hinalea

(Answers on page 31)

A Marine "Manabata" Fun Quiz

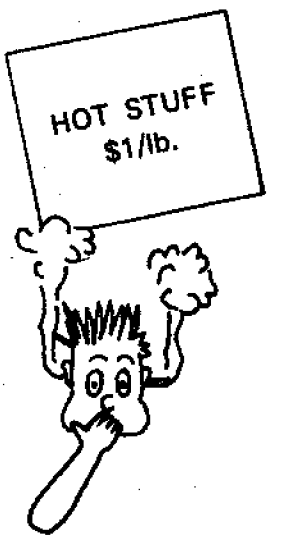
16

At the local fish market. . .What is being advertised by these signs?
Match the following to the signs: limu, tako, poki, taegu, bagoong, opihi.



1. _____

2. _____



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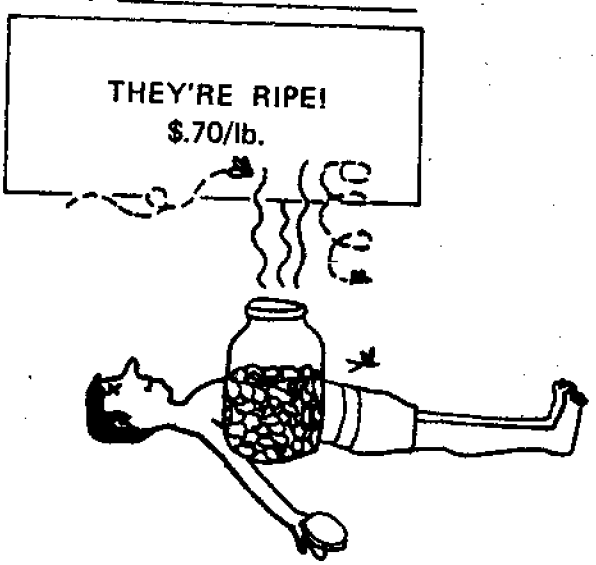
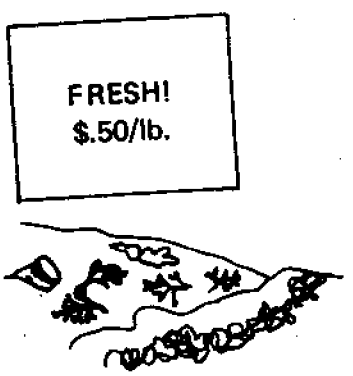
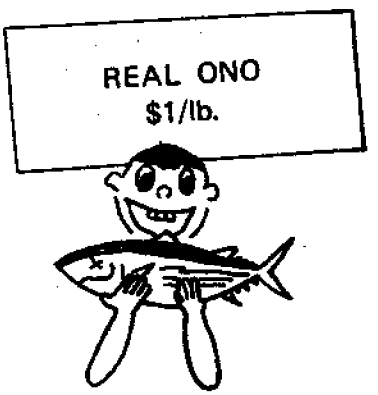


4. _____



5. _____



6. _____

(Answers on page 31)

Did you know...?

Is life found at all depths in the ocean?

Some scientists believed, as recently as 1860, that marine life could not exist below 1,800 feet. That view was altered when a telegraph cable laid in the ocean bottom at 6,000 feet deep was retrieved and found covered with many forms of marine life.

How many fish species are there?

The most oft-quoted estimate is 20,000. There may be as many as 20,000 more.

What is the world's largest fish? The smallest?

The largest is the whale shark, which grows to more than 50 feet in length and may weigh several tons; second largest is the basking shark, which may measure 35 to 40 feet long. The smallest fish is the tiny goby, an inhabitant of fresh-to-brackish-water lakes in Luzon, Philippines. It seldom is longer than a half-inch in adulthood, yet is so abundant it supports a fishery.

How is the age of fish determined?

Mainly by two methods: Growth "rings" on scales, and/or ringlike structures found in otoliths (small bones of the inner ear), are examined and counted. The rings correspond to seasonal changes in the environment and can be compared to the annual rings of tree trunks. A series of fine rings are laid down in scales for each year of life—in summer, the rings grow faster and have relatively wide separations; in winter, slower growth is indicated by narrow separations between rings. Each pair of rings indicates one year. Because scale rings are sometimes influenced by other factors, scientists often use otoliths, whose ringlike structures also indicate years of life.

How long do fish live?

A few weeks or months (some of the small reef fishes) to 50 years or more (sturgeons). Longevity information is still sparse, but scientists have learned that species live 10 to 20 years in temperate waters.

Do fish breathe air?

Yes, but not directly into the lungs as mammals do (except for some tropical fish). As water passes over a system of extremely fine gill membranes, fish absorb the water's oxygen content. Gills contain a network of fine blood vessels (capillaries) that take up the oxygen and diffuse it through the membranes.

Can fish swim backwards?

A number can, but usually don't. Those that can are mostly members of one of the eel families.

Do fish chew their food?

Not in the human manner. Carnivorous fish use their sharp teeth to seize and hold prey while swallowing it whole or in large pieces. Bottom dwellers such as rays are equipped with large flat teeth that crush the shellfish they consume. Herbivorous fish (grazers) often lack jaw teeth, but have tooth-like grinding mills in their throats, called pharyngeal teeth. Fish would suffocate if they tried to chew, for chewing would interfere with the passage of water over the gills, necessary for obtaining oxygen..

How many kinds of tuna are there, and which kind makes up the biggest catch?

There are several commercial and sport-caught tunas, as well as several related species, all of which are members of what is called the scombrid family. Commercially caught tunas consist of albacore, bigeye, blackfin, bluefin, bonito, skipjack, and yellowfin. Yellowfin, taken in the eastern Pacific and tropical Atlantic, makes up the biggest U.S. commercial catch. Albacore, caught in the eastern Pacific, is the true "white-meat" tuna; skipjack, caught throughout the world in tropical and subtropical waters, makes up the second largest U.S. commercial catch; bigeye is caught mostly in tropical waters; blackfin is caught commercially only in the Caribbean and off South America; the very large bluefin (rod-and-reel record, 1,040 pounds) is a highly prized sport catch in the Atlantic and Pacific; and the widely distributed bonito is used largely as pet food.

Do tunas have scales?

Yes, all species do, but scales are so small over most of the body as to be nearly invisible. Prominent scaling appears only around the head, on the cheeks, and in the triangular area on each side of the body near the head.

How do porcupine fish inflate themselves?

All puffer-like fish inflate by pumping water into special sacs when in their natural environment. Out of water, a puffer fills the sacs with air instead, and takes on a balloon-like appearance.

What fishes are named after other animals?

Many are named after animals—alligator, bird, boar, buffalo, cat, cow, dog, elephant, frog, goat, goose, hawk, horse, leopard, lizard, parrot, porcupine, rabbit, sheep, squirrel, tiger, toad, unicorn, viper, wolf, and zebra.

What attracts sharks? Which are most dangerous?

Considerable research has been devoted to finding out what stimuli attract sharks and incite them to attack. Results are mostly inconclusive, but some general principals have been advanced: certain types of irregular sounds—like those made by a swimmer in trouble or a damaged fish—seem to attract sharks from great distances. Sound, rather than sight or smell, seems to be a shark's primary cue for moving into an area. Some scientific experiments indicate that sharks can distinguish light colors from dark, and that they may even be able to distinguish colors. Yellow, white, and silver seem to attract sharks. Many divers maintain that clothing, fins, and tanks should be painted in dull colors to avoid shark attacks.

Though blood itself may not attract sharks, its presence in combination with other unusual factors will excite the animals and make them more prone to attack.

The most dangerous species in order of documented attack records are: the great white shark, bull shark, tiger shark, grey nurse shark, lemon shark, blue shark, whale shark, sand tiger, several species of hammerheads, and the mako. Some species such as the nurse shark are extremely sluggish and have poorly developed teeth, but even these have been known to attack man when excited or disturbed.

What sea creatures other than sharks may be dangerous to swimmers?

The barracuda (though divers claim its ferocious reputation is undeserved), moray eels, octopuses, and sharp-spined sea urchins can be dangerous to swimmers. The portuguese man-of-war has tentacles up to 50 feet long with specialized cells that produce painful stings and welts on contact by swimmers. Sting rays toadfish, catfish, and jellyfish can inflict damage on swimmers and waders. Certain coral-reef organisms are to be avoided by divers.

Can crabs swim?

Most crabs "walk" or run across the ocean bottom. Some, such as the commercially caught blue crab of the Atlantic coast (a member of the one family of "swimming crabs") can swim. Their rearmost pair of legs is modified for swimming and legs are paddle-shaped.

How do crabs grow?

By shedding their outgrown shell. The rigid shell imprisons the crab and limits growth. Once the shell is shed, the crab can absorb water and expand into its new-grown shell.

How do prawns, crayfish, and shrimp differ?

As so often happens, common names are used loosely and inconsistently in the shrimp family. The "prawn" of Great Britain and other countries is essentially the same animal as the shrimp of the U.S. In this country, the term "shrimp" applies to all crustaceans of the *Natantia* group, regardless of size. "Crayfish" or "crawfish" are names given to both a common freshwater crustacean and to the saltwater spiny lobster.

From NOAA April 1973-July 1973: *Fish: The most-asked questions.*

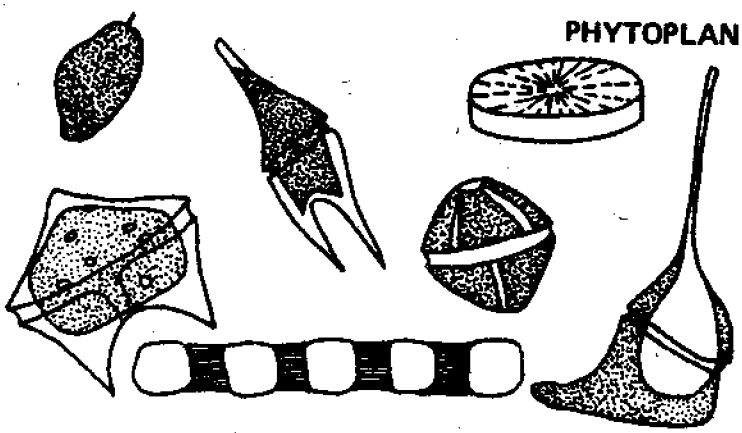
18 High Seas Drifter

WHAT ARE PLANKTON?

The word "**plankton**" means "**drifter.**" True to its name, plankton are tiny plants and animals that drift in ocean currents. Many of them are so small that you need a magnifying glass or microscope to see them. Plankton can also be the larger animals like jellyfish and portuguese man-of-war that are weak swimmers and cannot swim against the wind or currents.

Scientists divide plankton into two groups—**phytoplankton**, which are tiny plants, and **zooplankton**, which are animals.

PHYTOPLANKTON



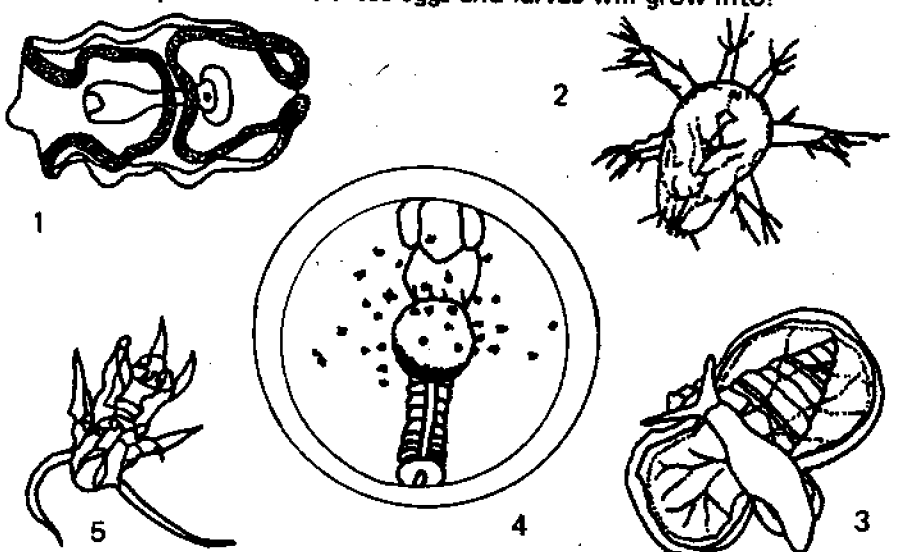
Phytoplankton are microscopic marine plants that use sunlight and minerals to grow like land plants. The most familiar sea plant is limu or seaweed, which grow attached to rocks, but phytoplankton spend their whole life floating near the sunlit surface of the ocean.

Plankton is the beginning of the **marine food web.** They are called **primary producers** and provide food mainly for zooplankton.

ZOOPLANKTON

Zooplankton are tiny animals that drift in the ocean currents like phytoplankton. Some zooplankton float for their entire life in the ocean. These **permanent zooplankton** do not change their body shapes as adults. Other zooplankton, called **temporary zooplankton**, spend only part of their lives as adults. These are the **eggs** and **larvae** of many kinds of marine animals. As babies, these animals float around but as they grow older, they change their shape and become starfish, sea urchins, crabs, fish, and many other animals.

Can you tell what these eggs and larvae will grow into?



Write the number in the boxes below of the larval form of each animal.

☐ ulua

☐ crab

☐ sea cucumber

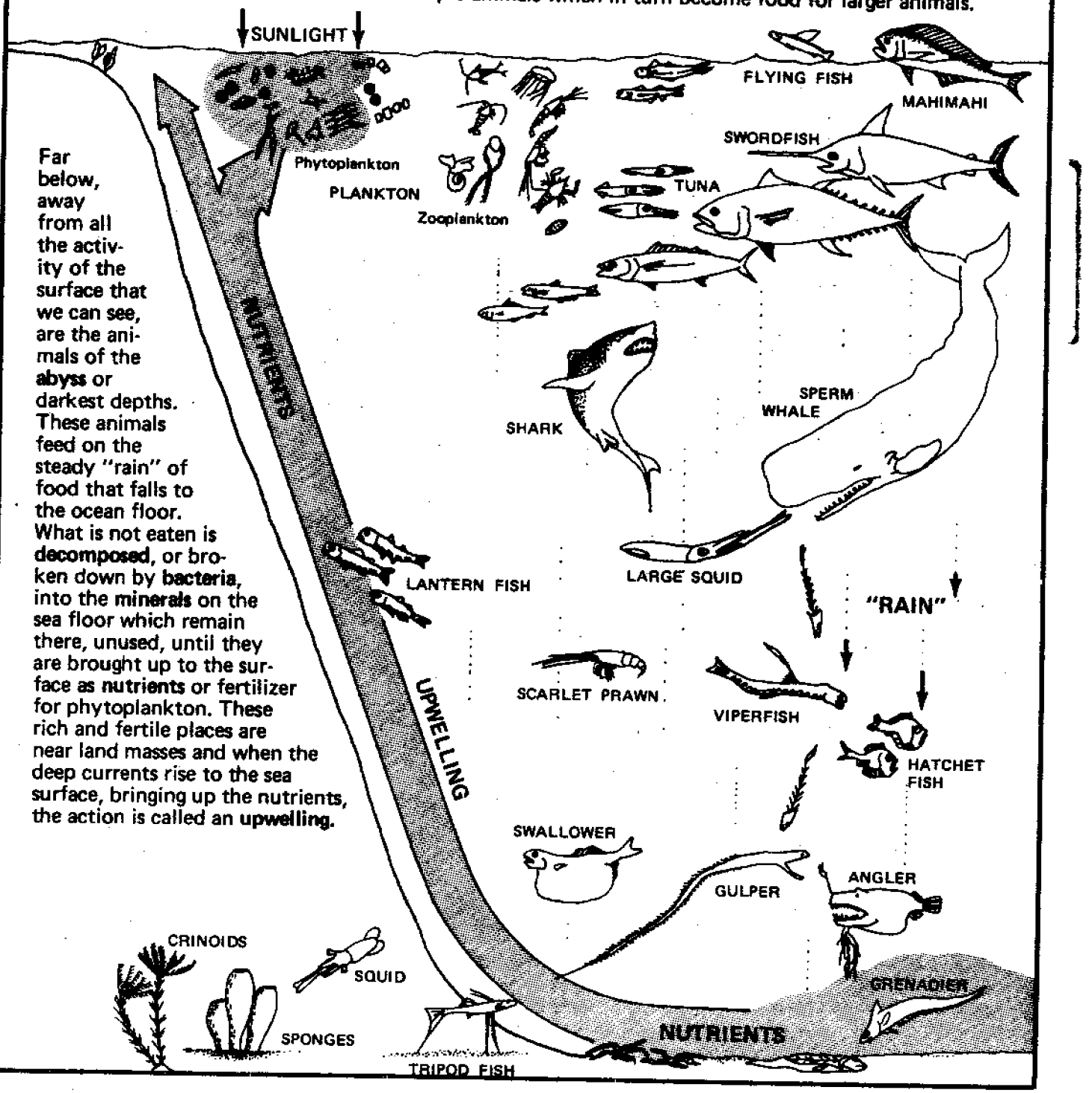
☐ snail

☐ sea urchin

(Answers on page 31)

Marine Food Web

All life in the ocean is a part of the **Marine Food Web.** The beginning of the web is in the sunlit zone of the ocean. Here, microscopic phytoplankton use energy from the sun, to grow. The phytoplankton then serves as food for other microscopic animals which in turn become food for larger animals.



Far below, away from all the activity of the surface that we can see, are the animals of the **abyss** or darkest depths. These animals feed on the steady "rain" of food that falls to the ocean floor. What is not eaten is **decomposed**, or broken down by **bacteria**, into the **minerals** on the sea floor which remain there, unused, until they are brought up to the surface as **nutrients** or fertilizer for phytoplankton. These rich and fertile places are near land masses and when the deep currents rise to the sea surface, bringing up the nutrients, the action is called an **upwelling.**

20

Limu! Limu! Limu!

Did you know that all that yukky stuff on the rocks at the beach is more than what you think it is? Did you know that limu is very important to the marine life cycle and to our fish? (Makes fish grow so we can eat 'em.) Did you know it can make a hearty meal for us too as well as having other practical uses such as art??!! Yes, it's true and **more!!!!!**

Some interesting things to know about it is that limu, scientifically called algae, can be classified in three different groups: green algae, red algae, and brown algae. The green kine are usually found in shallow waters. This is a very versatile algae and is also the most difficult to classify because it often looks green or brown in color. Tricky limu!!! Brown limu can also be found in shallow or deep waters. Kelp, a famous brown limu is made into iodine supplement tablets. Some of the limus are even used in medicine. Neat yeah???!!!

In actuality almost all algae found in the oceans are edible. However, most of these algaes or limus do not appeal to man's senses such as sight, smell, and touch. Therefore man misses out on one of nature's not only *"ono"* (DELicious) but nutritious foods. Many limus are found to be rich in protein, iodine, and vitamins.

Forty or fifty years ago it was a common sight in periods of low tide to see many small groups of Hawaiian tutus in muumuus and hats cleaning limu along sandy beaches. What were they cleaning limu for? Well, in the old days of Hawaii, limu was the third component of a nutritionally balanced but monotonous diet consisting of fish and poi. Together they furnished the necessary protein, carbohydrate, and minerals for adequate nutrition. Also while limu primarily supplied variety and interest, it also added significant amounts of vitamins and other mineral elements to those contained in poi. The famous limus that were traditionally eaten were ogo or manauea, limu kohu, and wawae'iole. Hey, not only the native Hawaiian can enjoy eating limu because we can too!!!!! There are some excellent recipes going around too! **Very ono!!!**

OGO KIM CHEE

(Korean: modified after the Korean methods of their famous pickled cabbage)

2 lbs. ogo ("limu long manauea") chopped into 2 to 3-inch pieces
Handful of coarse Hawaiian salt
2 cloves garlic (chopped) per quart of wilted seaweed
1 to 2 chopped round onions, or 1/2 c. chopped green onions
Chili pepper, chopped (to taste) or 1/2 tsp. cayenne (to taste)
1/2 tsp. paprika

Wash and clean the limu. Salt and let stand over night to wilt. Next day, drain off any liquid, add garlic, onions, chili pepper, and paprika. Pack tightly in jars, seal, and refrigerate. Let stand a few days before using.

Hey! Try limu kohu with stew or whatever turns you on! (Yummy)

You gotta try ogo with miso sauce too! It's a winner.

MISO SAUCE

1/4 c. miso
2 tbsp. vinegar
2 tbsp. sugar
1/2 tsp. MSG

GULAMON SALAD
(Filipino)

1 lb. or about 3 c. packed limu wawae'iole or limu manauea
3 to 4 c. boiling water
4 large tomatoes
1 tsp. salt
Chopped green onions
Chopped fresh ginger
2 tbsp. shoyu

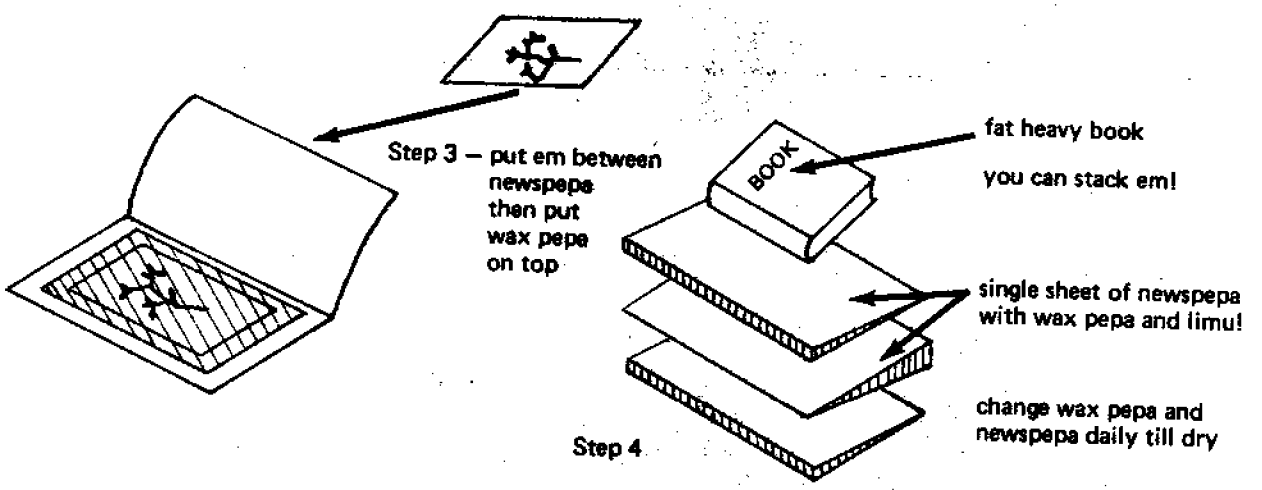
Wash and clean seaweed. Pour boiling water over the cleaned seaweed; let stand for a few minutes. Drain well. Chop or mash tomatoes and add to seaweed; add remaining ingredients. Serve cold.

Limu is not only good to eat but also terrific to collect and to use as art work. Yes, algae art!!!!! We are so lucky to live in Hawaii where our reefs and shorelines are blessed with the abundance and fantastic variety of the beautiful algae. Why don't you start a collection now!!! (Some collectors pay as much as $200 for a good algae or limu press!!) How do you do it? Well, by making algae presses. It's fast, easy, and beautiful!!!

Eh, all you need is newspepa, wax pepa, and typing pepa, and one fat, heavy book.

Step 1 – wash da limu good, gotta get all the salt off

Step 2 – put em on typing pepa (spread em out good)

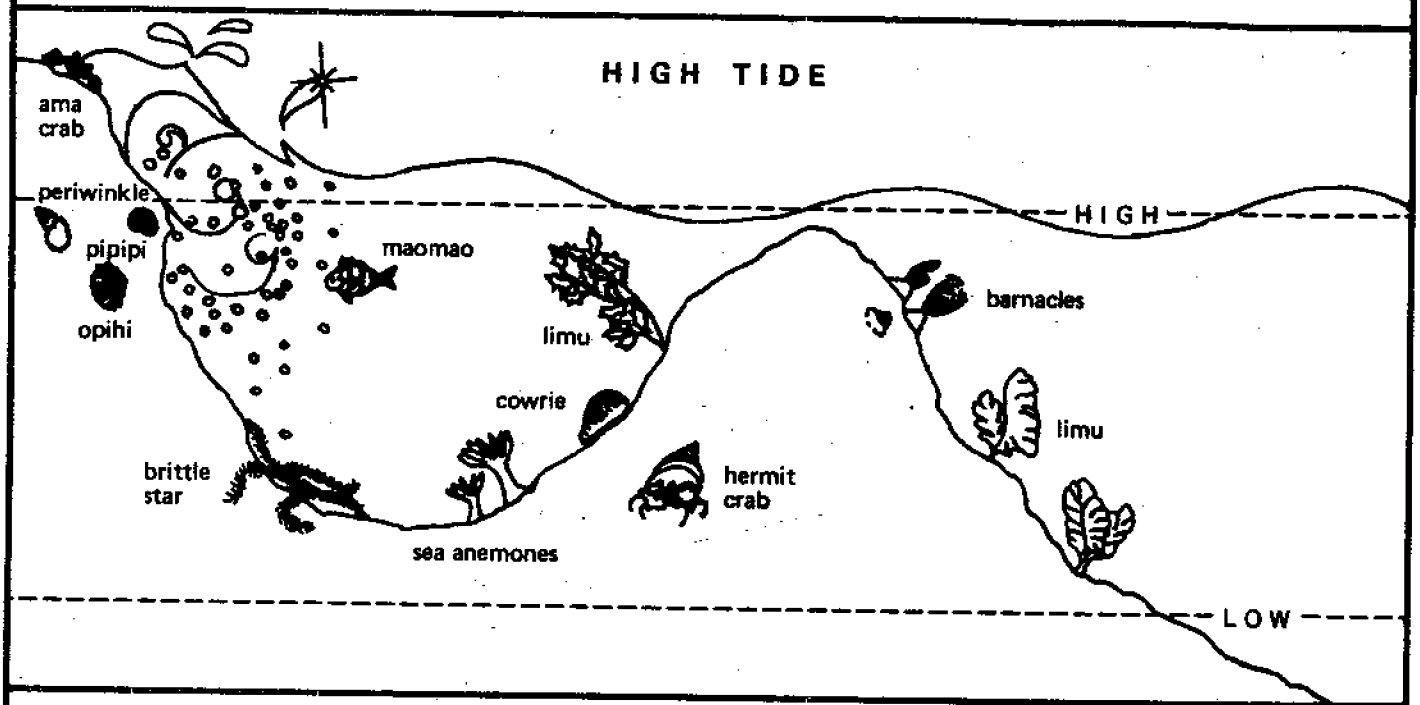


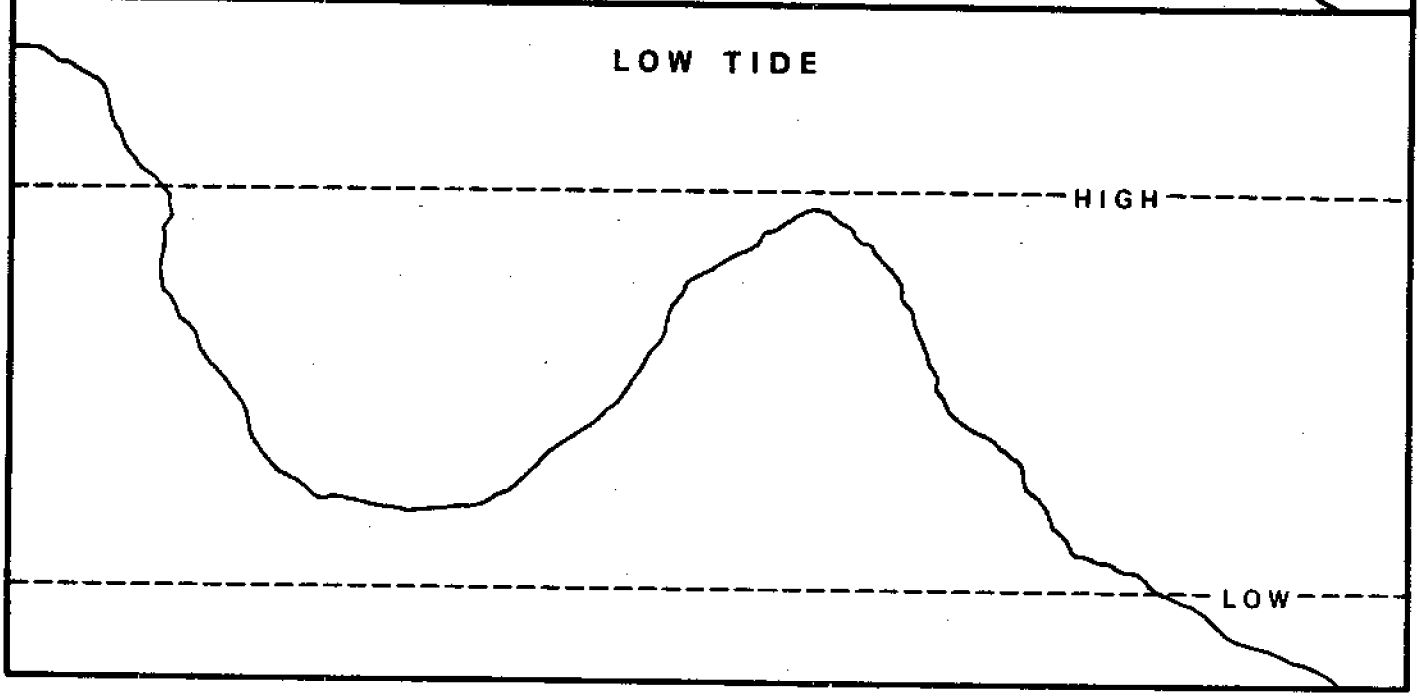
When done, algae presses are works of art! Soon they may turn into occasion cards, stationary etc. It's fantastic. There are tremendous uses of limu and you thought it was just dumb things clinging to rocks?!!!!

22 Ups and Downs of Tide Pool Life

Below is a diagram of a tide pool during **high tide**. The tidal pool animals are busy eating, moving about, and enjoying the cool, fresh sea water that is bringing in food and oxygen into the pool.

At **low tide** the tidal pool zone looks like a different place. Draw in, what it would be like in this tide pool at low tide.





Sea Animals of Hawaii — a word search

A H O L E H O L E H U Y I
H K M O A N A E L A N I H
I X A W E O W E O I I S I
R M E P K I O M H O N O P
L E L C A W A A W A I E O
A H U K L K M F V A N A W
W E K E A I A L A H A K P
A P A I H C A P N E M T A
K I B A K U M U O I O G P
A P M P H K A L I K A L I
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AKULE
AMAAMA
AWAAWA
AWEOWEO
EHU
HALALU
HINALEA
HUMUHUMU
KAHALA
KALA
KALIKALI
KAWAKAWA
KIHIKIHI
KUMU
MAHIMAHI
MANINI
MENPACHI
MOANA
MOI
NABETA
OIO
OMAKA
ONO
OPAKAPAKA
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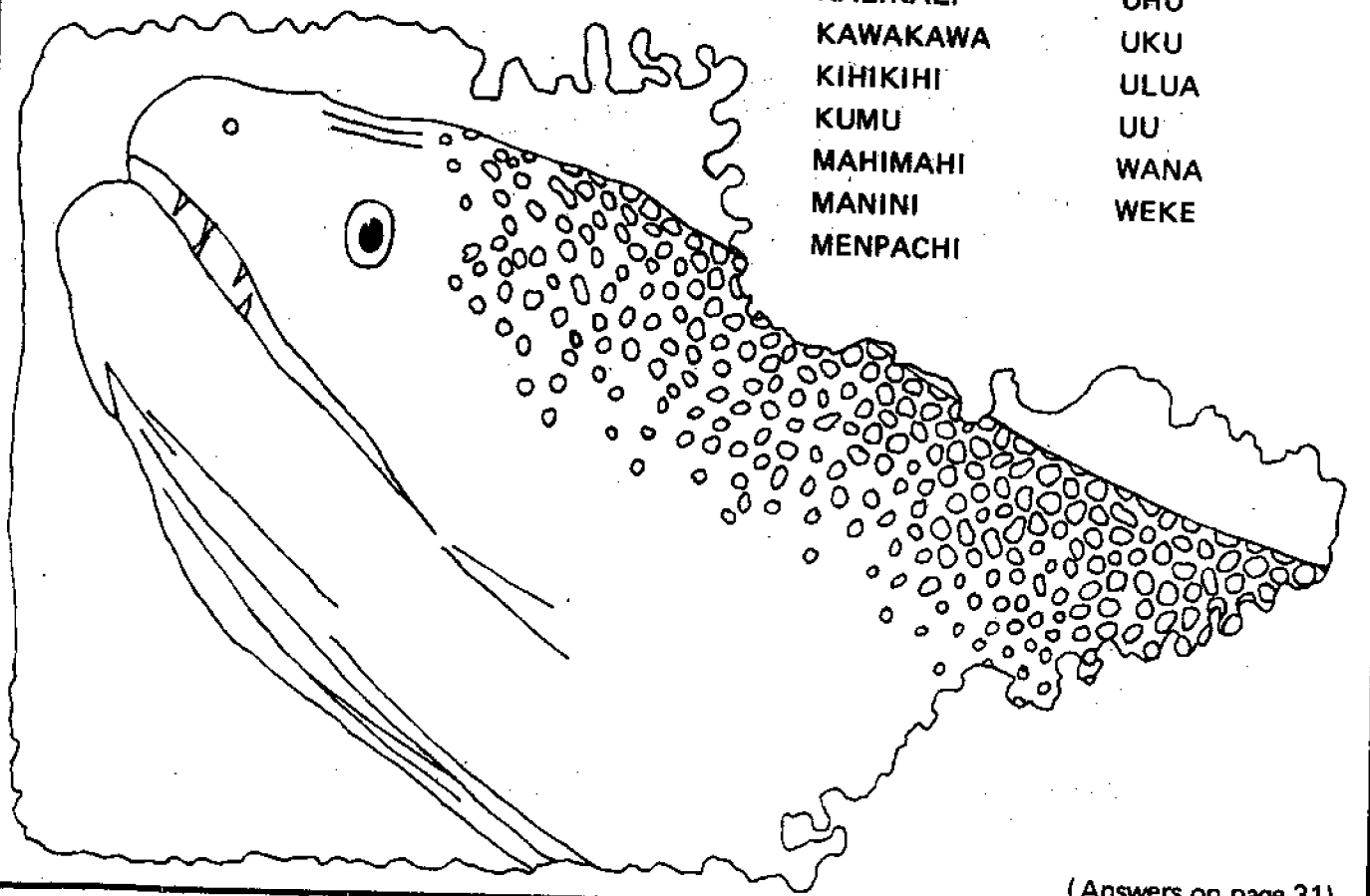
UKU
ULUA
UU
WANA
WEKE



(Answers on page 31)

24 Tuna as a World Resource

Did you know that the well-known Hawaiian tuna, aku or skipjack, is not the only variety of tuna?

The family name of tunas is *Thunnus*. The most common tunas in the Pacific Ocean are: albacores, big-eyes, yellowfin, bluefin, and skipjack. The Hawaiian name for the first four species is ahi. Tunas vary in size from 100 cm (aku) to 300 cm (bluefin).

CHARACTERISTICS OF THE DIFFERENT TUNAS

Albacore (*Thunnus alalunga*). Albacores are found at depths of about 150 m in abundance in the Northern and Southern Pacific, Indian, and Northern and Southern Atlantic Oceans, and the Mediterranean Sea. They are also found in lesser numbers near the equator.

Big-eye (*Thunnus obesus*). These medium-sized fish, about 180 cm in length, are found in cool temperatures at about 100-m depths. They are found in the temperate and tropical regions of the Pacific, Atlantic, and Indian Oceans. Big-eyes are most often found in the currents bordering the subtropical counter current and the tropical cold current.

Yellowfin (*Thunnus albacares*). Weighing nearly 500 kg, bluefins are about 300 cm long and are found close to the surface of the ocean. They are found in the temperate zones of the Northern Hemisphere to the sub-Arctic in the Pacific and the Atlantic Oceans. They are also found in the Mediterranean and Black Seas, and on both the eastern and western waters off Japan.

Skipjack (*Katsuwonus pelamis*). This heavily fished tuna is the only one of the five species that is not being fished to the limit of the fishery. They are surface fish.

Skipjacks are found in abundance in the Pacific Ocean off Japan and in the Trust Territory; lower California, Mexico, and the upper regions of South America; off the coast of Africa in the Atlantic Ocean, and around the Hawaiian Islands.

FISHING METHODS

Fishing methods are related to the depth at which fish are usually found and the behavior of the fish.

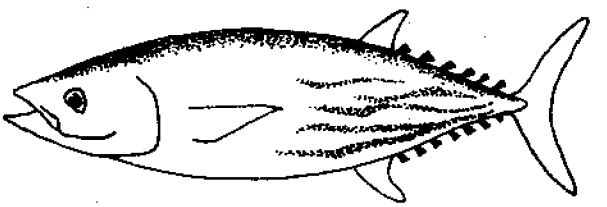
Albacore are caught by longline and pole and line.

Big-eye are caught by longline fishery.

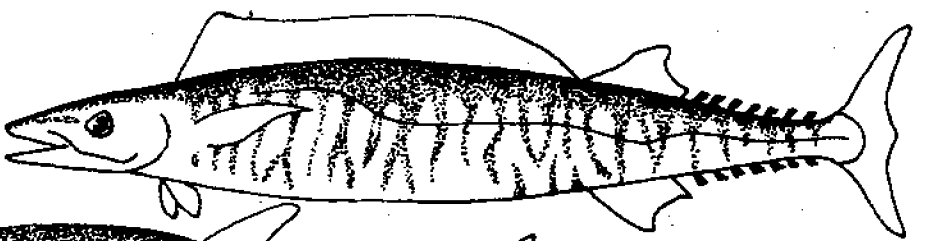
Yellowfin and bluefin are caught by pole and line and purse seine in shallow depths and longline in median depths.

Skipjacks are caught by pole and line in Hawaii and the Trust Territory and purse seine in California.

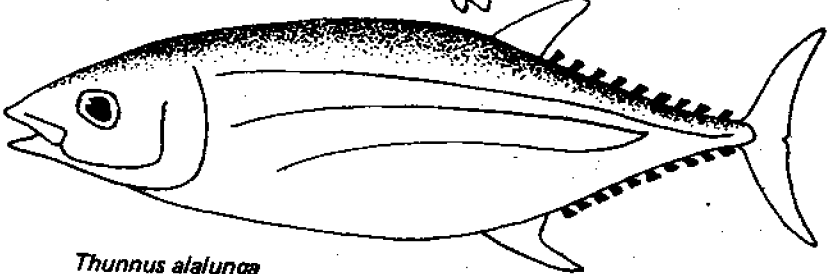
Common Varieties of Tuna



Katsuwonus pelamis
SKIPJACK (AKU)

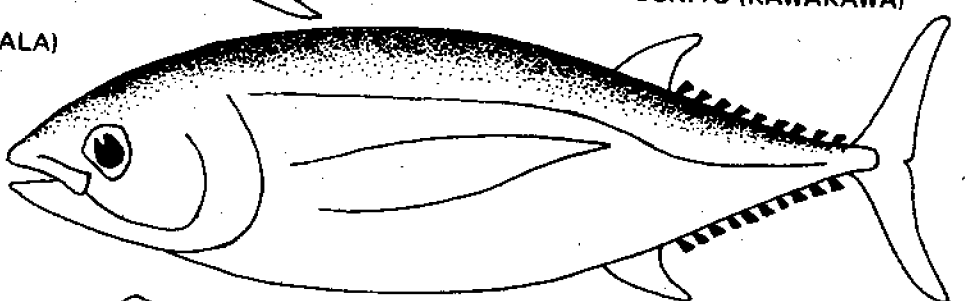


Acanthocybium solandri
WAHOO (ONO)

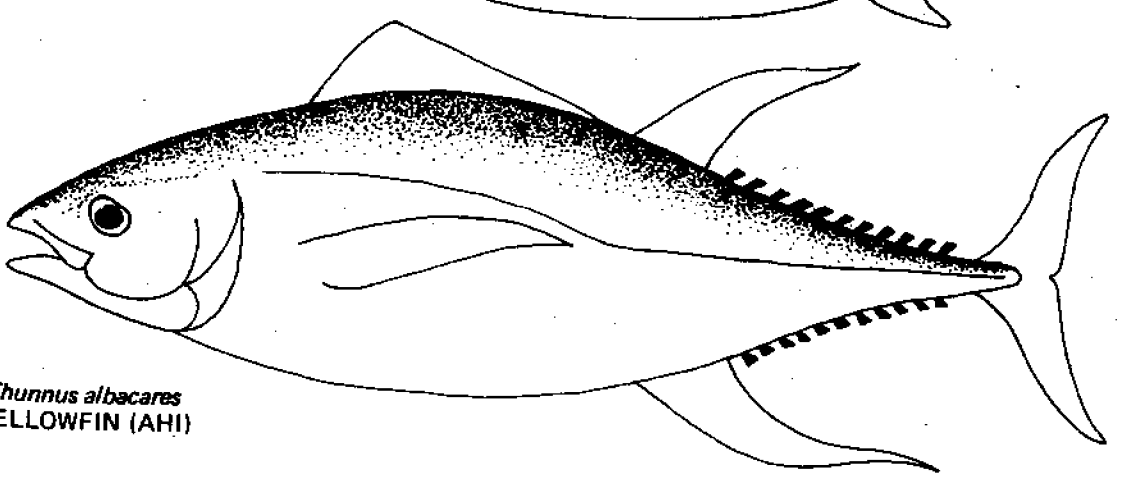


Thunnus alalunga
ALBACORE (AHIPAHALA)

Euthynnus yaito
BONITO (KAWAKAWA)



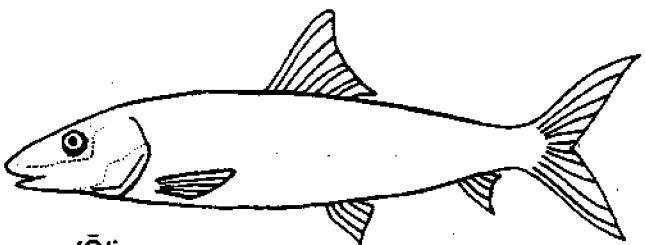
Thunnus obesus
BIGEYE (PO'O-NUI)



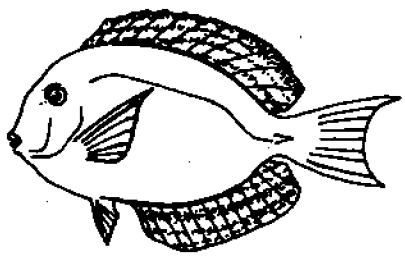
Thunnus albacares
YELLOWFIN (AHI)

26

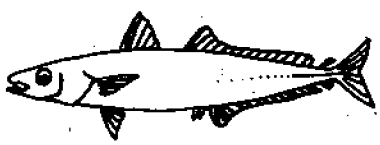
Common Hawaiian Food Fish



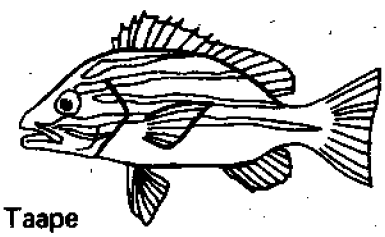
'Ō'io



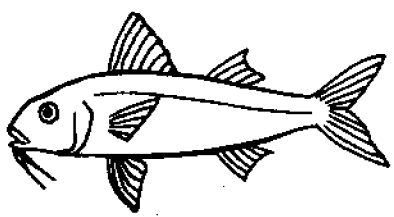
Pūalu



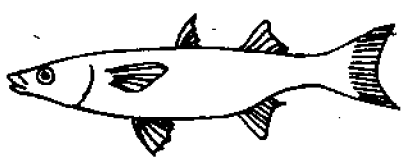
'Ōpelu



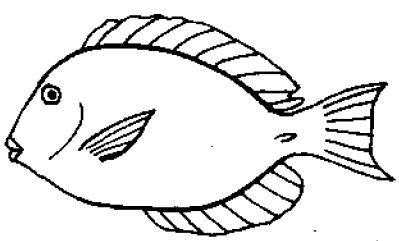
Taape



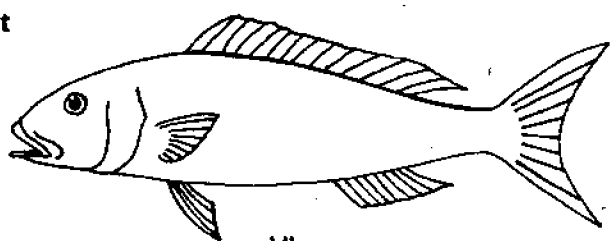
Weke



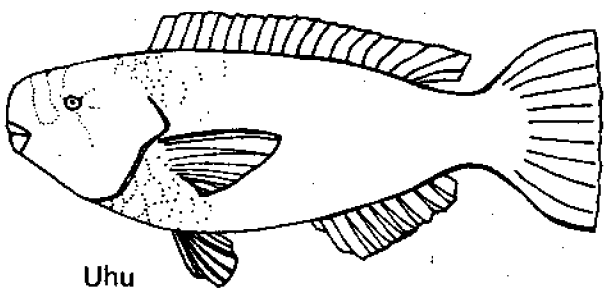
Mullet



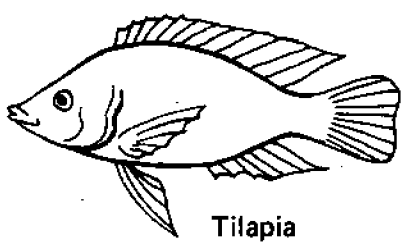
Palani



Uku



Uhu



Tilapia

Common Name	Size at Market (lb)	Approximate Cost April 1982 ($/lb)	General Characteristics	How to Prepare
Uu (menpachi malau)	1/4	3.05 (whole)	Red fish; firm, flakey, white flesh; distinctive flavor	Fry, broil, steam, soup, poach
Anae (mullet, bora, paltat)	1-1/2	1.89 (whole)	Silver fish; soft, moist, white flesh; often airflown from New Zealand and elsewhere	Fry, broil, steam, bake, poach
Oio (bonefish)	1-2	.99 (whole)	Silver fish; soft, moist, white flesh; fine texture; many bones	Soup, raw, fishcake
Uhu (parrotfish)	2-3	.99 (whole)	Colorful fish; moist, white flesh; variable texture (usually soft); distinct flavor	Broil, bake
Opelu (mackeral scad)	3/4	2.50 (whole)	Silver fish; firm, white flesh; somewhat oily	Fry, broil, raw, dry, pickle
Palani (surgeonfish)	1-2	.95 (whole)	Blue-grey fish; tender, moist, white flesh; mild flavor; tough skin	Fry, broil, barbeque, poki
Pualu (surgeonfish)	1-2	.95 (whole)	Grey fish; moist, white flesh; distinct flavor; tough skin	Fry, broil, barbeque
Taape (savani, blue-lined snapper, perch)	1/4	.70 (whole)	Yellow fish; tender, moist, white flesh	Fry, broil, steam, poach
Red weke (goatfish)	1/2-3/4	1.20 (whole)	Red fish; firm, flakey, dry, white flesh; mild flavor	Fry, steam, soup, dry, pickle
Tilapia				
Wild	1/2	.89 (whole)	If ocean caught—light, moist, white flesh	Fry, broil, steam, soup
Aquaculture	1/2	1.65 (whole)	Light, moist, white flesh	Fry, broil, steam, soup
Shark	Variable size steaks	2.00 (fillets)	Firm, white flesh; tough skin	Fry, broil, steam, bake, dry
Uku (grey snapper)	2-4	2.25 (whole)	Blue-grey fish; firm, moist, somewhat oily, white flesh	Fry, broil, steam, soup, bake, poach, sashimi

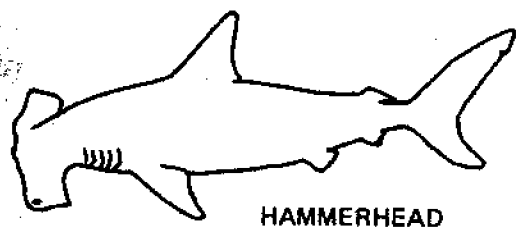
28 Sharks Teeth—Matching

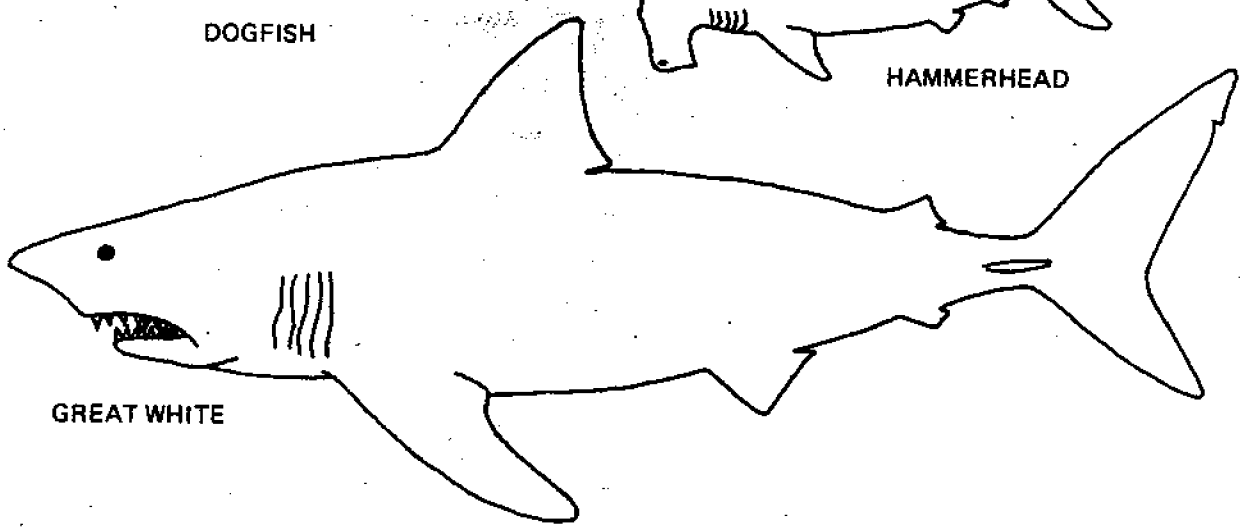
1 _____

2 _____

3 _____

4 _____





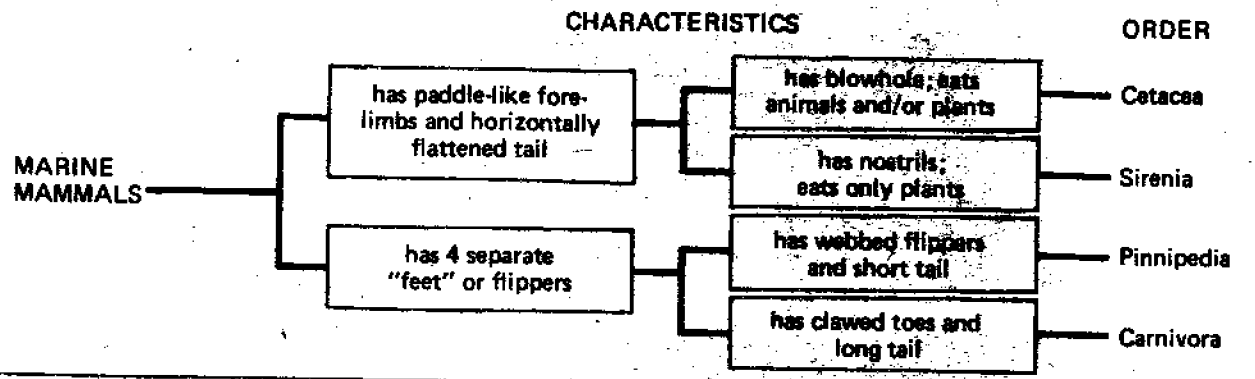
(Answers on page 31)

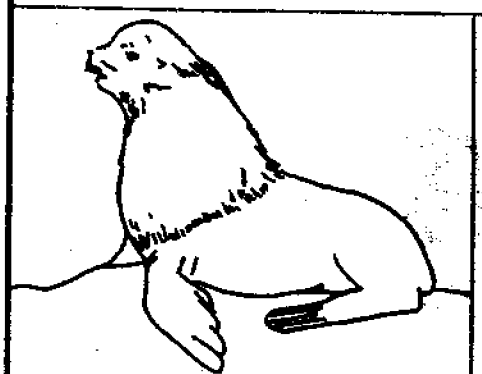
Marine Mammals

Mammals are divided into 20 different **orders**, or groups, according to how they are alike. For example, human beings and apes belong to the **primate order** and horses and zebras are placed in the **perissodactyla order.**

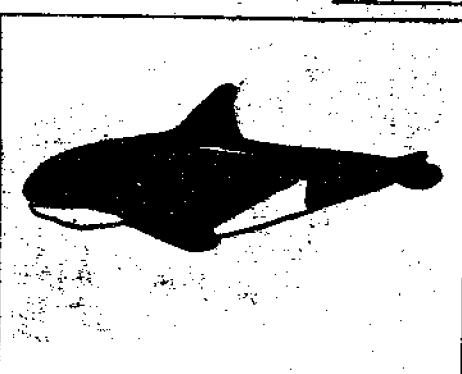
Marine mammals are classified into four **orders**: a) **cetacea**, b) **sirenia**, c) **pinnipedia**, and d) **carnivora.**

DIRECTIONS: Look carefully at the drawing of the marine mammals below. Using the following chart place each into the correct **order** and write the name of the **order** in the blank below each animal. (Answers on page 31)

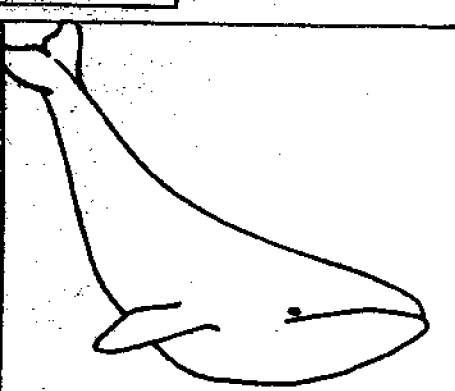




1_____



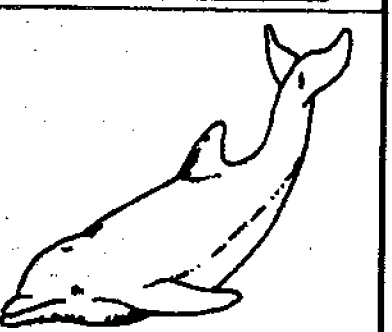
2_____



3_____

4_____

5_____



6_____

30 Gyotaku — Japanese fish printing

The techniques of Japanese fish printing has been used in Japan for over 100 years to record catches of sports fish and to gain ichthyological (fish biology) information. These prints have been used at the University of Washington to study how the physiology of a fish is related to its surface area.

The art of gyotaku (pronounced ghio-ta-koo) is a good way to gain an understanding and appreciation of the beauty and great variety of marine organisms. You can also use this technique for making prints of shells, rocks, flowers, and other items.

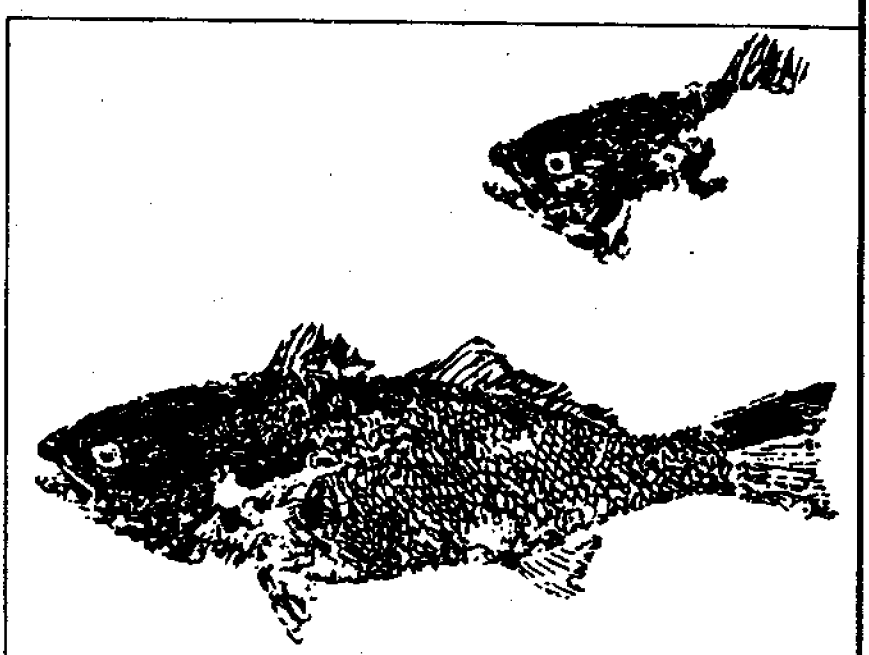
Before you make a print, identify the fish. What are the distinguishing characteristics of the fish? Study the life history of the fish. Where and how was it caught?

Materials

Obtain a very fresh fish. If you buy the fish at a market, select one that has bright red gills, clear eyes, and a fresh smell. If the fish has been gutted, make sure that it has not been cut anywhere else on the body.

You also need:

*newspaper
*plastic molding clay
*pins
*water base ink (linoleum block ink is best)
*a stiff 1/2-inch brush
*a very small brush
*rice paper, newsprint, or other moisture tolerant paper. Since rice paper is expensive, you might prefer to start with newsprint.



Method

1. Use soap and water to clean the outside of the fish as completely as possible. The cleaner the fish, the better the print. Dry the fish well.
2. Place the fish on a table covered with newspapers. Spread the fins out over some clay and pin them in this position. Continue to dry the fish.
3. Brush on a thin, even coat of ink. Leave the eye blank unless you prefer to fill it in.
4. Place a piece of newspaper or rice paper over the top of the fish.
5. Carefully lay the paper over the entire fish. Use your fingers to gently press the paper over the surface area of the fish. Be careful not to move the paper too much since this results in double prints. Then remove the paper and you have a fish print.
6. Use a small brush to paint the eye.

Cheat Sheet

p. 3

1. New Zealand
2. Cook
3. Friendly
4. Tahiti
5. Christmas
6. Kauai
7. New Albion
8. Vancouver
9. Cook Inlet
10. Bering
11. Alaska
12. Arctic Ice
13. Siberia
14. Hawaii

p. 4

750 = G
1778 = B
1820 = F
1846 = D
1878 = H
1925 = A
1941 = E
1975 = C

p. 8

1. B
2. B
3. B
4. B
5. B
6. B

p. 14

1. c
2. d
3. b
4. a

p. 15

1. Tako
2. Opihi
3. Taega
4. Bagoong
5. Limu
6. Poki

p. 18

4

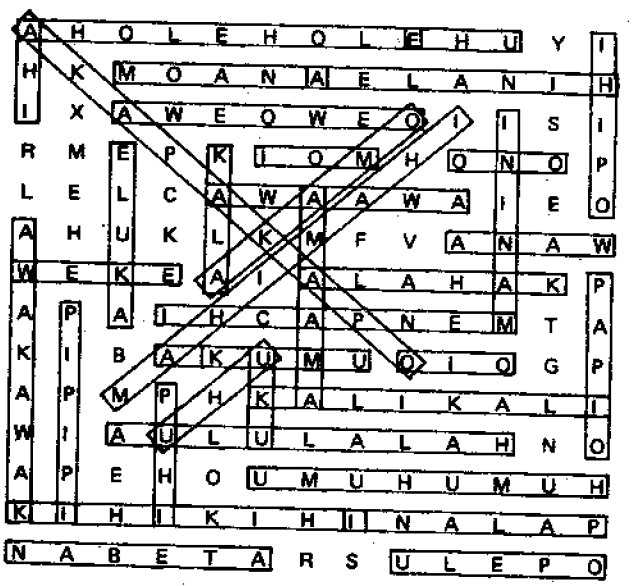
2

1

3

5

p. 23



p. 28

1. Great White
2. Hammerhead
3. Tiger
4. Dogfish

p. 29

1. Pinnipedia
2. Cetacea
3. Cetacea
4. Carnivora
5. Sirenia
6. Cetacea

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