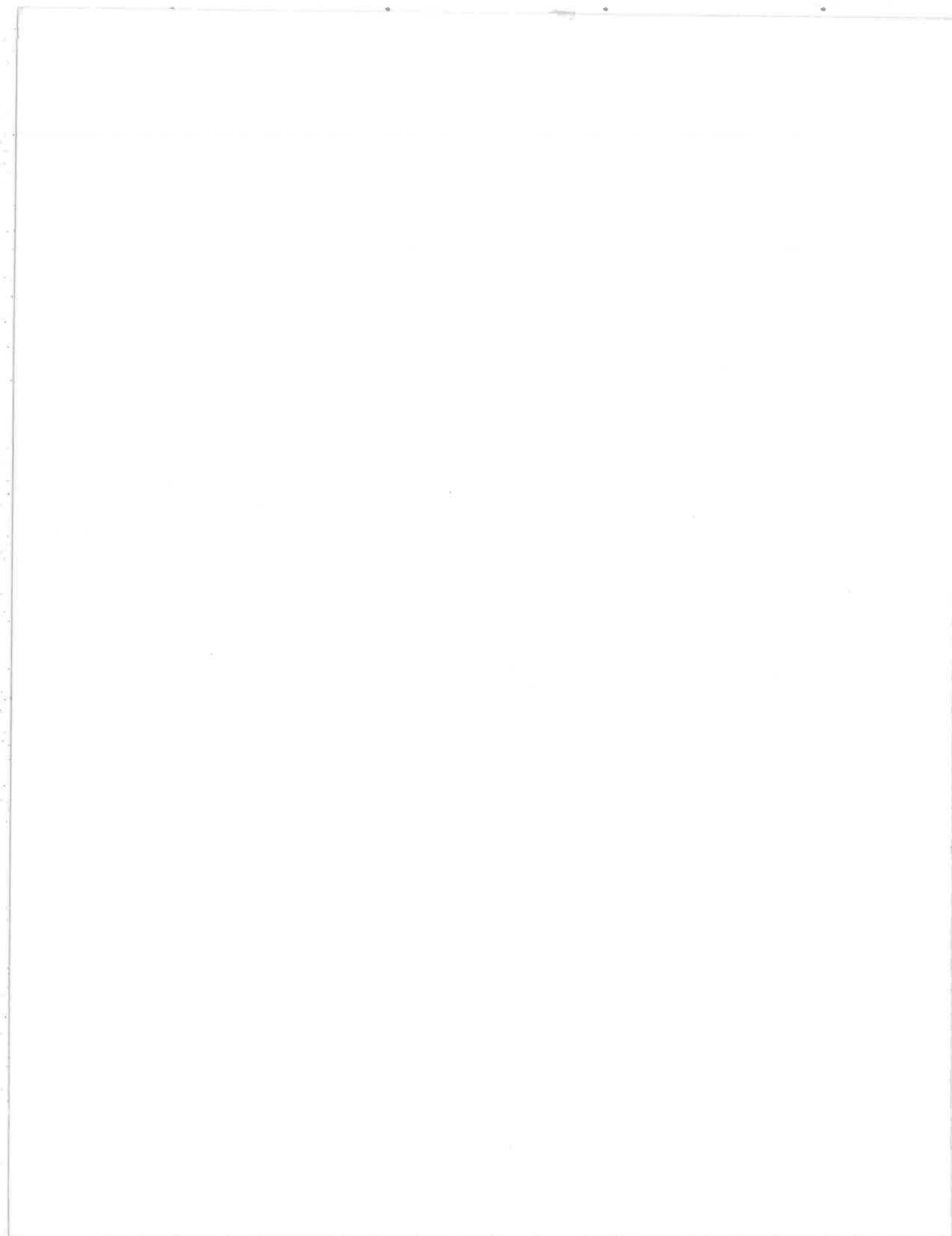


4-H MARINE SCIENCE Leaders' Manual



Cooperative Extension **University of California**
Division of Agriculture and Natural Resources

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4-H MARINE SCIENCE Leaders' Manual

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At the end of this publication there is a list of additional publications that will provide more in-depth information on marine resources. Other marine resources information will be developed, so check with your local 4-H Youth Advisor or Marine Advisor about new and useful materials.

PERFORMANCE OBJECTIVES

Each 4-H member will complete at least 8 of the 11 following objectives:

1. Put together a beach safety kit and list seven beach safety tips.
2. Explain to others basic concepts of oceanography such as tides and waves.
3. Identify the most common seashore plants and animals.
4. Name at least 10 food products from the sea.
5. Prepare a low cost seafood dish.
6. Describe one important local commercial fishery.
7. Rig and use recreational fishing equipment.
8. Do at least one type of marine-oriented art or craft.
9. Identify and discuss at least one marine policy issue.
10. Name at least five marine careers and the qualifications for these careers.
11. Name and describe to others one presently exploited ocean energy resource and one potential ocean energy resource.

CONTENTS

Introduction: Why Study the Marine Environment?.....	5
How to Use the Leaders' Manual.	5
Resources Available to 4-H Marine Resources Leaders.	6
Beginning Unit	
Introduction and Beach Safety.	7
Oceanography: tides and food chains.	9
Marine Biology: tidepools.	11
Marine Biology: tidepool field trip.	12
Food from the Sea: squid and product treasure hunt.	12
Fisheries: Armstrong reel and surf fishing.	13
Ocean Arts and Humanities: beach arts.	17
Marine Politics: environmental policy.	18
Marine Public Service: habitat improvement and public education.	19
Career Exploration.	19
Intermediate Unit	
Introduction and Safety: boating safety.	19
Oceanography: plankton, currents, and beaches.	20
Marine Biology: algae.	21
Marine Biology: birds.	21
Food from the Sea: algae and shellfish.	22
Fisheries: crabbing, commercial fishing, and aquaculture.	23
Ocean Arts and Humanities: fish printing and mass media information.	23
People and the Marine Environment: Native Americans and maritime history.	24
Marine Public Service: public education.	25
Career Exploration.	25
Advanced Unit	
Introduction and Safety: hypothermia and first aid.	26
Oceanography: drift bottles and food chains.	27
Marine Biology: intertidal zonation and marine research.	29
Marine Biology: marine mammals.	30
Food from the Sea: seafood safety and seafood processing.	31
Fisheries: poke pole fishing and commercial fishing methods.	32
Ocean Arts and Humanities:	
algae pressing, Native Americans and environmental policy.	33
Marine Resources Management: conflicts and marine research.	34
Marine Public Service: habitat restoration.	35
Career Exploration.	36
Other Activities	
Sailing.	37
Boat Building.	37
Scuba.	38
Ocean Energy.	38
Appendix: Sea Grant Activities and Information.	39
Selected References.	61
Audio-visual Materials.	64
UC Cooperative Extension Sea Grant Marine Advisory Program Leaflets.	66
4-H Publication Evaluation Sheet.	67

DON'T Join the **Bucket Brigade**



LEAVE TIDE POOL LIFE ALONE!

California law extends protection to all animal forms. Enjoy your heritage; don't destroy it by taking more than the law allows. Consult current sport fishing regulations.

4-H MARINE SCIENCE Leaders' Manual

INTRODUCTION: WHY STUDY THE MARINE ENVIRONMENT?

People are intimately tied to the marine environment. Approximately 80 percent of California's residents live in coastal counties, and many of them make their livelihood in such occupations as marine recreation, commercial fisheries, ocean-related energy development, shipping, and the marine sciences. Further, all Californians rely on the sea as a source of food—directly from fish and shellfish, and indirectly as a source of high protein feed for meats such as poultry. The ocean also strongly influences climate by supplying cooling breezes and fog during summer months, by generating storms, and by moderating winter temperatures. California's large agricultural and tourism industries benefit greatly from the moderating effects of the Pacific Ocean. Millions of Californians utilize the coast for recreation. California is truly a marine-oriented state, and it is important that our citizens increase their knowledge about the marine environment.

The purpose of the 4-H Marine Resources Project is to promote wise management of marine resources by increasing California youths' awareness of the marine environment. This Leaders' Manual provides three units, each with ten activities designed to fulfill performance objectives. With increased knowledge about the marine environment, today's youth will be able to make wiser decisions about marine issues.

HOW TO USE THE LEADERS' MANUAL

The manual is divided into Beginning, Intermediate, and Advanced units. Each unit has activities for ten 4-H sessions (approximately 1 year of 4-H meetings). The resources available for each activity (publications, slide sets, etc.) are listed at the end of the manual. In some subject matter areas where available resources don't exist, additional teaching ideas are supplied to assist the leader.

Because of the great variation in the ages, interests, and needs of 4-H youth groups, this project is designed to be very flexible. Often, more than one activity is suggested for each session. Choose the activities your group prefers, and don't feel restricted to the basic outline of the workbook. If the interests and capabilities of your 4-H group are varied, you can select activities from any of the three units or put together new learning activities that meet your needs and utilize local resources. Several of the activities discussed in this manual were developed by creative 4-H marine science groups. Many of the activities can be adapted to the freshwater environment and resources available to inland counties.

Often, marine education is dominated by sciences such as biology, geology, and oceanography. We feel that people's relationship to the sea is important. Many of the activities in this manual highlight the importance of the marine environment in the arts, literature, Native American culture, and environmental policy making. It is important to provide a marine element in many aspects of youth education.

RESOURCES AVAILABLE TO 4-H MARINE RESOURCES LEADERS

The Sea Grant College Marine Advisory Program, a part of UC Cooperative Extension, has developed numerous publications and audio-visual aids that are utilized in the 4-H Marine Resources Project. These materials are available through your 4-H Youth Advisor in your county's Cooperative Extension (Farm Advisor's) Office. All the publications and audio-visual materials used in this manual's activities are available through your County Cooperative Extension Office unless otherwise noted.

Cooperative Extension's Marine Advisors and Marine Specialists are another valuable resource. The Marine Advisors are located in coastal counties, and three Specialists are located on the UC Davis Campus. These people can supply information on local marine education resources, and they can help your group get started.

There are numerous other sources of good marine information and activities. The California Department of Fish and Game has a Conservation Education Program that includes materials on marine topics. A few individuals might give talks or help arrange activities. Offices are located in Bishop, Blythe, Eureka, Fresno, Long Beach, Menlo Park, Monterey, Morro Bay, Rancho Cordova, Redding, Sacramento, San Diego, Stockton, and Yountville. A list of Department of Fish and Game publications is available from the Office of Procurement, Publication Section, General Services, P.O. Box 1015, North Highlands, CA 95660.

There are numerous other potential sources of marine materials, activities, and expertise that could help you develop your local 4-H Marine Resources Project. Some of these are listed below.

1. The National Marine Fisheries Service has offices in La Jolla, Terminal Island, and Tiburon. They are good sources of fisheries information.
2. Universities and colleges have staff and students interested in marine subjects. Some campuses with particularly active public marine education programs are: University of California at San Diego (Scripps Institution of Oceanography), Santa Barbara (Marine Science Institute), and Santa Cruz (Long Marine Lab); Humboldt State (Fred Telonicher Marine Laboratory), Moss Landing Marine Laboratories, College of Marin, UC Bodega Bay Marine Laboratory, and Long Beach State (Southern California Ocean Studies Consortium).
3. County, state, and national parks in coastal areas often have educational materials, facilities, and programs.
4. Other governmental agencies such as the U.S. Fish and Wildlife Service, Army Corps of Engineers, State Department of Boating and Waterways, and the Bureau of Land Management have available environmental education materials and programs.
5. Environmental organizations such as the Oceanic Society are a good resource.
6. Many school districts have marine education programs. Schools in San Diego, Orange, Los Angeles, Alameda, Contra Costa, Sacramento, and Marin counties are especially active.
7. Members of local sportsfishing, scuba, and yacht clubs can be helpful.

8. Representatives of local marine industries can supply insight into their industries and the career outlook. Some examples include commercial fishing, seafood processing, boatyards, marinas, environmental consulting firms, and oil companies.
9. The National Marine Education Association is a good source of ideas and contacts through its journal, "Currents." Information on the Association is available from N.M.E.A., P.O. Box 666, Narragansett, RI 02882.
10. An "Inventory of Non-Technical Marine Resources, Publications, and Audio-Visual Materials" is available from Sea Grant Communications, 418 Administrative Services Building, Oregon State University, Corvallis, OR 97331. Ask for PASGAP Publication No. 5.

BEGINNING UNIT

Session I—Introduction and Beach Safety

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Name seven beach safety tips.
 - b. List four items in a beach safety kit.
 - c. Name four dangerous marine animals and explain why they may be dangerous.
- A. This is the introductory meeting. Help everyone get to know each other. Discuss what you would like to accomplish during the year. Have the group set goals for the year.
- B. Discuss beach safety. Several of the group's activities will be at the seashore and building good beach safety habits will carry over into future years. The seashore is an interesting but potentially dangerous place. Care and planning can lessen the danger.

Beach Safety Tips

1. Use a "buddy system" so that all participants will operate in pairs. It is advisable to have several adults along as helpers for each group of 4-H members on the beach.
2. When near the surf, don't allow anyone to turn their back to the ocean—a large breaker could sweep you off your feet. If swept off your feet, grab and hold onto the nearest rock if possible. If swept out to sea, don't fight against the current; drift or swim with or across the current until help arrives.
3. Keep a life ring (or inner tube) and a 40-foot rope in a handy spot on the beach and mark it with a red flag.

4. For tidepool trips, check the tide book for the times and heights of the tides. Stay aware of the time and tide level so you won't be trapped on the outer part of a reef.
5. Don't allow anyone to run or jump on algae-covered rocks. They are extremely slippery.
6. On trips to rocky areas, don't wear shorts or bathing suits because there are many sharp edges on rocks and many abrasive organisms such as barnacles. Be sure to wear rubber-soled shoes or boots because the rocks are wet and slippery.
7. Take along a first-aid kit.
8. Dress warmly, especially in northern California, because our coastal waters and climate can be quite cool. Subnormally low body temperature (hypothermia) reduces alertness and increases the probability of an accident.
9. Protect your skin from excessive exposure to sun and wind.
10. Know how to spot and avoid rip currents, especially if you plan to be in the water. Ninety percent (90%) of all lifeguard rescues are made of people caught in rip currents. Rip currents tend to be near jetties, piers, coves, and rock groins. Rip currents often have brown, murky waters that are choppy and foam-covered. Look at people and objects in the water; if they are floating out to sea, they are probably in a rip current.

If you get caught in a rip current, don't panic and don't fight the current. Determine which way the long shore current is moving and swim in a 45-degree angle toward shore, swimming with the long shore current. Another way out of a rip current is to swim in at a 90-degree angle to the current until you are out of the rip; then swim toward shore. If you can't get out of the rip current, yell and look for help.

- C. Put together a beach safety kit for future field trips. Some items to include are: a first-aid kit, life-rings or inner tube, a 40-foot rope, drinking water, and waterproof matches. You may want to add other items, such as warm clothes and blankets, depending on the nature of your trip.
- D. Discuss dangerous marine animals, such as jellyfish, using the following reference: Halstead, B.W. 1970. *Poisonous and Venomous Marine Animals of the World*. U.S. Government Printing Office, Washington, D.C. (available at many libraries).

Session II—Oceanography

- I. **Performance objectives.** After completing this session's activities 4-H members will be able to:
- Answer correctly all seven tide table questions.
 - Give two examples of marine food chains.
- A. Teach the group how to understand and use tide tables. Tide tables are usually available through local marine businesses such as sporting goods stores, bait shops, and boating equipment dealers for free or a minimal charge. Newspapers often print tide tables.

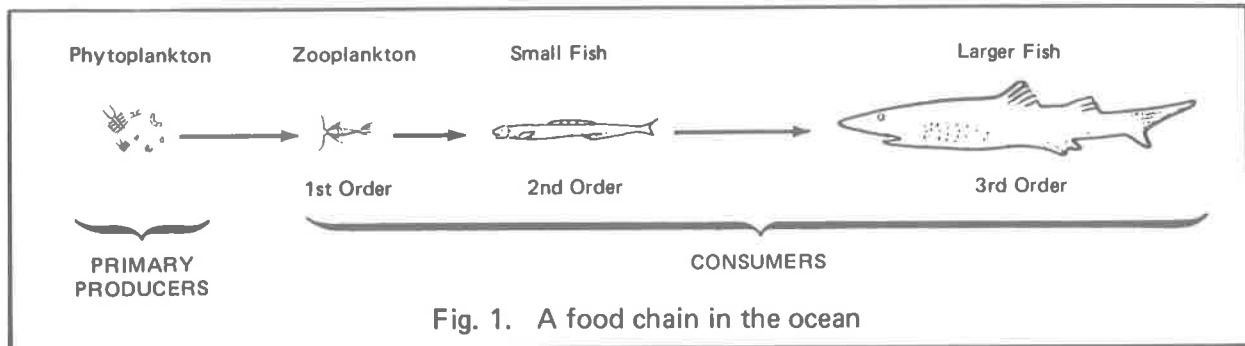


Fig. 1. A food chain in the ocean

Knowledge of tides is essential to people who make a living or enjoy recreation at the coast. For example, ability to use a tide table is necessary to determine the best fishing or clamming tides or to plan a boating trip to take advantage of the tidal current.

California has mixed tides, which means that there are two high and two low tides of unequal heights. Tide tables will show the time (0000 = midnight, 1200 = noon) and height of the tide.

Most tide tables have appendices that give the differences in times and heights of high and low water at various locations along the coast. Some tide tables also include tidal current tables which give time and flow rate of incoming and outgoing tides as well as the time of slack current. Tidal current information is especially useful to boaters.

For a more complete explanation of tides, consult one of the textbooks listed under Oceanography at the end of this publication. Another good reference is "Understanding Tides" (SG 25). It is available from Sea Grant Communications, 418 Administrative Services Building, Oregon State University, Corvallis, OR 97331.

The following tide table quiz can be used to test and enhance the 4-H members' ability to use tide tables.

Tide Table Quiz

- What are mixed tides? How many high and low tides are there per day on the California Coast?
- How is 3:20 a.m. written in the tide table? 7:30 p.m.?
- Which is the lower tide: 1.1 or -1.1?

4. Find what the tides are on your birthday.
 5. Find a good day for a tidepool field trip. Why is it good?
 6. Why are tides important to boaters?
 7. List the time and tide level for all four tides today.
- B. Another activity for the group is to place a pole or mark on an existing structure in the intertidal zone and watch the water rise and fall throughout the tidal cycle. Compare the observed difference between low water and high water with the difference listed in the tide table. If you can't get to the seashore, graph the tides out of the tide tables for a week on graph paper. Notice how the times of high and low water change each day.
- C. A third oceanography activity is to utilize UC Cooperative Extension Leaflet 2255, "Biological Oceanography," to discuss ocean food webs and the transfer of energy from primary producers (phytoplankton) to higher order consumers (zooplankton and fish)* To illustrate the interdependence of the organisms involved, play the food chain game described below. Predator-prey relationships are often more complex and dynamic than illustrated by this game.
- D. Play the "food chain game." (Adapted from: Bagnall, N. 1980. *Children's Literature and the Sea*. Texas A&M Sea Grant College Program [TAMU-SG-80-401].)

Materials:

- Cloth streamers, about 2" × 18" in three different colors.
- 24 to 30 plastic sandwich bags, and plastic produce bags.
- Dried beans or styrofoam packing material.
- Scoreboard and magic marker.

Leader's instructions:

1. This is an outdoor game to illustrate a food chain and to show how it can change.
2. Mark the sandwich bags with two strips of tape or magic marker at one-inch intervals from the bottom.
3. Mark the produce bags approximately two-thirds from the bottom.

Members' instructions:

1. Set the boundaries for the playing area and a 5-minute time limit.
2. Divide into three teams: anchovies, mackerel, and tunas (or a food chain of your choice). Tie a different colored streamer to the wrist or belt to identify team members.
3. Anchovies and mackerel have plastic sandwich bags to represent their stomachs. Tunas, which are larger, use plastic produce bags.
4. Spread the beans or styrofoam packing material, which represent plankton, around the area.

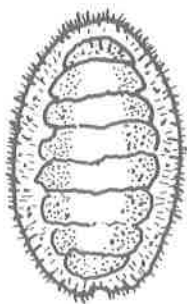
*All leaflets referred to are UC Cooperative Extension Leaflets unless otherwise identified.

5. Anchovy stomachs are filled when the beans or styrofoam reaches the first line on the sandwich bag. Mackerel stomachs are filled when the captured anchovy stomachs reach the second line on the bag. Tuna stomachs are filled when the captured mackerel stomachs reach the line on the produce bag.
6. Players tagged are out of the game.
7. One of each species must survive to maintain the food chain. Survivors are those left in the game at the end of the time limit whose stomachs (or bags) are filled to the line indicated. Record the number of survivors on the scoreboard.
8. After the first game, players can change one rule to see if they can balance the system so there will be survivors in each group.

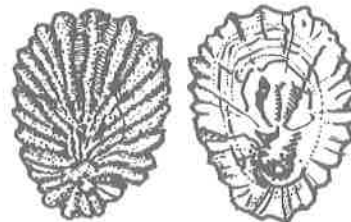
Session III—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Select a good tidepool field trip time by consulting a tide book.
 - b. Explain laws protecting tidepool organisms.
- A. Plan a tidepool field trip. Look for a convenient date with a low tide. Minus tides are best, but with any tide less than 1.0 feet there will be many interesting organisms to see. Select a rocky intertidal area by consulting local experts.

Chiton



Limpet

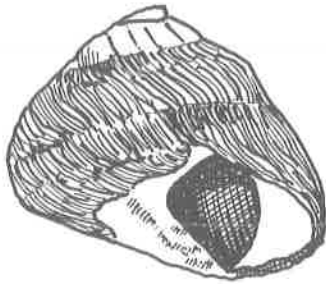


- B. Discuss field trip tips. These include reviewing and using beach safety tips and taking along equipment such as a hand lens, binoculars, tidepool identification books, notebook and pencil, a camera, and extra clothes and shoes.
- C. Using UC Cooperative Extension Leaflet 2246, "Ecology of the Intertidal Zone," and other references if desired, discuss tidepool ecology and conservation. Review the laws about protection of tidepool organisms in the Sportsfishing Regulations. Put emphasis on observing; California law prohibits collecting almost all tidepool organisms. California tidepool resources are limited and could be ruined by collecting and disturbing by the thousands of visitors each year.
- D. Show and discuss the slide-cassette tape set "Introduction to Intertidal Plants and Animals". It is available from Visual Media, University of California, Davis, CA 95616, (916) 752-0590. This slide-tape set will introduce the members to the common organisms they will encounter.

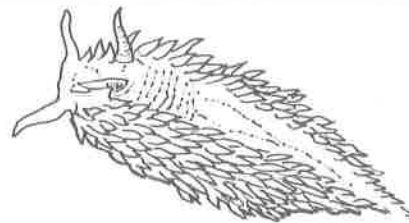
Session IV—Marine Biology

- I. **Performance objective.** After completing this session's activities the 4-H members will be able to:
 - a. Locate and identify five intertidal animals and three intertidal plants.
- A. Take the group on the tidepool field trip. Give members note paper to record notes about the organisms discovered. Don't collect organisms; enjoy observing them.

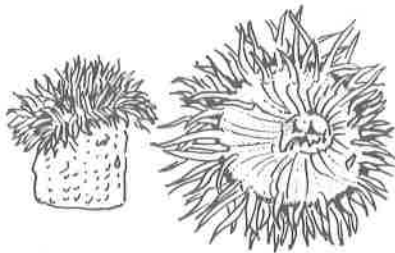
Turban Snail



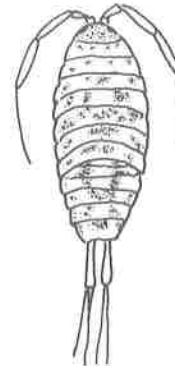
Nudibranch



Sea Anemone



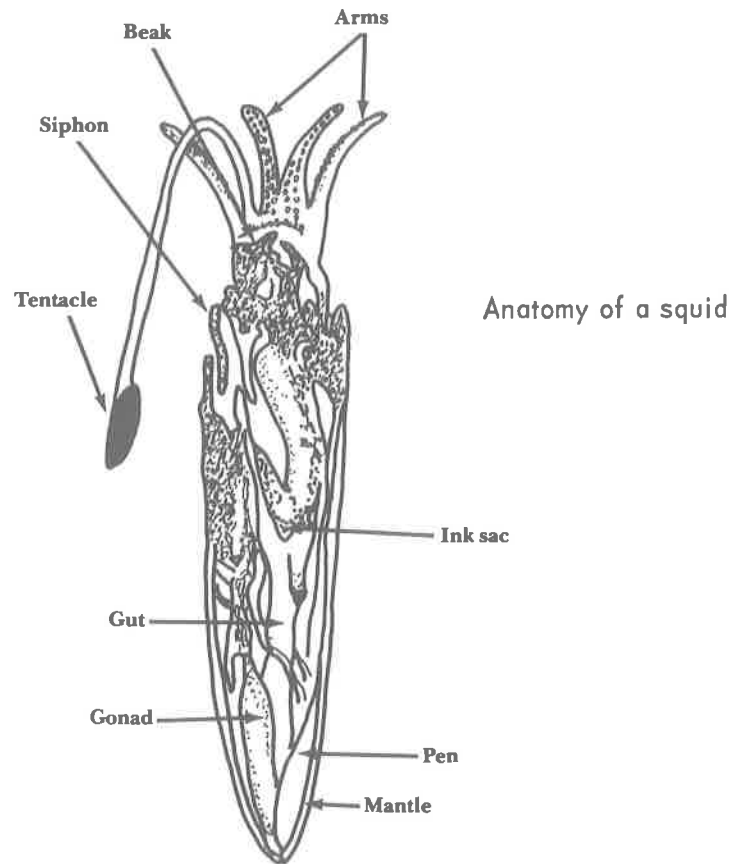
Rock Louse



Session V—Food from the Sea

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Clean and cook squid.
 - b. List 30 seafood products.

- A. Using UC Cooperative Extension Leaflet 21112, "Catching, Cleaning, and Cooking Squid," obtain and have the members prepare squid for eating. Squid is a good example of a tasty, economical, underutilized seafood. Squid is being used more and more as a substitute for scarce and expensive abalone.



- B. Take your members on a "Supermarket Seafood Treasure Hunt." The object of this activity is to make the members aware of the many different seafood products available. In an average supermarket, the members should find a minimum of 30 seafood products. Some of the areas to look are the meat counter, frozen food section, canned food, pet food, gourmet section, soups, and delicatessen. The members can either work together to compile a list or divide up into teams. Comparing prices of different products and discussing where and how these seafood products were caught would add depth to the activity.

Session VI—Fisheries

- I. **Performance objective.** After completing this session's activities the 4-H members will be able to:
- Construct, rig, and use simple fishing gear.
- A. Find out about and discuss fishing licenses and regulations. In California, everyone 16 years of age and older must possess a license when fishing except from public piers, jetties, and attached breakwaters. Booklets containing sportsfishing regula-

tions are available from anywhere fishing tackle and bait are sold. Review the regulations for fishing in your area and have a group discussion about the reasons for these regulations.

- B. Construct and use Armstrong fishing reels for a fishing trip. This is a low cost, easily-built device which can be made from recycled materials. It can be used from a pier, boat, or shore. An alternative, if you don't want to construct fishing gear, is purchasing simple, inexpensive droplines from a tackle shop.

Materials:

One size 10 tin can (often available from restaurants and food service businesses).

One board $\frac{3}{4}$ " \times $1\frac{1}{2}$ " \times 6".

Four galvanized shingle nails size 3d ($1\frac{1}{4}$ ").

100 feet or more of line 10- to 40-pound test dacron or braided nylon line, or size 9 nylon seine twine—use the heavier line if fishing in rocky areas.

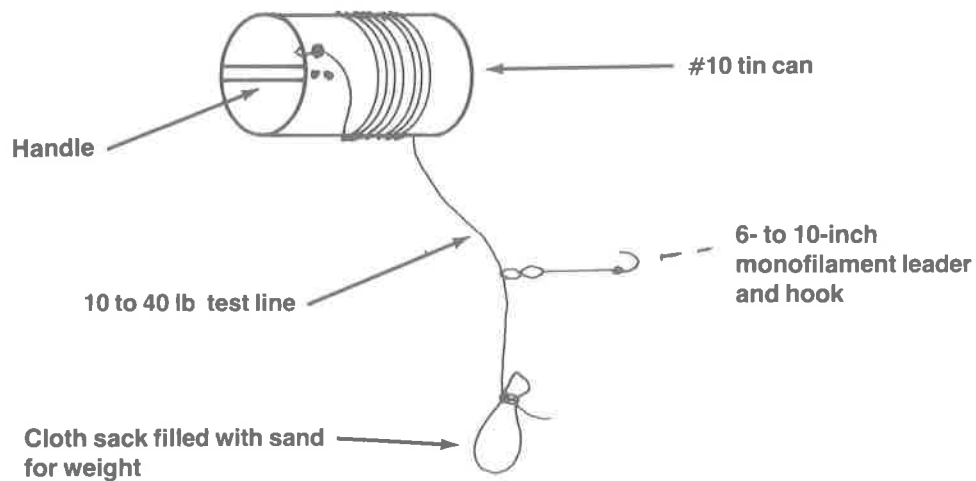
One 10-inch monofilament leader for hooks—leaders are 2- to 4-pound test (lighter than the main line).

One or two size 2 to 6 hooks for pier fishing—size 6 to size 2/0 for rocky areas.

One weight made with a 6" \times 6" piece of heavy cloth to contain sand (see instructions, which follow).

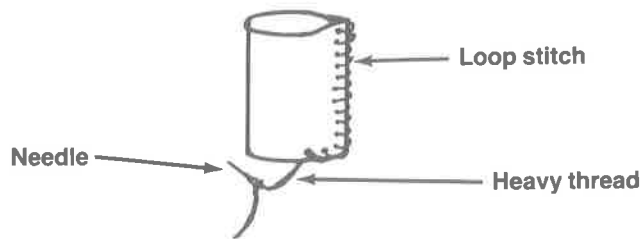
Building the Armstrong Reel

1. Wash the can and remove label. Drill or punch a small hole in the lip of the open end of the can to secure the fishing line.
2. Plane or sand the edges of the board (handle) to make it slightly rounded for a comfortable grip.
3. Insert the handle across the opening of the tin can. It should fit snugly. Turn the can on its side and nail the handle in place with two nails on each side.
4. Attach the fishing line to the hole in the lip to secure it. A $\frac{1}{2}$ " split ring can be used in the hole to prevent wear on the line. Most tackle shops carry split rings. Wind the line around the outside of the can.
5. Tie a loop using an overhand knot about 15" from the end of the main line. Attach a 6" to 10" monofilament leader and hook to the loop in the main line. Tie the cloth sack filled with sand to the end of the main line. Vary the amount of sand according to the strength of the ocean current.



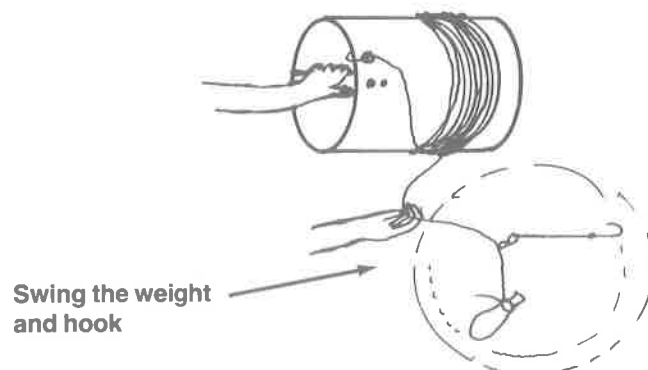
Making Cloth Sack Weights

1. Make the cloth sack weight with a 6" × 6" piece of cloth. Recycled denim trouser scraps make good sack material, but any strong cloth will do. Fold the cloth in half and sew the side and one end with heavy thread. Use the loop stitch or a sewing machine.



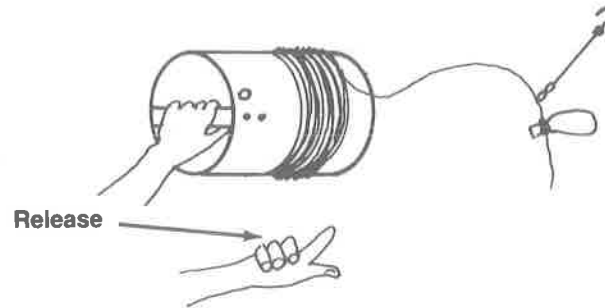
Turn the sack inside out after sewing. The sack is filled with sand and acts as an expendable weight. If it is caught on a rock and tears, you lose only sand. Make several sacks to take fishing.

How to Use the Armstrong Reel



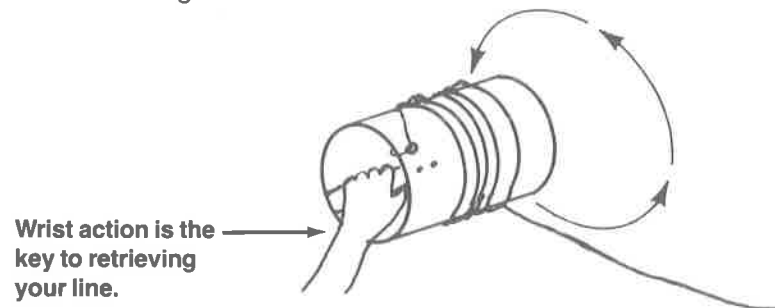
1. Right-handed persons should grasp the *handle* of the Armstrong reel with the *left* hand. The line should be held in the right hand ready for casting. Left-handed persons should reverse this procedure. Point the end of the can toward the area you want to fish.

2. Swing the sack-weight and hook in a circular motion and release. With practice, you will be able to release most of your line and accurately hit the area you wish to fish.



Reeling In

Retrieve the line by using a circular wrist motion with the left hand while guiding the line back on the can with the right hand.



Fishing Tips

The Armstrong reel, which is guaranteed to develop a strong arm if used each day, can be used on piers, boats, and the shore. Consult with local fishing experts and your local fishing tackle shop about where to take youngsters fishing. Select a location with a high probability of success, regardless of the size of the fish, rather than a locale with only a few large fish.

One of the best times to fish is on the early morning incoming tide. Check your tidebook for a midmorning high tide. The best baits include: shrimp, marine worms, mussels, clams, squid, and pieces of anchovy. Make sure everyone dresses warmly and wears tennis shoes, especially when fishing on the rocks. Take a gunny sack for your catch. Keep it wet and shaded. Keep only the fish you plan to eat and return all others to the ocean alive. Nearly all the fish you catch will be delicious. Consult the references under Recreational Fisheries at the end of this manual for sources of fishing information.

(Adapted from "The Armstrong Fishing Reel," Santa Barbara County Cooperative Extension publication by John Richards, UC Area Marine Advisor.)

- C. Obtain and view "The Grunion Story" movie. It is available from the California Department of Fish and Game regional headquarters listed under "Audio-Visual Materials" at the end of this manual. Grunion are small (6") silversides and spawn on southern California beaches on the nights of the highest tides.

- D. In southern California, plan and participate in a grunion fishing or viewing trip. Check with your local fishing tackle shop or California Department of Fish and Game Office about the best nights and times for fishing. Check the sportsfishing regulations concerning seasons. Grunion can only be captured with your bare hands. Keep only as many as you plan to eat.
- E. In northern California, plan and participate in an outing to catch herring (winter months) or surf smelt (rest of the year). Check with local tackle shops about the best times, locations, and gear. Surf smelt are captured in nets in the surf on beaches, and herring are caught while spawning in rocky areas in southern California's bays. Check the sportsfishing regulations.

Session VII—Ocean Arts and Humanities

- I. **Performance objectives.** After completing this session's activities 4-H members will be able to:
 - a. Create a beach casting.
 - b. Create a sand painting.
- A. Have the members do beach castings either at the beach or in sand-filled containers.

Materials:

Plastic basins or buckets.
Plaster of Paris packed in watertight bags.
Shells, driftwood, sticks, stones, and other objects.

Methods:

Dig a shallow area in wet, firm sand (about one square foot) and create any design you want by molding the sand and decorating with the collected objects. Mix the plaster with equal amounts of sea or fresh water and plaster. Mix gently until plaster has dissolved; excessive mixing will cause the plaster not to harden. Slap the side of the container to bring air bubbles to the surface.

Blow on the bubbles to burst them. Pour the milkshake-thick mixture onto the design. If there is enough plaster left, other youngsters can fill their molds. Stop as soon as the plaster begins to harden in your container; rinse out container and mix a new batch.

Before the plaster is too hard, have the makers initial their casting for future identification. When the plaster has hardened, carefully remove the casting from the mold and brush off the sand. The castings can be mounted on canvas or burlap-covered boards or hung as they are using picture hangers. Explore creative ways to use the beach castings for decorations.

(Adapted from "Beach Casting: You Don't Really Need a Beach to Do It" by Katie Sallos. National 4-H News, June-July, 1974, pp. 22-23.)

- B. Make sand paintings. This can be done at home or at the beach.

Materials:

White glue.
Cardboard pieces or paper plates.
Pencils and a brush.
Sand (several colors and/or textures preferable).
Tempera powdered paints (optional).

Methods:

On a piece of cardboard or paper plate, draw a simple design. If tempera colors are used, mix them with the sand. With white glue paint the portion of the interior of the outline that you want in one texture or color of sand. Sprinkle one color or texture of sand over the picture. Let dry. Brush off excess sand. Repeat the process for each texture or color of sand used. Simple designs are best.

(Adapted from "4-H Ocean Adventures" by Vicki Osis and Don Giles, Oregon State University Cooperative Extension.)

- C. Collect flotsam and jetsam as well as nonliving natural marine items along the beach. Try to figure out where these items came from. Discuss the problem of ocean litter. Discuss the currents that carried these items to that beach. Discuss the power of waves and how the shapes of the items on the beach have been changed by the ocean's forces.

Session VIII—Marine Politics

- I. **Performance objective.** After completing this session's activities the 4-H members will be able to:
- a. Explain one ocean public policy issue to others.
 - A. Collect and discuss newspaper clippings on ocean public policy issues. This activity will increase the participants' awareness of the importance of ocean affairs. Some examples of topics include: offshore oil development, pollution, coastal land use planning, local marine recreation opportunities, seafood products, habitat protection, and international maritime incidents. Additional information on offshore oil development is contained in the Ocean Energy Unit, listed under "Other Activities."
 - B. Invite a speaker to discuss an important marine issue or legislation. Speakers on timely issues may be available through local government agencies, educational institutions, conservation organizations, or industry.
 - C. Make a world map with territorial limits and fishery economic zones drawn in. Discuss possible conflicts.

Session IX—Marine Public Service

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Assist with a habitat improvement project.
 - b. Assist in preparation of a marine education display.
- A. Organize a seashore cleanup project. There may be marshes, beaches, and bays in your area that are visually degraded by trash. Consult with local officials who manage the area to plan your project. Possible coordination of efforts with other youth groups or service organizations should be explored as well as opportunities for recycling the discarded materials.
- B. Plan and prepare a marine education display. Your local 4-H Youth or Marine Advisor may be able to help with this project. The display should present well documented information about marine resources. Some ideas for display topics include: local fisheries, biology of local marine organisms, underutilized seafood products, 4-H marine projects, and marine issues. A well prepared display could be placed in a location with substantial public exposure such as banks, fairs, stores, schools, and libraries.

Session X—Career Exploration

- I. **Performance objective.** After completing this session's activities the 4-H members will be able to:
 - a. Name five marine careers and their qualifications.
- A. Brainstorm with the group to come up with a list of marine careers and the type of background needed to qualify for these careers. Do these careers exist in your area? Why are the members interested in these careers? What careers do you think will exist in the future.
- B. View and discuss one of the films about a marine career listed at the end of this manual.

INTERMEDIATE UNIT

Session I—Introduction and Safety

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. List eight beach safety tips.
 - b. List five causes of boating accidents and explain how they can be avoided.
- A. This is the introductory meeting. Help everyone get to know each other. Discuss what the group would like to accomplish this year. Have the group set goals.

- B. Review the beach safety rules outlined in the Beginning Unit. Check or put together the beach safety kit.
- C. Invite a speaker to demonstrate marine safety equipment such as life preservers, life rafts, and marine safety procedures such as the prevention of hypothermia and water safety. Speakers are often available through local Coast Guard Auxiliaries/Power Squadrons, yacht clubs, Red Cross, Sheriff's Departments, safety equipment manufacturers and retailers.
- D. Discuss boating safety. A list of basic publications on boating safety is available from the California Department of Boating and Waterways, 1416 Ninth Street, Sacramento, CA 95814.

Session II—Oceanography

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Collect and identify three types of zooplankton.
 - b. Explain upwelling to others.
 - c. Demonstrate the differences in sand particles between beaches.
- A. Using the instructions in "Sampling Plankton" (see appendix) construct and use a plankton net. View the zooplankton (animal plankton) collected with a hand lens or a dissecting scope. Plankton are the tiny plants and animals that serve as food for larger animals. This activity will help members understand ocean food webs. Try to identify a few of the common types of zooplankton using the guides listed in "Sampling Plankton" or other identification guides available through your library.
- B. Study ocean currents. Learn about their causes, types, and location. Have the group make a world map with all of the major ocean currents on it. Oceanographic texts listed at the end of this manual will show the major currents. Check for them at your library. Study the major currents off the California coast. Using Leaflet 2939, "Upwelling in California Coastal Waters," learn about upwelling. Discuss the effect of upwelling on weather, water temperature, fishing, and marine life.
- C. Using "Ocean Currents" (see appendix), do the exercise demonstrating the effects of salinity and temperature in ocean waters. Are there local areas where differences in salinities or temperatures might occur?
- D. Make a sand collection, using clear plastic pill bottles (purchased from a druggist) or small plastic bags. Collect sand from different beaches and label the containers. Sands will vary from beach to beach because they come from different sources. Examine the sand with a magnifying glass or hand lens to see the different types of sand particles (quartz, jasper, etc.) and compare the relative composition of the sands from different beaches. Discuss why sand from different beaches is different.

Another activity is to set up a beach sand exchange with 4-H groups or others in different parts of California or the United States. A film which will help in understanding the dynamics of beaches is "Beach, A River of Sand" available from Extension Media Center, University of California, Berkeley, CA 94720.

- E. Using the Ocean Energy Unit described under "Other Activities" have the group draw and discuss potential ocean energy resources using currents, salinity, and temperature differentials.

Session III—Marine Biology

- I. **Performance objective.** After completing this session's activities the 4-H members will be able to:
 - a. Identify and press three species of marine algae.
 - A. Learn about the different types of algae and their utilization. Leaflet 21110, "Marine Algae," presents a general introduction to marine algae identification and utilization. The references at the end of that leaflet will supply more in-depth information for intermediate members.
 - B. Using "Pressing Algae" (see appendix), collect, identify, and press algae. Consult the sportsfishing regulations about algae collecting laws. The group can make an educational display of their algae pressings or frame them individually for decorations or gifts.

Session IV—Marine Biology

- I. **Performance objective.** After completing this session's activities the 4-H members will be able to:
 - a. Identify ten species of seashore birds.

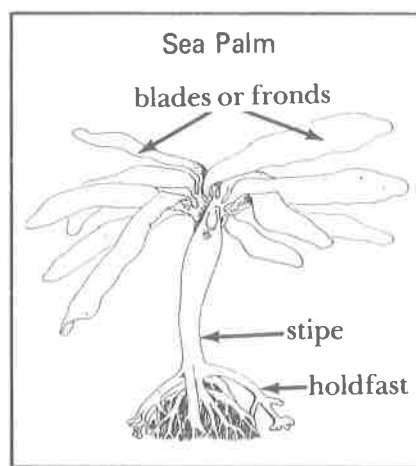


- A. Learn to identify common seashore birds. Leaflet 2550, "Identifying Seashore Birds," and bird identification guides available in most libraries will help the beginning birder. The slide-tape cassette set "Identifying Coastal Birds of California," available from Visual Media at University of California, Davis, CA 95616, will help in preparation for a field trip.
- B. Take a field trip to a bay, marshland, or beach to view and identify seashore birds. Take along binoculars, your bird identification materials, and a clipboard with Leaflet 2550 and additional paper to record your sightings. It is best to go with someone who

knows birds well. Often the local chapter of the Audubon Society or other environmental organizations will organize trips and bird counts. Early morning is usually best for bird watching, and many seashore birds are most visible at low tide when they feed along mudflats.

Session V—Food from the Sea

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Prepare one food dish from marine algae.
 - b. Explain paralytic shellfish poisoning to others.



Seaweed Parts

- A. Make and eat the seaweed bread and/or other algae-based foods from recipes in "Marine Algae," Leaflet 21110. Other sources of marine algae recipes include:

Abbott, I.A. and W. Williamson. 1974. *Limu...* Pacific Bot. Garden (2nd Edition).
Loggins, P. 1975. *The Uncommon Cookbook*. Sea Grant Bulletin #8. Orono, Maine: University of Maine.
Madlener, J.C. 1977. *The Seavegetable Book*. New York, New York: Clarkson-Potter Pub. Co.
- B. Organize and/or participate in a food festival with marine foods. This could be a 4-H event, an event planned with the Cooperative Extension Home Economist, or a fair.
- C. Learn about paralytic shellfish poisoning by reading "Paralytic Shellfish Poisoning and Red Tides" (see appendix). Discuss the precautions necessary to ensure that you are harvesting shellfish that are safe to eat.
- D. Learn about new marine products. Visit a seafood market and ask about new and unusual products.

Session VI—Fisheries

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Construct and use a crab or crayfish trap.
 - b. Describe four major types of commercial fishing methods to others.
 - c. List five types of fish and shellfish produced by aquaculture.

- A. Construct and use crab or crayfish traps. "Catching and Cooking Crabs" (see appendix) supplies a trap design, fishing hints, and cooking instructions. If you live in an inland area, crayfish can be trapped in many lakes and streams. Check with your local fishing tackle shop about designing crayfish traps. Cylindrical crayfish traps can be made out of small-mesh chicken wire with a funnel-shaped entrance at each end. Be sure to check the sportsfishing regulations for seasons, size limits, bag limits, and gear restrictions. Cook and eat the crabs or crayfish you keep.

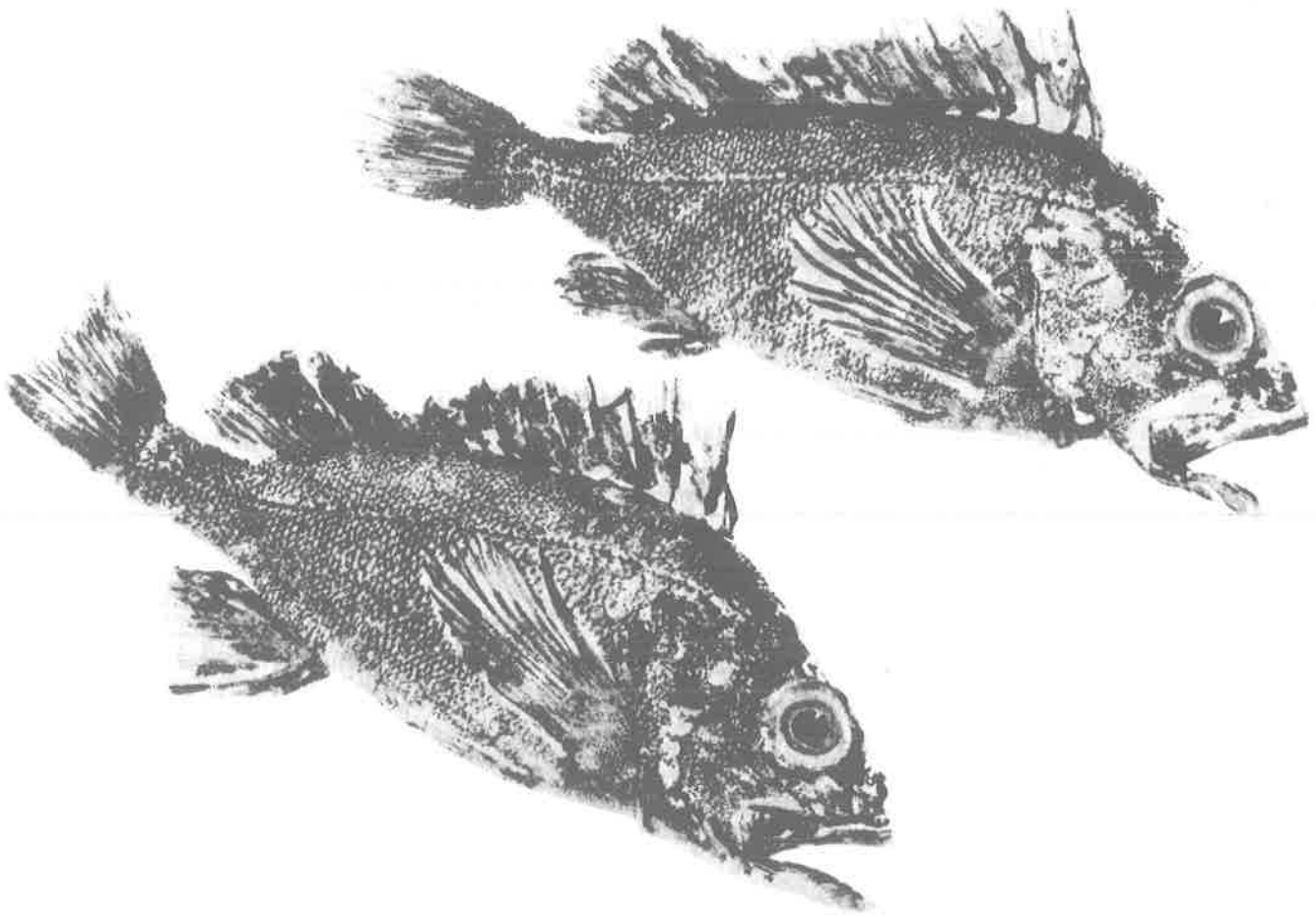
- B. Learn about commercial fisheries through films and videotapes. Invite a commercial fisherman to talk about his industry. Some available films and videotapes include:
 - "Oregon Trawler"—16 mm color, sound
 - "Making Waves"—four 15-minute, 3/4-inch cassette videotapes with question sheets.
 1. "Commercial Bottom Fishing"
 2. "Seafood Processing"
 3. "Coastal Estuaries"
 4. "Oyster Farming"

(Available from Sea Grant MAP Extension, University of California, Davis, CA 95616.)

- C. Visit a hatchery to learn about aquaculture and fisheries. The California Department of Fish and Game and other government agencies operate hatcheries throughout the state. Contact the one nearest you to find out about hours, best seasons, and public education programs. Some private aquaculture companies may allow visitors. They are usually listed in the phone book. Several films on hatchery operations are available from the Department of Fish and Game. These are listed at the back of this manual.

Session VII—Ocean Arts and Humanities

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Create a fish print.
 - b. Explain both sides of a marine policy issue to others.



- A. Make fish prints using the techniques described in Leaflet 2548, "Gyotaku—Japanese Fish Printing". This activity will teach the members about external fish anatomy. The fish prints can be used for displays at fairs, as home decorations, or as gifts. Using fish caught in a group fishing trip is a good idea.
- B. Use the mass media (television documentations, magazine articles, local talks) as a source of information about marine issues. For example, collect newspaper and magazine clippings on marine issues for a month. Have the 4-H group discuss the programs or articles. Do they present a balanced argument with documented facts?

Session VIII—People and the Marine Environment

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Simulate fisheries regulations and their impact on fish populations.
 - b. Give one example of Native Americans' historical use of marine resources.

- A. Do the activities in “Marine Resource Laws and Regulations” (see appendix). Discuss how the activities relate to current commercial and sportsfishing regulations. Environmental variability, economics, fisher behavior, and politics combine to make resource management complex. List reasons and cite examples showing that this leaflet’s activity greatly simplifies the real world situation.
- B. Visit museums or invite a speaker to discuss maritime history or Native Americans’ utilization of marine resources.

Session IX—Marine Public Service

- I. **Performance objective.** After completing this session’s activities the 4-H members will be able to:
 - a. Assist local organizations with a public service project.
 - A. Participate in local bird counts which are often organized by local Audubon Society chapters, schools, or other environmental organizations. Use the skills acquired from your earlier Marine Biology Session on seashore birds.
 - B. Offer to assist your local Cooperative Extension Marine Advisor with public service projects. Marine Advisors can be contacted through the Cooperative Extension offices in coastal counties. Some types of public service projects that have been done include: marine education displays at open houses, underutilized seafood demonstrations at fishermen’s festivals and fairs, assisting at county fairs, and providing training to beginning 4-H Marine Project groups.

Session X—Career Exploration

- I. **Performance objective.** After completing this session’s activities the 4-H members will be able to:
 - a. List ten marine careers and their qualifications.
 - A. Organize and/or participate in a career fair that includes ocean-related careers. This can be either a 4-H event or part of your school’s career day.
 - B. Invite a speaker to talk about their marine career. Some common types of careers include: boat repairmen, fishermen, marine biologists, shipping, Navy and Coast Guard, energy development, and marine recreation businesses.
 - C. Read and discuss the helpful publication “Today’s Youth in Tomorrow’s Sea”. It is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Another helpful reference is “Careers in Oceanography: Romance versus Reality” by John McManus (Neritic Enterprises, P.O. Box 5485, Santa Barbara, CA 93108).

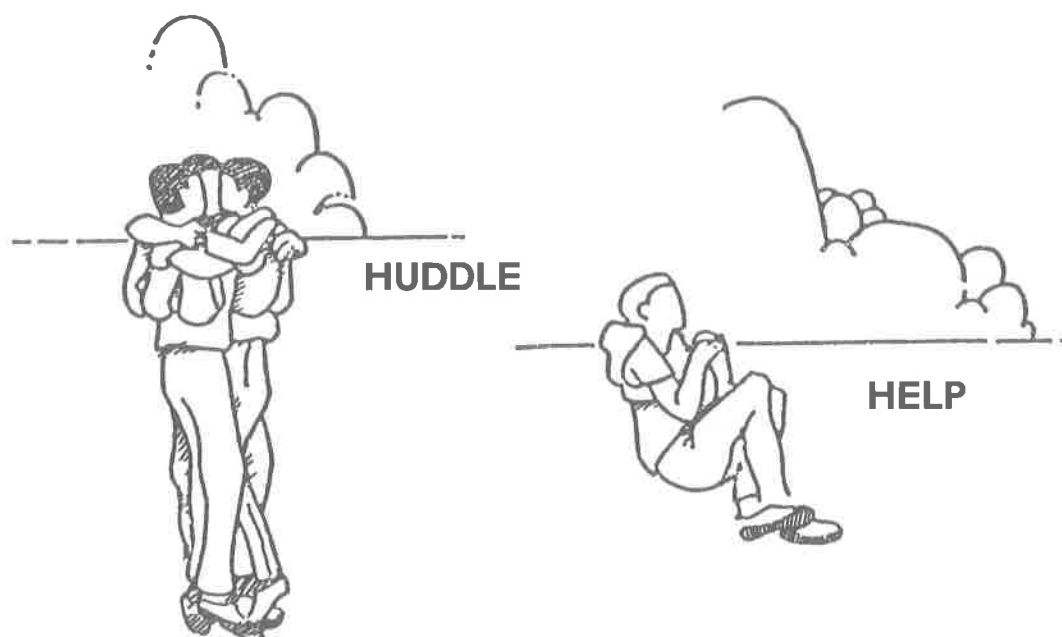
ADVANCED UNIT

Session I—Introduction and Safety

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
- a. List nine beach safety tips.
 - b. Define hypothermia and demonstrate the H.E.L.P. and HUDDLE positions.
- A. This is the introductory meeting. Help everyone get to know each other. Discuss what the group would like to accomplish during the year. Have the group set goals.
- B. Learn about combatting the effects of hypothermia. The slide-tape set "Survival in Cold Water" is available from Visual Media, University of California, Davis, CA 95616, (916) 752-0590. If you have a swimming pool available, the group can practice the procedures outlined in the slide set and listed below.

Hypothermia and Cold Water Survival

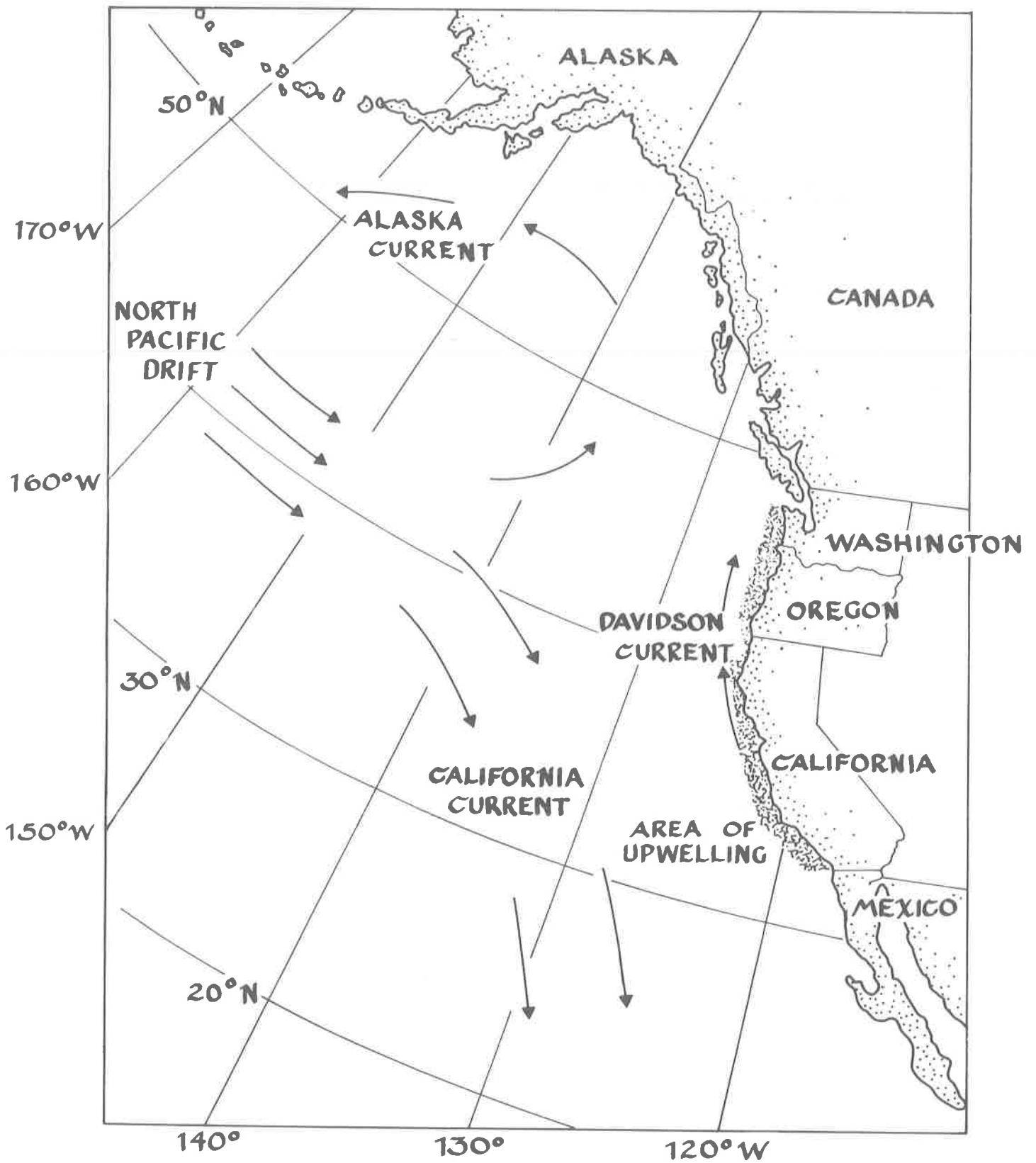
Falling into the cold San Francisco Bay waters can be very serious because of hypothermia, the lowering of your inner body temperature. Studies have shown that if an adult man falls into 50°F water with a life jacket, he can expect to survive for 2½ to 3 hours. Women and children, due to their smaller body size, have a shorter survival time. There are several things you should know to increase your survival time in cold water. Even a few minutes of survival time can mean the difference between rescue and death.



- Do not swim unless you are sure you can make it. Tests show that the average person, swimming with a life jacket, can swim slightly less than one mile in 50°F water before being overcome by hypothermia. Your body cools 35 percent faster swimming than holding still.
 - Your head, neck, and groin and the sides of your chest are regions of high heat loss. Concentrate your efforts on reducing heat loss from these body regions.
 - If alone, use the Heat Escape Lessening Posture (HELP). This can increase your survival time by 50 percent.
 - If there are several of you, huddling together can also up your survival time 50 percent.
 - Don't drink alcohol. It increases your cooling rate by about 20 percent.
 - Loose-fitting kapok lifejackets offer no significant protection from cold water. Snug-fitting foam vests and flotation jackets can increase your predicted survival time by 50 percent to 75 percent.
 - If you plan to spend much time around cold waters or earn your living at sea, you should consider the use of thermofloat jackets or full survival suits. These two flotation devices increase your predicted survival time by almost 400 percent.
- C. Invite a speaker to talk about first aid with an emphasis on marine medical problems.
- D. Review the beach safety rules from the Beginning Unit. Check or put together your beach safety kit.

Session II—Oceanography

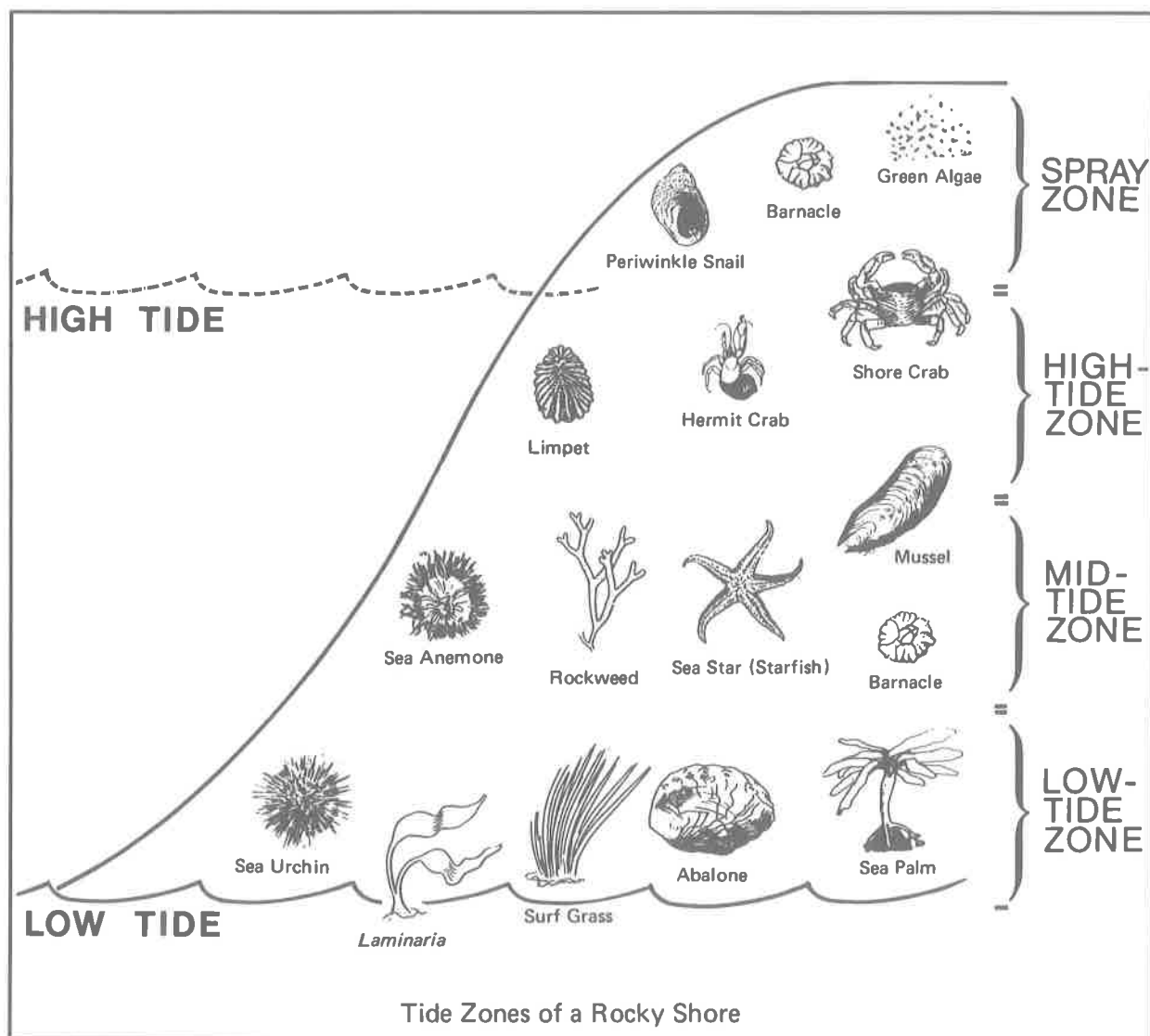
- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
- a. Diagram the major currents in the North Pacific Ocean.
 - b. Identify five prey items from fish stomachs.
 - c. Compare the food habits of two species of fish.
- A. Closely following the instructions in Leaflet 4-H-7004, "Using Drift Bottles to Measure Ocean Currents," conduct a study of coastal currents. Chart the results and discuss them. Periodically, a summary of all of the 4-H drift bottle experiments will be sent to you. These can be plotted on a chart, compared to your experiment, and discussed. Be sure that the members send thank you letters to those who return the cards. The results of your study can make an attractive educational display or a good report.
- B. Use Leaflet 2255, "Biological Oceanography," to learn more about ocean food webs. Collect stomachs from fish caught at piers or on boats. Examine and record the types of food items found in different types of fish. Use the fish and invertebrate identification keys listed at the end of this manual to determine the types of food consumed. Identify the food items as best as you can; don't worry if you can't figure some of them out. Compare the food habits of different types of fish. What can you say about the habits of the fish from their stomach contents?



Major currents of the northeastern Pacific Ocean.

Session III—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Statistically analyze the distribution of one organism across the four intertidal zones.
 - b. Describe one marine research project to others.
- A. Do the activity outlined in Leaflet 2551, "Intertidal Zonation." This will give the advanced members a deeper understanding of the unique ecology of the intertidal zone as well as a very basic introduction to the use of statistics in research. This should be a challenging exercise.

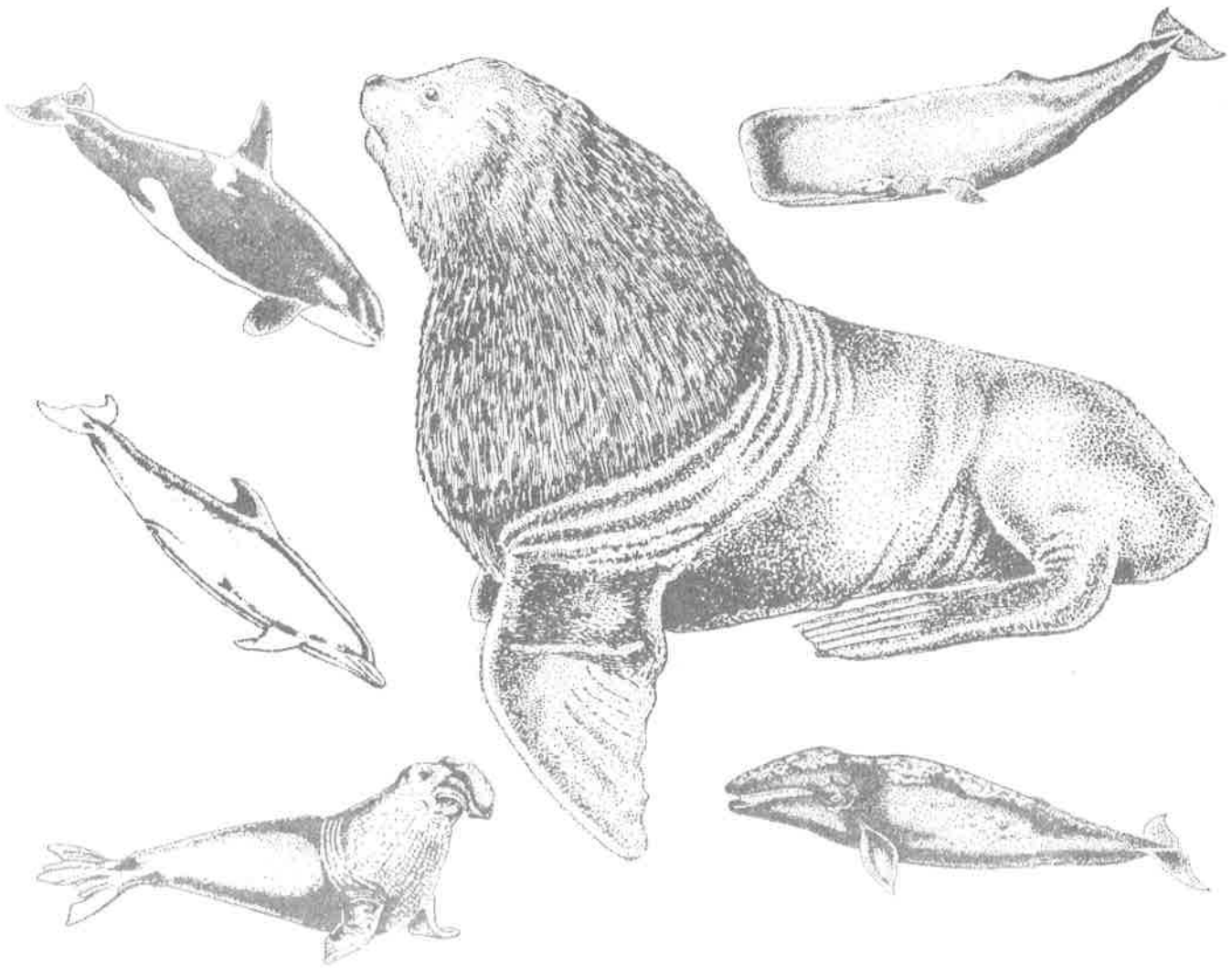


- B. Learn more about marine research through speakers, films, and publications. If you live near a university or college campus, find out when marine scientists are going to give presentations about their research. A list of technical publications about current University of California Sea Grant research is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Obtain the list and order a few publications of interest to you.* Another source of current marine research information is journals in large libraries. Journals such as *California Department of Fish and Game*, *Copeia*, *Ecology*, *Fishery Bulletin*, *Marine Fisheries Review*, *Oceanography and Limnology* contain technical papers. Magazines such as *Oceans*, *Outdoor California*, and *Sea Frontiers* present popular articles summarizing marine research. Read and discuss articles of interest.

Session IV—Marine Biology

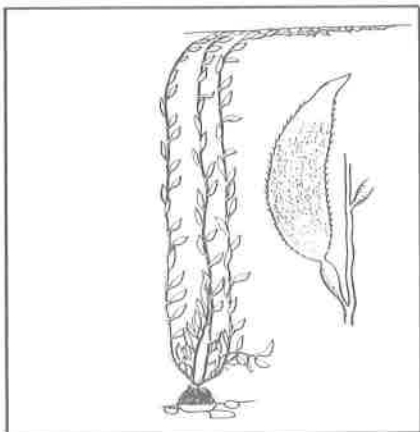
- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
- a. Identify three species of marine mammals.
 - b. Describe the life history of one marine mammal to others.
- A. Learn the identification of and stimulate interest in marine mammals. Leaflet 2274, "Marine Mammals", will supply much of this information plus useful references. A more thorough booklet, "Marine Mammals of California", is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Have each member of the group select an animal or group of animals of their choice and have them give a brief report to the group.
- B. Plan and participate in a whale-watching trip. The gray whale, *Eschrichtius robustus*, makes the longest known migration of any mammal. They make a 12,000-mile round trip between Arctic waters and the lagoons on the Pacific coastline of Baja California. The gray whales migrate close to shore, and are visible from boats and rocky headlands. Numerous sportsfishing vessels run whale-watching trips during the winter months. Check with local sportsfishing landings, environmental groups such as the Oceanic Society, or the yellow pages for local trips. The whales can be seen from shore also. Rocky headlands all along the coast are the best spots. Take along binoculars. The best months are December through May. The whales migrate southward during December, January, and February to their Mexican breeding grounds. By late May they usually have completed their migration northward to feed in the Bering Sea and Arctic waters.
- C. Visit one of the public or private marine exhibitions. Examples include Marineland, Steinhart Aquarium, Sea World, Cabrillo Marine Museum, and Marine World/Africa, U.S.A. These exhibits often have educational displays about marine mammals, and you will get a chance to view them close up.

*Several Sea Grant publications are incorporated into this Leaders' Manual: *Buying Quality Seafood*, *Catching and Cooking Crabs*, *Marine Resource Laws and Regulations*, *Ocean Currents*, *Paralytic Shellfish Poisoning and Red Tides*, *Poke Pole Fishing*, *Pressing Algae*, *Safe Handling and Storing of Seafoods*, *Sampling Plankton*, *Seafood Myths and Misconceptions*, and *Smoked Shark and Shark Jerky*.



Session V—Food from the Sea

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Prepare one food dish from marine algae.
 - b. Use two methods of home preservation of seafoods.



Giant kelp, *Macrocystis pyrifera*, a brown alga.

- A. Prepare seaweed pickles or other seaweed recipes contained in Leaflet 21110, "Marine Algae".

Seaweed Sweet Pickle Recipe

4 cups of rings or rectangles cut from fresh stems of kelp
¾ cup white vinegar
1½ cups sugar
1 teaspoon whole cloves
1 tablespoon mixed pickling spice

Remove the outer skin of the kelp with a vegetable peeler and slice into thin rings, or cut into longitudinal strips and then into rectangles. Soak the cut kelp in fresh water for three days, changing the water several times a day to remove the bitter-tasting salts.

Enclose the spices in a cheesecloth bag and place in simmering vinegar and sugar for five minutes. Remove spices and pour the hot syrup over the sliced kelp. Let stand overnight.

On the following day, remove syrup and heat to boiling. Cook in covered pot to save energy. Place kelp slices in hot jars, cover with boiling syrup and seal, or store the pickles in a covered crock.

For dill seaweed pickles, handle the kelp in the same manner, but substitute your favorite dilling process for the above syrup.

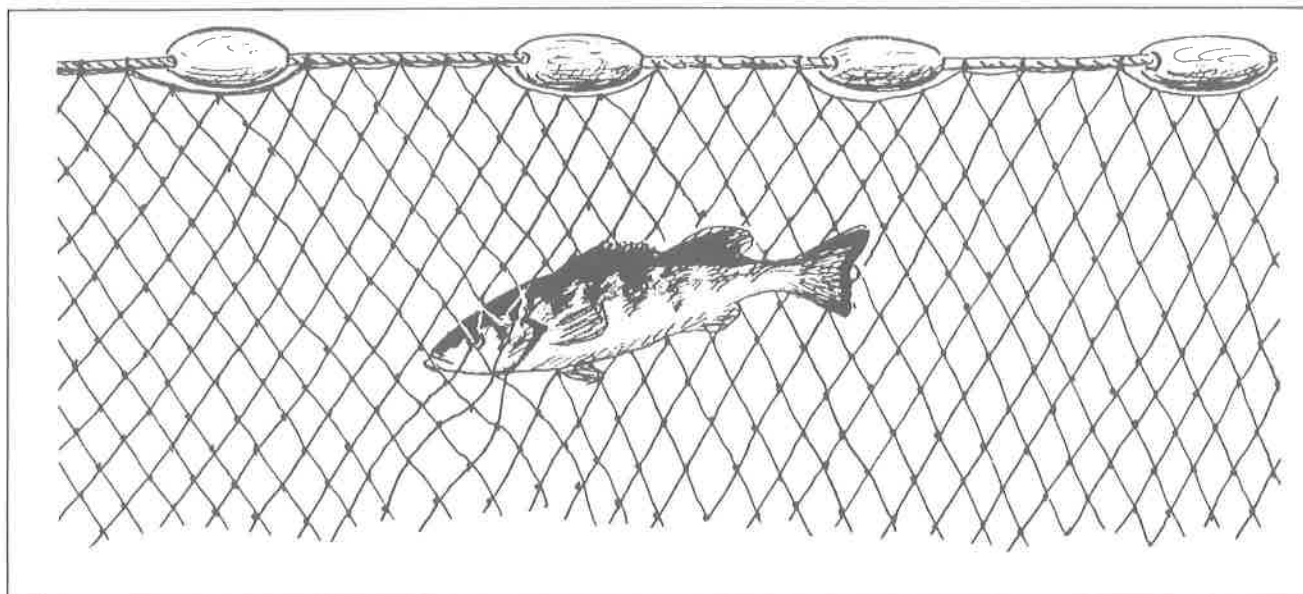
(From: "4-H Ocean Adventures," Cooperative Extension, Oregon State University.)

- B. Learn about safe handling of seafoods. Read and discuss "Safe Handling and Storing of Seafoods," "Seafood Myths and Misconceptions," and "Buying Quality Seafood" (see appendix).
- C. Visit a seafood-processing plant and a fish market to learn how different kinds of fish are unloaded, processed, and sold.
- D. Construct and use a fish smoker. Learn about smoking fish from "Smoked Shark and Shark Jerky" (see appendix), and from Leaflet 2669, "Smoking Fish at Home." Compare the different types of fish you smoke.

Session VI—Fisheries

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
- a. Rig and use a poke pole.
 - b. Draw a fish and label all fins, lateral lines, and nostrils.
 - c. Sketch three types of commercial fishing gear and describe how they function to others.
- A. Using "Poke Pole Fishing" (see appendix), construct and use poke poles. Poke pole fishing is an inexpensive way to fish rocky nearshore waters. All that is needed is a long bamboo pole, a piece of heavy wire, and a fish hook. Because the fishing is in rocky intertidal areas at low tide, be prepared to get wet, and be sure to observe your beach safety rules. You are likely to catch greenlings, perch, rockfish, blennies, and cabezons.

- B. Using instructions in Leaflet 2548, "Gyotaku—Japanese Fish Printing", make fish prints out of the fish you catch with your poke poles or use fish from another source. Use the fish printing activity to learn more about the fishes' external anatomy.
- C. Invite a commercial fisherman or a professional fishing guide to your meeting to discuss his lifestyle, fishing methods, and gear. Perhaps you can visit his vessel for the meeting. The film "Oregon Trawler" and the videotape "Commercial Bottom Fishing" are available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Both films illustrate fishing methods and lifestyle. Other films and publications listed at the end of this manual will help you learn more about commercial fishing.



- D. Take a field trip to a harbor which has a fishing fleet. Note the differences between recreational and commercial fishing vessels. Note and try to identify the different types of commercial fishing vessels (i.e. troller, trawler, etc.). Look for different types of fishing gear such as gill nets, longlines, traps, etc. Photograph or draw the different types of gear and vessels. Useful references for this activity include Leaflet 2272, "Major Commercial Fisheries California," and *Fisheries of the North Pacific* by Robert Browning (Northwest Publishing, Anchorage, Alaska).

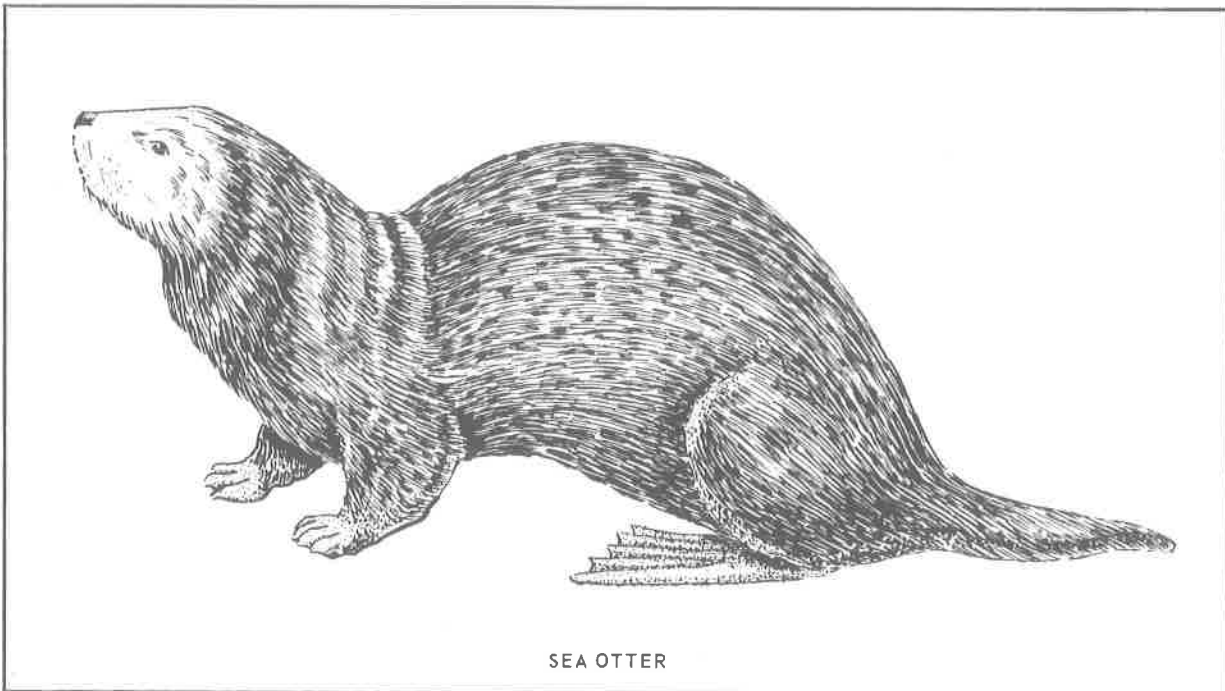
Session VII—Ocean Arts and Humanities

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Describe one local marine policy issue to others and recommend at least one possible solution.
 - b. Describe one use of marine resources by Native Americans.

- A. Learn about and discuss the biology of coastal marine mammals. The film "From the Edge of Extinction" gives an excellent overview of sea otter biology (available from Sea Grant MAP Extension, University of California, Davis, CA 95616).
- B. Learn about and discuss Native Americans and their relationship with the marine environment. Local libraries and museums, especially natural history museums, are good sources of information. Discuss current utilization of marine resources by Native Americans such as their subsistence fisheries for salmon and marine mammals.
- C. Have a group discussion or brainstorming session about man's use and/or abuse of the marine environment. You can make the discussion cover man's interaction with the marine environment in general, or you can focus on specific issues such as power plant or factory siting, coastal wetlands, coastal land use planning, fishing regulations, etc. Supply each member with a pencil and paper and have them write down and then share their thoughts with the group.

Session VIII—Marine Resources Management

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. Simulate a hearing on sea otter management.
 - b. List three reasons for and against restricting the sea otters' range.
 - c. Debate one marine policy issue.



- A. Have the group play the sea otter simulation game which is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. The game places the players in the roles of the different interest groups concerned with sea otter and shellfish fishery management in California. The members act out a simulated hearing on whether the range of the sea otter should be restricted. The game gives the members an understanding of the many viewpoints about marine mammal—fishery conflicts. A summary of the issues involved is included with the game (summary from “California’s Environment Newsletter,” #59: January-February, 1981, UC Cooperative Extension, Ray Coppock and Roy Rauschkolb, Editors).
- B. Debate an important marine issue. Have the group pick a topic, divide up into debate teams, gather information on the issue, and debate the issue. Some of the topics under Activity “C” of Advanced Unit VII would make good debate topics. Viewing the film “Mammals of the Sea” would be an excellent discussion starter.
- C. Discuss current marine research. Have each member select a topic of their own and have them find out about current research through local marine researchers or through library magazines and journals such as *California Fish and Game*, *Copeia*, *Fisheries*, *Journal of the Fisheries Research Board of Canada*, *Marine Fisheries Review*, *Oceanography and Limnology*, *Oceans*, *Outdoor California*. Information on current University of California Sea Grant College research is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Each member can then give a brief report about the research and its relevance.

Session IX—Marine Public Service

- I. **Performance objective.** After completing this session’s activities the 4-H members will be able to:
 - a. Assist local organizations with a marine project.
 - A. Participate in a habitat restoration project in cooperation with the appropriate agency. If you have a local Cooperative Extension Marine Advisor, he or she may be able to direct you toward a suitable project. Many state agencies (Department of Fish and Game, etc.), environmental groups, and local governments are involved in habitat restoration or enhancement projects.
 - B. Assist in a local marine research project. Local researchers may need help in taking measurements or monitoring research projects. Check with your Marine Advisor, college researchers, environmental groups, or government agencies about areas in which you can help.

Session X—Career Exploration

- I. **Performance objectives.** After completing this session's activities the 4-H members will be able to:
 - a. List five locations for academic or vocational training in the marine field of interest to them.
 - b. Identify five potential ocean-related summer jobs.
 - c. Write a resume and fill out a job application.
- A. Find out about schools offering marine training. An excellent reference for this is "University Curricula in the Marine Sciences and Related Fields". This is available at libraries or for free (limited supply) from Office of Sea Grant, NOAA, 6010 Executive Boulevard, Rockville, MD 20852. If there are local community colleges or universities offering marine courses, find out more about their programs.
- B. Find out about vocational training for marine careers. Land-based skills such as engine repair, hydraulics, welding, boat building, energy-resource management, business administration, cooking, and refrigeration are examples of valuable skills for marine careers. Read "Today's Youth in Tomorrow's Sea" for ideas on careers (available from Sea Grant MAP Extension, University of California, Davis, CA 95616).
- C. Explore ocean-related summer jobs. This is a way to find out if you enjoy working on or near the ocean. Some examples of summer jobs are fishing boat deckhand, seafood processing, seasonal help for government agencies, marine construction, and marine recreation (sailing instructor, boat maintenance, etc.). In some cases you may want to work as a volunteer just to gain experience. "Hands-on" experience is an important factor to your future employers.
- D. Improve job application skills. Learn about and practice writing resumes, interviews, filling out applications. Critique each other's job application skills. Use the skills to find summer jobs.

OTHER ACTIVITIES

Additional activities have been suggested as we developed this Leaders' Manual. Because these are major activities that would take up the bulk of a project year, they have been listed separately. In some cases the added resources needed for these activities may make it necessary to undertake some fund-raising activities.

Sailing

The sport of sailing teaches valuable skills, develops confidence, and illustrates the importance of teamwork. Sailing instruction is often available through yacht clubs, city recreation departments, scouting organizations, universities, and parents who actively sail. Sailing instruction and practice can be done periodically during the school year or for intensive one- or two-week sessions during the summer. Water and boating safety skills should be emphasized. The publications listed under "Safety" at the end of this manual should be helpful.



Boat Building

There is a growing interest in building small skiffs and dories. Such long-term projects will teach valuable wood-working skills as well as an appreciation for traditional boat design. A completed boat could be used for boating activities by the group, or it could be sold to recover expenses for materials. The key to this project will be locating a skilled boat builder or wood worker to instruct the group. Ideas for boat designs and plans can be found in periodicals such as *Wooden Boat Magazine*, *National Fisherman*, and in books on boat design (at your local library).

Scuba

Many youths and adults are attracted to the ocean by diving. Scuba diving instruction is available through dive shops, schools, recreation departments, and other organizations. Be sure that you use only instructors who are certified to teach Scuba. Swimming skills and water safety instructions are essential.

Ocean Energy

The ocean is an important energy resource. We currently extract much of our oil from reserves located offshore. Today our society is trying to resolve conflicts between the economic benefits of offshore oil extraction, and the environmental risks involved in use of this resource.

Utilization of alternative ocean energy resources is still primarily in the research and development stage. These resources include energy derived from waves, currents, temperature differentials, water pressure, and water salination. Some of these energy sources will become more important in the future as our petroleum reserves dwindle and become more expensive. An understanding of present ocean energy issues and potential new energy sources is important to California citizens.

An Ocean Energy Unit encompassing several sessions has been developed by Carolyn Cook Grassi. This unit will be helpful to 4-H groups who would like to take an in-depth look at ocean energy problems and potentials. It is available from Sea Grant MAP Extension, University of California, Davis, CA 95616.

APPENDIX

Sea Grant Activities and Information



Marine Advisory Publication

The author is Robert J. Price, Seafood Technology Specialist, Cooperative Extension, Davis.

BUYING QUALITY SEAFOOD

Most varieties of fresh seafood, like many other foods, are more abundant during certain seasons of the year. Your local fish dealer can tell you about seasonal offerings and can indicate the most economical varieties. Lesser-known species of seafood are often as satisfactory as popular species and are usually more economical.

Frozen seafoods are packed during seasons of abundance and held in cold storage until ready for distribution. Thus, the consumer can select from a wide variety of seafood throughout the year. High-quality seafoods that are properly processed, frozen, packaged, and stored can be equal in quality to fresh seafood.

When you purchase seafood, look for the following characteristics of quality.

Fresh whole fish

Skin is shiny and color unfaded. When first taken from the water, most fish have an iridescent appearance. Each species has characteristic markings and colors, which fade and become less pronounced as the fish loses freshness.

Eyes are bright, clear, full, and often protrude. As the fish becomes stale, the eyes often turn pink and become cloudy and sunken.

Gills are red and free from slime. The color fades with time to light pink, then gray, and finally greenish or brownish.

Flesh is firm, elastic, and not separating from the bones.

Odor is fresh and mild. A fish just taken from the water has practically no "fish" odor. The fishy odor becomes more pronounced with time but should not be disagreeably strong when the fish are purchased.

Fresh fillets, steaks, and chunks

Flesh is firm, elastic, and has a fresh-cut appearance without traces of browning or drying around the edges.

Odor is fresh and mild.

Wrapping material is moisture-vaporproof. There is little or no air space between the fish and the wrapping material, and no liquid in the package.

Frozen seafood

Flesh is solidly frozen with no discoloration or drying (freezer burn) on the surface.

Odor is not evident or is very slight.

Wrapping material is moisture-vaporproof, fits closely around the product, and is undamaged.

Packaged products are stored below the "load line" or "frost line" of the display freezer and are solidly frozen.

Breaded and unbreaded products have a clean, uniform appearance. Individual pieces are easily separated and not frozen together. Breading or coating is essentially intact.

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Shrimp

Fresh shrimp have a mild odor and firm-textured meat. The shrimp meat or shell is not slippery, and the meat is firm when thawed. The shell may be grayish green, pinkish tan, or light pink. When cooked, the shell turns red, and the meat takes on a similar attractive reddish tint, occasionally with some dark red spots.

Clams and oysters

Clams and oysters in the shell are alive, and the shells close tightly when tapped gently.

Shucked oysters are plump and have a natural creamy color and clear liquid. There should not be more than 10 percent liquid, by weight, when shucked oysters are purchased in a container.

Crabs and lobsters

Live crabs, lobsters, and spiny lobsters show movement of the legs. The "tail" of a live lobster curls under the body and does not hang down when the lobster is picked up.

Frozen spiny lobster or rock lobster tails have clear white meat, no odor, and are hard-frozen when bought.

Cooked crabs and lobsters have bright red shells and are free of any disagreeable odor.

Scallops

Scallops have a sweetish odor and are practically free of liquid when bought fresh in packages. The meat of the large sea scallop is white, orange, or pink; that of the smaller bay scallop is either creamy white, light tan, or pinkish.

Inspection marks and grade seals



Inspection marks and grade seals are a useful guide to quality fish and shellfish. These marks signify that federal inspectors have inspected, graded, and certified the products. Products bearing these marks and seals are certified to be clean, safe, and wholesome, and to meet U.S. grade standards or approved specifications.

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Catching and Cooking Crabs

Several species of crab are important in the California sports catch. One is the Dungeness or market crab (*Cancer magister*). This crab is yellowish-brown in color and is caught in ocean waters around Morro Bay and northward. Another similar group of crabs (three species), known as rock crabs, are more reddish in color and often have black markings on their pincers. Rock crabs are found both in bays and rocky ocean areas.

Reproduction takes place in the spring when the male crab fertilizes a female that has just shed (molted) her shell. By the next winter, 0.7 to 2.5 million eggs will have hatched into free-floating microscopic larvae. Few of these larvae survive long enough to take on their adult form 3 to 5 months later. After settling down to the bottom of the ocean, the crabs grow only when they molt (shed their shell and form a new one). It usually takes 4 years before the crabs reach a legal commercial size. During this time, the average market crab molts 13 times. Crabs eat fish and shellfish and, contrary to popular belief, they prefer fresh material.

BUILDING A CRAB HOOP NET (RING)

A typical crab ring is described below. You may want to improvise if some materials are

not available. If all else fails, you can buy crab rings at sporting goods stores. You need the following to make a crab hoop net.

Two rings. One ring should be 5/8-inch steel rod or cable, approximately 30 inches in diameter. The other ring should be 3/8-inch steel rod or cable, approximately 26 inches in diameter.

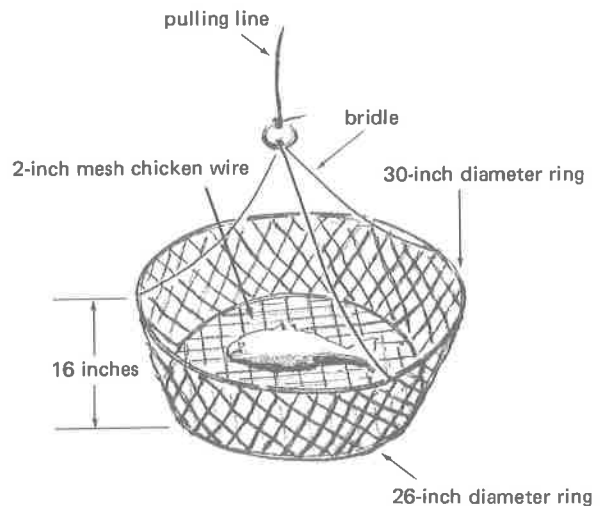
Side netting. The side netting should be approximately 16 inches deep. Use 1/8-inch cotton, nylon, or linen net twine with a 3- to 4-inch mesh. Shuttles for weaving nets are available from sporting goods stores. You can also use tennis netting.

Bottom netting. Galvanized, 2-inch mesh chicken wire is best.

Lines. Make a bridle by attaching three 1/4- to 3/8-inch lines to the top ring. You need a metal ring or a loop to connect the pulling line—a length (25 to 50 feet) of 3/8-inch line. If you plan to fish from a boat, you also need a float (plastic jug).

Bait holder. The type of bait holder you use depends on the bait. You can attach a fish carcass directly to the bottom netting. If you use squid, small fish, or clams, a small plastic jar (or baby food jar) with holes punched in it is very effective and protects the bait.

CRAB HOOP NET



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CRAB FISHING

The most successful market crab fishing for sport is in Humboldt and Tomales Bays and the ocean north of San Francisco. These crabs are most often found on sandy bottoms. Rock crabs are common all along the coast, especially near piers. (Ask at fishing tackle stores for local fishing information.)

Crabs are opportunity feeders and the best baits seem to be razor clams, herring, anchovies, squid, and fresh fish carcasses. When fishing with squid, small fish, or clams, use a plastic container or baby food jar with holes in it to make the bait last longer. After baiting up your hoop net, let it down to the bottom. Check it every 15 to 20 minutes.

During open season, only male market crabs over 6 1/4 inches may be taken. The limit is 10 per day. There are **no restrictions** on the size, sex, season, or bag limit for the **rock crabs**. Be sure to check the *Sport Fishing Regulations* for changes in the laws, since the regulations may change from year to year.

CLEANING AND COOKING CRABS

You can clean crabs either before or after cooking, but they taste best if you clean them before cooking. Use the following method for cleaning crabs.

1. Remove the carapace (back) of the crab by forcing the edge of the shell against a solid object.
2. Break the crab in two by folding it like a book—first up, then down.
3. Shake out the viscera from each half.
4. Shake off the gill filaments. Now nothing remains except the shell and the edible meat.

The authors are Christopher M. Dewees, Extension Marine Resources Specialist, and Jon K. Hooper, Staff Research Associate, Davis.

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Cook crabs alive if uncleaned, or as soon as possible after cleaning because the meat spoils quickly.

1. Add 1/4 pound of salt per gallon of fresh water, or use sea water.
2. Bring the water to a boil. Then add the crabs and cook for 12 to 15 minutes after the water returns to a boil. Cook uncleaned crabs for 20 to 25 minutes.
3. Remove the crabs and immediately immerse in or spray with cold water.
4. Chill, crack the crab, and serve.

GLOSSARY

Species	—a population or group of distinct organisms that have some common characteristics and are reproductively isolated from other distinct organisms
Larva	—early form of an animal before it takes on its adult form. For example, a tadpole is the larva of the frog. (Larvae is the plural form of larva.)
Opportunity feeder	—an organism that feeds on whatever is available rather than choosing one specific food
Open season	—time when fishing for a particular species is permitted
Limit	—number of one species that may be captured and possessed
Viscera	—inner parts of the body, such as intestines, stomach, etc.



Marine Advisory Publication

Marine Resource Laws and Regulations

ACTIVITY

You can see for yourself how different fishing regulations affect the size of fish populations. Set up three model fish populations of 20 fish each. (You can use beans or other small objects to represent the fish.) Assume that each population has the same yearly recruitment rate of 50 percent—that is, the number of young fish surviving to become available to fishers each year equals 50 percent or one-half the total number of fish in the population.

Have a different set of fishing regulations for each population. The idea is to follow the three populations through several years of fishing and natural reproduction to see whether the population numbers increase, decrease, or remain about the same. (In this activity, fishing includes the effects of starvation, disease, and so on.) For each year, represent fishing by removing fish (beans) from the population; show recruitment by adding fish to the population.

For population No. 1, set regulations that allow no fishing—no fish or 0 percent are removed each year. In population No. 2, have regulations that permit 25 percent or one-fourth of the fish to be removed by fishing each year. In population No. 3, use regulations that allow 50 percent or one-half of the fish to be removed by fishing each year.

Fishing laws and regulations are designed to maintain healthy fish populations and, at the same time, give each person an opportunity to enjoy the sport of fishing or to make a living from commercial fishing. Without these laws and regulations, our fish populations could soon be destroyed and everyone would lose the opportunity to fish.

Through flexible laws and regulations, fishery biologists are able to maintain a balance between the number of fish lost each year due to fishing, starvation, disease, predation, and other causes and the number gained each year from natural reproduction. In a year of good reproduction and survival, fishing seasons may be extended and limits increased. In a poor year, the season and limits may be reduced. Thus, laws and regulations are important management tools to ensure that fish populations are neither depleted nor wasted.

The authors are Christopher M. Dewees, Extension Marine Resources Specialist, and Jon K. Hooper, Staff Research Associate, Davis.

GLOSSARY

Fishery biologist	— professional scientist who studies the habits, numbers, and environment of fish	Limit	— number of fish that can be caught
Predation	— the hunting and killing of one organism by another for use as food	Recruitment	— number of young fish that survive and add to a population
Season	— time when fishing for a particular species is permitted.	Habitat	— the region or type of environment where an organism is found

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Example

Let's look at population No. 2 where regulations permit 25 percent (one-fourth) of the population to be removed by fishing each year.

Start with 20 fish (beans) and first show the effect of fishing by removing 25 percent of the population:

$$.25 \times 20 = 5.$$

This leaves a population of 15 fish:

$$20 - 5 = 15.$$

Next, add yearly recruitment of young fish, which is 50 percent of the remaining population:

$$.50 \times 15 = 7.5, \text{ which rounds off to } 8.$$

This results in a new population size of 23 fish:

$$15 + 8 = 23.$$

The first year of fishing and recruitment is summarized below.

Population No. 2 (25 percent of fish removed yearly by fishing):

20 fish (population size at start)
- 5 fishing (25 percent of 20)
<hr style="width: 10%; margin-left: 0;"/> 15
+ 8 recruitment (50 percent of 15)
<hr style="width: 10%; margin-left: 0;"/> 23 fish (population size after 1 year)

Now you have completed 1 year of fishing and recruitment. Continue this process for several years for each of the three populations.

QUESTIONS

1. Did any of the populations increase in size? Decrease in size? Remain about the same?
2. If you were a fishery biologist, which set of regulations (0 percent, 25 percent, 50 percent) would be best to—
 - Keep the size of a fish population about the same?
 - Decrease the size of a fish population?
 - Increase the size of a fish population?
 - Allow the optimum catch by fishers over a long period of years?
3. If you were a fishery biologist and wanted to increase the size of a fish population but also wanted to allow people to enjoy fishing, which set of regulations would you use—0 percent, 25 percent, or 50 percent?
4. What would happen if regulations did not allow any fishing (as in population No. 1) and the size of the fish population increased beyond the limits of the fishes' habitat?



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Ocean Currents

Ocean currents are important in many ways. The best fishing is often found where two currents come together. Also, currents transport fish and shellfish that are too young to swim to areas rich in food, thus ensuring their survival.

There are several types of currents. The best known are wind-caused currents where the wind actually pushes the water along. In the demonstration below, you can observe two lesser-known factors that cause currents—differences in salinity and temperature densities between two masses of water.

Materials

Two 1-pint milk bottles or two 250-milliliter Erlenmeyer flasks with flat rims

Some 3- by 5-inch cards

Table salt
Food coloring
Paper towels or rags

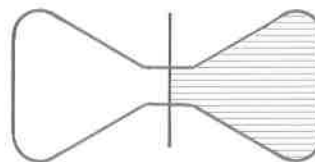
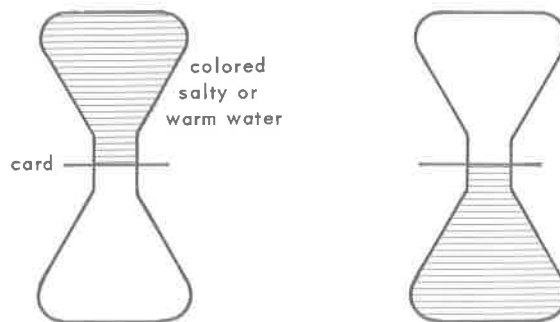
Plastic dishpan (optional)

NOTE: You might want to use the plastic dishpan when you do these demonstrations in case of spillage.

Method

Salinity currents. Fill both bottles with tap water. Dissolve $\frac{1}{2}$ teaspoon of salt in one bottle to make salt water. Add a drop of food coloring to identify it. Place a 3- by 5-inch card on top of the bottle of salt water and carefully turn the bottle upside down. The upward pressure of air will hold the card in place. Place the bottle of salt water on top of the bottle of fresh water and carefully remove the card. Observe. Next place the bottle of fresh water on top of the bottle of salt water and remove the card. Observe. Then place both bottles horizontally, remove the card, and observe. Is salt water heavier or lighter (higher or lower density) than fresh water? What happens to river water when it flows into the ocean?

Temperature currents. Fill one bottle with warm tap water and the other with cool tap water. Add a drop of food coloring to the bottle of warm water. Do the three variations shown below. Is warm water heavier or lighter than cool water?



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QUESTIONS

1. Where in the world's oceans might these factors be most noticed? Where does most heating take place? Where does most dilution of sea water occur?
2. Is it easier for a human to swim in salty water or in fresh water? In cool water or in warm water?

GLOSSARY

Current	— a body of water that flows in a definite direction
Salinity	— the amount of salts in water, usually expressed in parts per thousand
Density	— the quality of being dense or compact; the ratio of the mass of an object to its volume

The authors are Christopher M. Dewees, Extension Marine Resources Specialist, and Jon K. Hooper, Staff Research Associate, Davis.

Adapted from: *Ocean Currents* by Donald E. Giles, Marine Education Specialist, Oregon State University, Marine Science Center, Newport.

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Paralytic Shellfish Poisoning and Red Tides

The author is Robert J. Price, Seafood Technology Specialist, Cooperative Extension, Davis.

Red tides

During late spring, summer, or fall, localized patches or streamers of color appear in the ocean or bays along the California Coast. These reddish areas appear suddenly and last from a few days to a few months before disappearing. They are commonly called red tides. The reddish discoloration of the water results from the presence of millions of dinoflagellates, tiny one-celled organisms having both plant and animal characteristics. The color varies from brown to red depending on the density of the mass of dinoflagellates.

Red tides and poisonous shellfish

Many people who gather clams, mussels, scallops, and oysters from California's coastal waters believe that red tides cause these molluscs to be poisonous. In fact, *most red tides are harmless*. Of the hundreds of species of dinoflagellates in California waters, only *Gonyaulax catenella* is known to produce a poison that causes outbreaks of paralytic shellfish poisoning. *Gonyaulax catenella* is not generally involved in California red tides. The dominant dinoflagellate in red tides along the southern California coast is the nontoxic *Gonyaulax polyedra*, which can, however, be responsible for fish kills, because it removes oxygen from the water.

Although the presence of a red tide is a warning that the molluscs may be poisonous, *the absence of a red tide does not mean they are safe to eat*. Bivalve molluscs such as clams, mussels, scallops, and oysters gather their food by filtering dinoflagellates and other planktonic organisms out of the water. Because of their ability to filter large

quantities of water, molluscs can consume enough *Gonyaulax catenella* to become poisonous even when not enough of these organisms are present to form a visible red tide.

For reasons not completely understood, molluscs are rarely harmed by the poison produced by *Gonyaulax catenella*, but other animals including man can be poisoned by eating toxic molluscs. The extremely powerful nerve poison can cause temporary paralysis and even death if enough poison has been consumed to paralyze the breathing mechanism.

Any plankton-feeding mollusc may at times become poisonous, and outbreaks of paralytic shellfish poisoning in California have been associated with mussels, scallops, clams, and oysters. Abalone, crab, shrimp, and fish do not feed on plankton and there is no danger of poisoning from them.

California's effort to protect the public

It is impossible for the public to distinguish between poisonous and safe molluscs or to destroy the poison by normal methods of cooking. Because of this, the California State Department of Health Services imposes a quarantine on all mussels from the ocean shore, bays, inlets, and harbors of California from May 1 to October 31, the time of the year when *Gonyaulax catenella* is present off the California coast in greatest numbers and when mussels may become poisonous. If high levels of poison are found in mussels, the quarantine may be extended to include all sport-harvested bivalve molluscs in the area.

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During the quarantine, mussels can be harvested only for fish bait and, if sold, must be broken open and placed in containers labeled:

“MUSSELS MAY CONTAIN POISON—
UNFIT FOR HUMAN FOOD.”

Local health officers enforce the quarantine and post signs advising the public of the mussel quarantine. These signs also warn the public that clams may contain poison and should be thoroughly washed and cleaned before being cooked. Because these signs are often mutilated or destroyed, their absence does not alter the quarantine period.

The Department of Health Services also conducts a year-round paralytic shellfish poison surveillance program for all shellfish growing areas in the state. This program enables the Department to detect any changes in toxin levels in both sports and commercial shellfish growing areas, and to alert the public and local health agencies if necessary. If elevated toxin levels are detected in or near commercial oyster beds, an event which occurs only rarely, the Department takes immediate action, including closure of the beds, to protect the consumer.

No recorded outbreaks of paralytic shellfish poisoning have occurred in California during the nonquarantine period, which is normally from November 1 to April 30. Shellfish from California's coastal waters can be safely gathered and eaten during the nonquarantine period.

Precautions to take when gathering shellfish

- Be familiar with the California Department of Fish and Game sport fishing regulations. These regulations give open seasons, minimum size limits, and bag and possession limits for shellfish gathered in California. These regulations are published annually and are available in sporting goods stores.
- Gather clams, mussels, and scallops only in areas known to be free from sewage contamination. If in doubt, contact local health authorities—county health officer or sanitarian—to determine if shellfish are safe to eat.

- Do not gather mussels for food during the quarantine period. Mussels containing paralytic shellfish poison are particularly dangerous because the entire mussel, including the viscera, is eaten.
- During the mussel quarantine period, thoroughly clean and wash all other bivalve molluscs before cooking or eating them. Discard the dark digestive gland of all clams.
- In scallops, paralytic shellfish poison accumulates primarily in the viscera, and the viscera can remain toxic year-round. Because of this, scallop viscera should not be eaten at any time.
- When an outbreak of paralytic shellfish poisoning occurs, or when high levels of the poison have been found, no bivalve molluscs should be eaten if harvested in the affected area.
- Following an outbreak of paralytic shellfish poisoning, the necks or siphons of Washington clams, *Saxidomus nuttalli*, may retain the toxin for periods of up to 2 years. If this should occur, the Department of Health Services will establish and publicize a special quarantine on Washington clams in the affected area.
- Forget the old saying that shellfish should be eaten only during the months with “R” in them. Many people think the saying means that shellfish are always safe to eat during the “R” months, but poisonous shellfish occasionally occur in California in the “R” months of September and October. This saying was originated in Europe and was based on factors connected with the reproductive events of oysters, not with paralytic poisoning.

Commercially harvested shellfish

Although oysters are the major bivalve molluscs harvested commercially from California coastal waters, clams, mussels, scallops, and oysters are all available in California retail stores and restaurants throughout the year. These products come from both local and out-of-state sources. All commercially grown shellfish in the United States are subject to federal and state regulations designed to ensure that only safe, wholesome, and non-toxic shellfish are available to the consumer.

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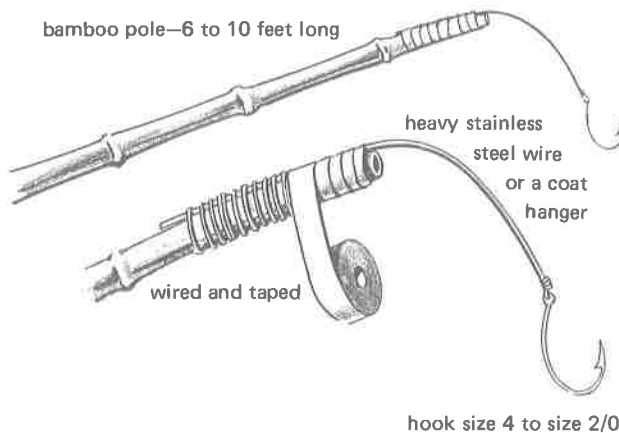
Marine Advisory Publication

Poke Pole Fishing

Poke poling is a simple, inexpensive type of fishing that allows you to learn more about fish. You can make your own fishing pole from a long bamboo pole, a piece of heavy wire, and a fish hook.

Poke poling is a very rewarding sport. You will be surprised at the number and size of fish you can catch. Also, you are practically going into the fish's environment to catch it. This means you can learn more about its habits and its relationship to other plants and animals (organisms) in the intertidal zone.

POKE POLE



When you go poke poling, be sure to dress warmly, check the tides (low tide is the best time), and be safety conscious. If there is a large surf, stay away from the water's edge.

It is best to go poke poling in rocky intertidal areas. Bait the hook with squid, shrimp, or mussel or abalone guts. Fish by sticking the pole down into deep pools and crevices around the rocks. If you do not catch anything within a few minutes, move around and try other nearby spots. You are likely to catch greenlings, rockfish, blennies (eel-like fish), striped perch, cabezon, and an occasional lingcod.

Here are some things you might want to do with your catch.

- * Identify, measure, and release the fish. Use the references to help you identify the fish. If you measure many fish of one species, you may notice that the fish fall into two or more size groups. Each one of these size groups probably represents an age class of the fish—fish of the year, fish that are 1+, 2+, etc.
- * Try the technique of *gyotaku* (Japanese fish printing).
- * Study the contents of each fish's stomach to gain an understanding of its food habits. Read about the life history of the fish.
- * Have a fish fry.

GLOSSARY

- Environment** —all the things (conditions, circumstances, and influences) that surround and affect organisms
- Organism** —any living thing
- Intertidal zone** —area between the highest high tide and the lowest low tide

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UNIVERSITY OF CALIFORNIA
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Sea Grant
MARINE ADVISORY
 PUBLICATION
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The authors are Christopher M. Dewees, Extension Marine Resources Specialist, and Jon K. Hooper, Staff Research Associate, Davis.

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The authors are Christopher M. Dewees, Extension Marine Resources Specialist, Jon K. Hooper, former Staff Research Associate, and Isabella A. Abbott, Professor of Biology at Stanford University.

A great variety of algae is found along the seashore. If you press and mount algae as you collect them, you can learn more about them while making attractive decorations. Use the references to help identify the algae you collect.

The California Department of Fish and Game regulates the collection of organisms from the intertidal zone. Check the *Sport Fishing Regulations* carefully before going to the seashore. Do not collect in state parks without a special permit from the State Department of Parks and Recreation.

Materials

- shallow pan (cafeteria tray, cookie sheet, dishpan)
- thin piece of masonite or hardware cloth cut to fit the shallow pan
- mounting paper (drawing, art, or herbarium paper firm enough to support wet seaweed)
- lots of newspaper
- clean cloth to fit mounting paper (old sheets, dish towels, muslin)
- hollow-type cardboard (from corrugated cardboard cartons)
- two pieces of plywood (approximately 12 by 20 inches)
- two belts or a length of rope

Herbarium supplies are available from:

Herbarium Department
Carpenter/Offutt Paper, Inc.
P.O. Box 3806, Rincon Annex
San Francisco, California 94119

PRESSING ALGAE

Method

The object is to float the seaweed, to arrange it as flat as possible on a firm piece of paper so that it will dry quickly, and to apply pressure to insure a print-like appearance. Several species may be arranged together to make artistic prints if they are of the same thickness so that they will dry evenly. This method works on freshwater algae as well as marine algae.

1. Wash seaweed in clean seawater or in fresh (tap) water if seawater is not available. (Tap water is not recommended for delicate red seaweeds because they lose their color easily.) Take off all animals, rocks, shells, etc. and trim the plant to your liking. (A plant that is too thick will not dry readily.)
2. Pour seawater or fresh water into the shallow pan. Slip in the piece of masonite or hardware cloth. Place paper for mounting the specimen on the masonite or hardware cloth.
3. Place the specimen in the water and allow it to float out over the paper. Arrange it on one plane as flat as you can, and as artistically as you like.
4. By one end, carefully lift the masonite or hardware cloth, with paper and specimen on it, from the water. Drain by tilting at about a 45° angle.
5. Cover a piece of cardboard with a double layer of newspaper. Place the wet paper, with the algae specimen on it, on the newspaper. Lay a piece of cloth over the specimen and a piece of newspaper over the cloth, and top with another piece of cardboard.

Cooperative Extension
UNIVERSITY OF CALIFORNIA
Division of Agriculture and Natural Resources

Sea Grant
MARINE ADVISORY
PUBLICATION
7059
FORMERLY LEAFLET 2556

This is the basic unit for drying a specimen, starting at the bottom: cardboard, newspaper, mounting paper with specimen, cloth, newspaper, cardboard.

6. Keep adding units to this pile until you are finished. Place the finished pile between two pieces of plywood and tie securely with belts or rope. Place a weight on top if possible (a rock or bricks, for example).
7. Place the plant press near a heater or in a warm, open window.
8. Change the cloth, newspapers, and cardboard after 12 to 24 hours. Remove the cloth at the second change. Change the newspapers and cardboard daily until the specimen is dry to the touch. (Very delicate plants will be dry in 48 hours; coarse plants may take 5 days or more.)
9. Most plants will be stuck to the paper when dry as most algae have their own "glue." If they are not stuck, apply white glue.
10. If your specimens are to be used for reference, label with the place and date of collection, adding your name as collector. The

name of the alga can be added after reference to one of the books.

Some collectors use waxed paper between the specimen and the cloth. Others consider this step unnecessary. If you have a desk blotter that can be cut up, use it in place of top newspaper. Blotters are handy to use, but not necessary for successful pressing.

GLOSSARY

Algae	a group of plants that have no true root, stem, or leaf — often called seaweed, but found in both fresh and ocean water
Herbarium	a collection of dried plants used for botanical study
Intertidal zone	area between the highest high tide and the lowest low tide
Specimen	an individual organism used as an example or sample of an entire group

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Marine Advisory Publication

SAFE HANDLING AND STORING OF SEAFOODS

The author is Robert J. Price, Seafood Technology Specialist, Cooperative Extension, Davis.

Seafoods, like many other foods, are perishable and must be handled properly to avoid spoilage and food poisoning.

Seafood spoilage and food poisoning

Both food spoilage and food poisoning are caused primarily by bacteria. Bacteria cannot be seen with the naked eye, yet they are present almost everywhere: in water, air, and dirt, and on our skin, clothing, and foods. These bacteria are usually harmless, but many of them can cause serious problems when they are present on foods that are mishandled.

It has been estimated that over one million Americans experience some type of "food poisoning" each year. Because this is such a common problem, you should be aware of food handling techniques that will prevent food poisoning outbreaks in the home.

Spoilage bacteria and disease-producing bacteria thrive at warm temperatures and can live very well on seafood. In the danger zone — between 40° and 120° F — bacteria can double in number every 15 to 30 minutes.

Let us take 15 minutes per generation as an example to see what this means. If we started at 12:00 with one bacterium, at 1:00 there would be 16 bacteria; at 2:00 there would be 256; and by 5:00, only 5 hours later, there would be over one million.

Because fresh seafood normally contains thousands of bacteria, seafood held at room tempera-

ture for only a few hours will contain hundreds of millions of bacteria. This tremendous growth rate is not theoretical; it is exactly what happens in and on seafood and other perishable foods that have been mishandled by being left at the wrong temperature.

Handling seafoods

What can you do to prevent spoilage and food poisoning? The secret is to handle seafood properly right from the start, whether you purchase it at a store or catch it yourself.

If you purchase seafood, always buy from a source that maintains high standards. Know the characteristics of quality seafood, and avoid low-quality products.

When you leave the fish market, keep your seafood cold. Leaving a sackful of groceries in the car on a hot day hastens spoilage and may make seafood unsafe to eat.

If you're bringing home fish that you have caught, pack them in ice before starting home, rather than throwing them in the hot trunk of your car where they may spoil rapidly.

When you get home, place seafood in the refrigerator immediately.

Storing fresh seafood

Wrap fresh seafood in "cling wrap" or store in air-tight containers.

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Sea Grant
MARINE ADVISORY
PUBLICATION
7124
FORMERLY LEAFLET 21119

Store fresh seafood at 35° to 40° F to maintain quality, retard spoilage, and prevent the growth of food-poisoning bacteria. Fresh seafood spoils rapidly at temperatures above 40° F.

Seafood quality also decreases with storage time, and fresh fish and shellfish should not be held more than a day or two before being cooked.

Live clams and oysters will stay alive in the refrigerator for a week or more. Store live shellfish in open containers covered with a damp cloth. Storing live shellfish in salt water shortens their shelf life, and storing them in fresh water kills them.

Storing frozen seafood

Frozen seafood products should be placed in the freezer in their original moisture-vaporproof wrapping immediately after purchase, unless they are to be thawed for cooking. Frozen products packaged in overwrap trays should be re-packaged in cling wrap or other moisture-vaporproof material before being stored in the freezer.

A temperature of 0° F or lower is needed to maintain the quality of frozen seafood. At temperatures above 0° F, slow chemical changes cause the seafood to lose color, flavor, texture, and nutritive value.

Freezer storage is a convenient way to keep seafood, but storage time should be limited to maintain quality. Shellfish and fatty fish, such as salmon and mackerel, should not be held longer than 3 to 4 months before being cooked. Lean fish, such as sole and rockfish, can be stored satisfactorily for 9 to 12 months.

For the best flavor, *all* frozen seafoods should be used within a month or two.

Thawing frozen seafood

Many frozen seafood products, such as fish sticks, fish portions, and breaded shrimp, should not be thawed before cooking. Other frozen products, such as fillets and steaks, may be cooked without thawing if additional cooking time is allowed. If you must thaw frozen seafood, use one of two recommended methods:

- Thawing in the refrigerator. This takes about 18 hours per pound.
- Thawing under cold running water. This takes only about ½ hour per pound.

With either method, keep the seafood in its original wrapper until it has thawed.

Thawing at room temperature or in warm water *is not* recommended. Thinner parts of the seafood thaw faster than thicker parts, and the outer edges may start to spoil before the center has thawed.

Thawed seafood is more susceptible to spoilage than fresh seafood and should not be held more than a day before cooking.

If a package of frozen seafood has thawed, it is best not to refreeze it. Although refreezing will not make the product unsafe, it will lower the quality of the seafood considerably.

By learning how to handle and store seafood properly, you can preserve its quality and be sure that it will have the delicious flavor you enjoy.

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Marine Advisory Publication

Sampling Plankton

Plankton are tiny, usually microscopic plants and animals. They drift in both fresh water and seawater, and are an important source of food for larger animals. Plankton come in many different sizes and shapes. The intricate shapes of plankton help them float in the sunlight-filled surface waters where the plankton must remain if they are to survive.

You can make your own plankton net from a piece of wire (coat hanger wire works well) and a nylon stocking.



1. First bend the wire into a circle about the size of the top of the stocking and secure the loose ends.
2. Sew or otherwise attach the top of the stocking to the wire. You can leave the foot intact, but then you must rinse out the plankton after sampling. For this reason, you may prefer to cut off the foot of the stocking and secure a small bottle in the end to catch the sample.

You can collect plankton from lakes, bays, beaches, and the ocean. When collecting from the surf, pour several bucketfuls of water through the net. If you drag the net through the surf, you collect too much sand.

To view the zooplankton (animal plankton), use a dissecting scope or a hand lens.

Things To Do

Use the references to identify as many types of plankton as possible. Which ones are the most common?

Collect plankton samples from different areas (bays, ocean, beaches). Are the types of plankton and their relative abundance different at each site? (If you want, you can try the statistical analysis described in the activity on *Intertidal Zonation*, UC Leaflet 2551.) Do the plankton populations vary at each location at different times of the year? Why?

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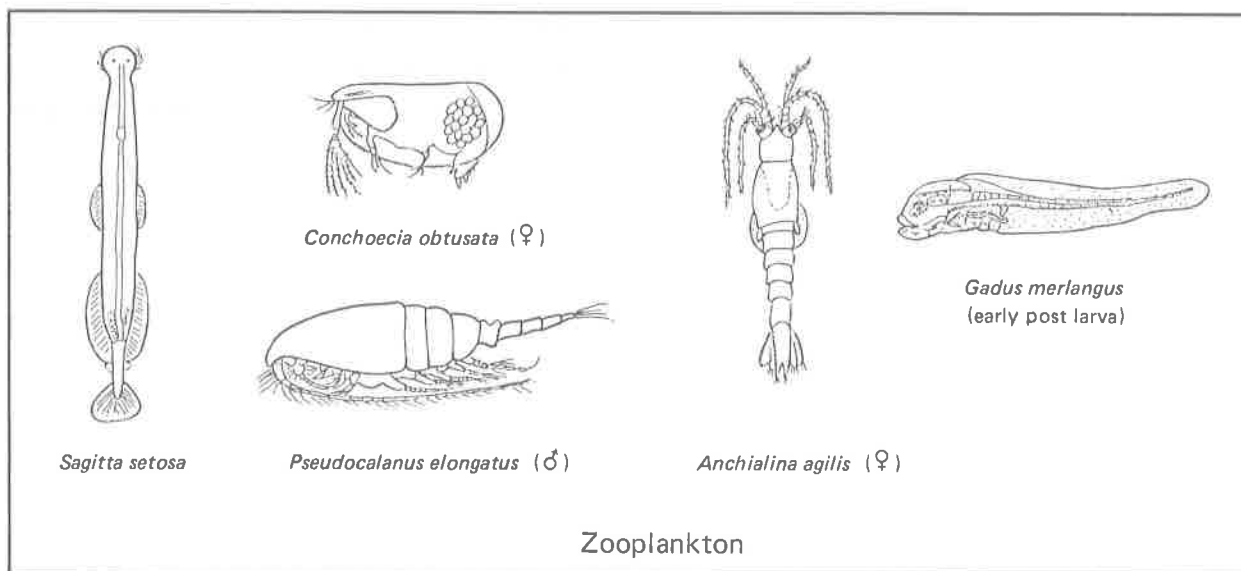
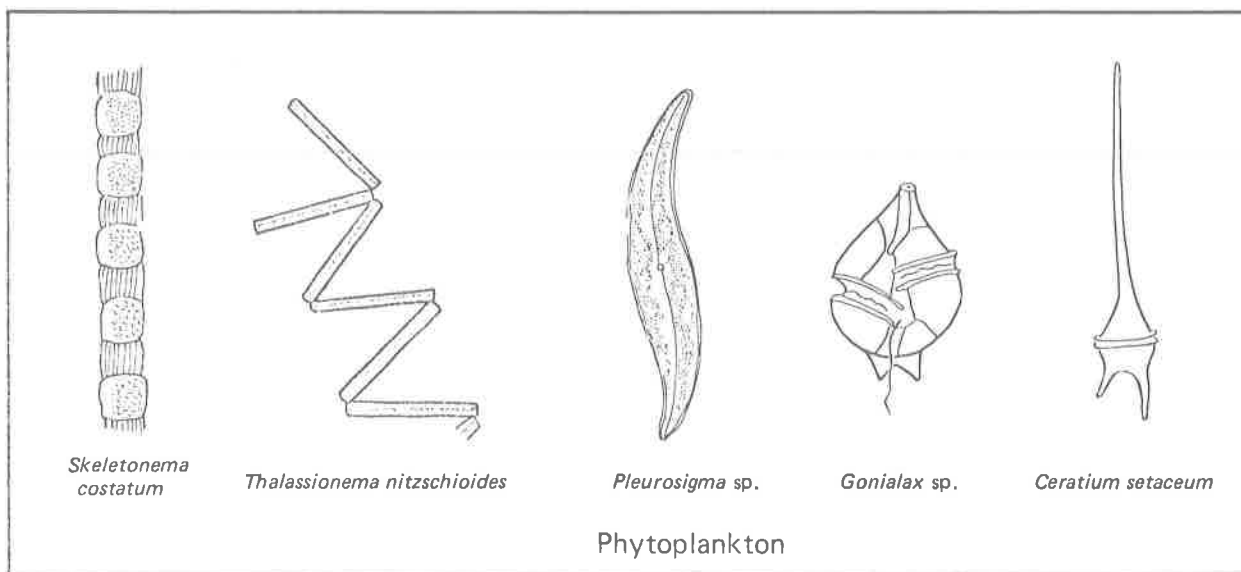
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The authors are Christopher M. Deweese, Extension Marine Resources Specialist, and Jon K. Hooper, Staff Research Associate, Davis.

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Marine Advisory Publication

The author is Robert J. Price, Seafood Technology Specialist, Cooperative Extension, Davis. This leaflet was prepared in part from information from Marine Resources Bulletin, November/ December 1977, published by Virginia Institute of Marine Science, Gloucester Point.

SEAFOOD MYTHS AND MISCONCEPTIONS

A variety of myths, misconceptions, and old wives' tales concerning seafoods have passed from generation to generation throughout history. Some of these beliefs are based in part on fact, but others have no logical basis.

Shellfish should be eaten only during months with an "R" in them

This saying originated in Europe and was based on factors connected with the reproductive events of European oysters. The oyster species in Europe brood their young and are unpleasant to eat from May to August because of the crunchiness of the baby oyster shells in the brood chamber. In addition, the spawned-out European oysters are generally less plump and tasty during this period. Oysters in this country do not brood their young and are good to eat throughout the year.

Many people think the saying means that shellfish are always safe to gather and eat during the months with an "R" in them, but shellfish containing paralytic shellfish poison can occasionally be found in California during the "R" months of September and October. For this reason, the State Department of Health imposes a quarantine on the sports or recreational harvesting of mussels from May 1 to October 31. Clams harvested during the quarantine should be thoroughly cleaned, and only the white meat prepared for human consumption.

Commercially harvested oysters, clams, and mussels are sold in California retail stores and restaurants throughout the year. These shellfish are raised and harvested under federal and state regulations designed to ensure that only safe, nontoxic shellfish are available to consumers.

Fish is brain food

The idea that eating fish enhances mental ability dates back to the 19th century, when a Harvard University scientist discovered that compounds containing phosphorus are abundant in the brain. He urged people to eat fish, which is rich in phosphorus. The scientist reasoned that eating such foods would increase the amount of phosphorus in the brain, and thus increase brain power. Although phosphorus is an important nutrient, the concept that phosphorus will improve IQ has long since been disproved.

Raw oysters are an aphrodisiac

Will eating raw oysters or other raw seafoods make you more amorous? Oysters and some other seafoods do contain cholesterol, the basic building block of both male and female sex hormones. But the human body produces enough cholesterol to satisfy our total needs. The additional cholesterol from oysters will not affect sexual behavior or act as a love potion.

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PUBLICATION
7125
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Dead shellfish are toxic and should not be cooked or eaten

People have been warned not to eat clams, mussels, oysters, crabs, lobsters, and other shellfish unless they are alive when cooked. This suggestion is good, but not because shellfish become toxic when they die.

When a shellfish dies, its digestive gland breaks down, releasing powerful enzymes that begin to digest the animal's flesh.

This digestion proceeds rapidly, resulting in discoloration of the shellfish meat and producing off-flavors and off-odors. Dead shellfish may appear fresh, but when cooked they can have a decomposed flavor and odor. For this reason, it is best to clean and cook only live shellfish.

Mahi-Mahi is actually porpoise meat

Mahimahi is a species of fish caught in tropical waters and marketed throughout the world. Because mahimahi is often called *dolphinfish* or *dolphin*, many people confuse it with the marine mammal of the same name. The dolphin (mammal) is protected by the 1972 Marine

Mammal Protection Act and is not harvested or used for food in this country.

Eating seafood with fresh milk will make you sick

The myth that eating seafood with fresh milk will make you sick has been around for many years. The origin of this misconception is unknown, and there does not appear to be any logical basis for it. If both the milk and seafood are fresh and wholesome, the combination of the two cannot possibly cause food poisoning.

Frozen seafood is inferior to fresh seafood

Many people believe that frozen seafood is always inferior to fresh seafood. Because most seafoods are harvested seasonally, a portion of the harvest is usually processed into frozen products. This enables consumers to select from a variety of seafoods throughout the year.

High-quality seafood that is properly processed, packaged, frozen, and stored can be equal in quality to fresh seafood.

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Marine Advisory Publication

SMOKED SHARK AND SHARK JERKY

The authors are John B. Richards, Area Marine Advisor, San Luis Obispo, Santa Barbara, and Ventura counties, and Robert J. Price, Seafood Technology Specialist, Cooperative Extension, Davis. Special thanks go to Joe and Vonnie Pak of Depoe Bay, Oregon, for the smoking recipe, and to Jim Graybill of Sandy, Oregon, for sharing the jerky recipe.

Smoking or drying fish at home is an easy, economical way to preserve your catch of large fish, such as shark, for later use. Smoked shark makes a delicious hors d'oeuvre; shark jerky is a good snack and a fine trail food for backpacking. Most other fish can be prepared exactly the same way.

For best flavor and texture, use fresh or recently frozen shark or other fish.

SMOKED SHARK

The best species to use for a smoked product are the soupfin, thresher, leopard, angel, and dog shark (pin back). The blue shark is best prepared as jerky, because its flesh is softer. The following recipe also works well with salmon.

1. Fillet about 4 pounds of shark and cut the pieces into chunks or strips about 1½ inches thick and 2 inches wide.
2. Prepare a brine of 2 cups of well-packed dark

brown sugar, ⅔ cup salt, 1 tablespoon seafood seasoning (optional), and 2 quarts water. Mix well until salt and sugar are dissolved.

3. Soak shark chunks in brine overnight.
4. Remove shark from brine and rinse well with fresh water.
5. Place shark on a rack in a cool, shady, breezy place to dry for about an hour. A tan shiny skin, or pellicle, should form on the surface.
6. Smoke the shark in a commercial or home-made smoker for 10 to 14 hours, depending on outside temperature. Drying takes longer in cold weather. The temperature of the smoker should be between 130° and 150° F (54° and 66° C).
7. Wrap each piece of fish in heavy waxed paper. Some moisture remains in the smoked product, so it should be refrigerated. Smoked shark should last 2 weeks or more in the refrigerator, longer if frozen.

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Sea Grant
MARINE ADVISORY
PUBLICATION
7126
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SHARK JERKY

Any shark species can be used, but jerky made of blue shark is especially good. Most other fish, as well as beef and venison, can also be prepared in this way.

Plans for building a portable electric food dehydrator are given in Leaflet 2785, *Drying Foods at Home*, available from county University of California Cooperative Extension offices.

1. Fillet the shark or fish, and cut into strips approximately $\frac{1}{2}$ inch thick and 2 inches wide. Use any length you desire. Cut across the grain of the muscle for a more tender product. Placing the fillets in the freezer for a day or so makes slicing easier.
2. For every 2 pounds of sliced shark, prepare a sauce from $\frac{1}{8}$ cup teriyaki sauce, $\frac{1}{8}$ cup liquid smoke, 6 drops of tabasco sauce, 1 teaspoon garlic powder, 1 teaspoon onion powder, and 2 teaspoons salt.
3. Place about half of the prepared shark in a plastic bag. Pour half of the sauce over the shark. Add remaining shark and sauce. Roll the bag back and forth so that the sauce covers all of the shark.
4. Marinate strips in the refrigerator for 8 hours (for blue shark) or 12 to 15 hours (for other shark).

5. Remove marinated strips from the refrigerator and place on $\frac{1}{2}$ -inch-square hardware cloth or other racks. Sprinkle coarse-ground black pepper on both sides of the strips.
6. Place racks in oven or food dehydrator and set the temperature to 140° F (60° C). If you use an oven, prop the oven door open at least 4 inches. A small smoker will also work well.
7. Blue shark should be dried for about 12 hours. Other species may take less time. Time in the smoker will depend a great deal upon the amount of moisture in the flesh at the beginning of the process and the temperature of the smoker. Check at regular intervals and remove the fish before it becomes too dry.

The finished product should be firm, dry, and tough, yet not dry enough to crumble to the touch. When chewed, the meat should have some resiliency, or a rubbery characteristic. Overcooked jerky comes out crunchy.

8. Store finished jerky in airtight jars in a cool place.

The same method can be used to make jerky from beef or venison. Remove all fat from meat before cutting it into strips. Marinate the strips for 24 hours and dry for about 24 hours.

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AUDIO-VISUAL MATERIALS

Available from: Sea Grant MAP Extension
University of California
Davis, CA 95616

"Oregon Trawler" (describes commercial bottom fishing).
"From the Edge of Extinction" (sea otter management).
"Silvers for San Francisco Bay" (describes salmon enhancement project).
Four ¾" videotape cassettes

- | | |
|-------------------------------|------------------------|
| 1. "Commercial Bottom Fishing | 3. "Coastal Estuaries" |
| 2. "Seafood Processing" | 4. "Oyster Farming" |

Available from: Motion Picture Library
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"Mammals of the Sea" (marine mammal conflict) #27-819.
"Canning and Freezing Fish at Home" (describes methods) #27-109.

Available from: California Department of Fish and Game Regional Offices.*

- "Fish in the Sea" (Fish and Game ocean sportsfishing projects)
- "From the Edge of Extinction" (sea otter management)
- "The Grunion Story" (grunion spawning and hatching)
- "Hatcheries to Save Fish Runs" (Feather River Salmon Hatchery)
- "Life at the Edge of the Sea" (tidepool conservation)
- "Salmon—Today and Tomorrow" (salmon habitat problems)
- "Science Gets the Facts—The Anchovy Project" (anchovy fishery management)
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- "Beach, A River of Sand" (beach dynamics).
- "Challenge of the Oceans" (ocean research in the 1950s).
- "Fish Out of Water" (grunion biology).
- "Ocean Tides" (explains tides).
- "Plankton and the Open Sea" (importance of plankton in food chains).
- "Sea" (marine biology and research).
- "Sea Lions and Fur Seals" (describes behavior).
- "Three Fishermen" (compares lives of fishermen).
- "Waves on Water" (describes sources and structure of waves).
- "What Is a Fish?" (describes different types of fish).

Available from: Visual Media
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(Slide-cassette tape sets with scripts. Send for a catalogue showing prices.)

- "Canning Fish at Home" (Spanish and English).
- "Smoking Fish at Home" (Spanish and English).
- "Freezing Seafood at Home" (Spanish and English).
- "Seafood Facts and Bargains"
- "How to Eye and Buy Seafood"
- "Handling and Storing Seafoods"
- "Survival in Cold Water"
- "Introduction to Intertidal Plants and Animals"
- "Identifying Coastal Birds of California"

**UC COOPERATIVE EXTENSION
SEA GRANT MARINE ADVISORY PROGRAM LEAFLETS
(Available from the Cooperative Extension office in your home county)**

Leaflet number	Title
2246	Ecology of the Intertidal Zone
2255	Biological Oceanography
2272	Major Commercial Fisheries in California
2274	Marine Mammals
2548	Gyotaku—Japanese Fish Printing
2550	Identifying Seashore Birds
2551	Intertidal Zonation
2669	Smoking Fish at Home
2727	Characteristics of Rope Used in the Fishing Industry
2784	Marine Education Bibliography
2911	Sharks—An Annotated List of Selected References
2939	Upwelling in California Coastal Waters
21110	Marine Algae
21112	Catching, Cleaning, and Cooking Squid
21114	Fish Eggs for Caviar and Bait
21318	Protecting Your Dog from Diseases Caused by Eating Raw Fish
21330	The California Squid Fishery
4-H-7004	Using Drift Bottles to Measure Ocean Currents

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IMPORTANT!

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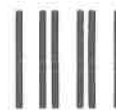
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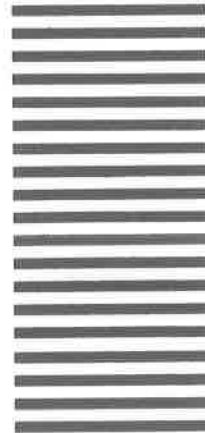


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the 1990s, the number of people with a mental health problem has increased in the UK (Mental Health Act 1983, 1990).

There is a growing awareness of the need to address the needs of people with mental health problems in the community. This has led to the development of a range of services, including community mental health teams, crisis teams, and day centres.

One of the key challenges for these services is to ensure that they are accessible to all people who need them. This is particularly true for people who are homeless or living in poor housing.

Homelessness is a major problem for people with mental health problems. It is often a result of a combination of factors, including poverty, unemployment, and a lack of family support.

People who are homeless are at a higher risk of mental health problems. This is because they often lack a stable home, which is essential for their well-being.

It is therefore essential that services for people with mental health problems take account of their housing needs. This may involve providing temporary accommodation or helping people to find permanent housing.

There are a number of ways in which services can help people with mental health problems to find housing. These include providing advice and support, and helping people to access housing benefits.

It is also important to ensure that people with mental health problems are able to access housing services. This may involve providing transport or other support to help them get to the service.

Finally, it is important to ensure that housing services are aware of the needs of people with mental health problems. This may involve providing training and support to staff.

By addressing the housing needs of people with mental health problems, services can help to improve their quality of life and reduce the risk of further mental health problems.

There is a need for further research into the housing needs of people with mental health problems. This will help to develop more effective services for these people.

In conclusion, housing is a key issue for people with mental health problems. Services need to take account of their housing needs in order to provide effective support.

CALIFORNIA



Marine Advisory Publication

Gyotaku

PERMANENT
FILE

Flayt

Japanese Fish Printing

The technique 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 even 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?

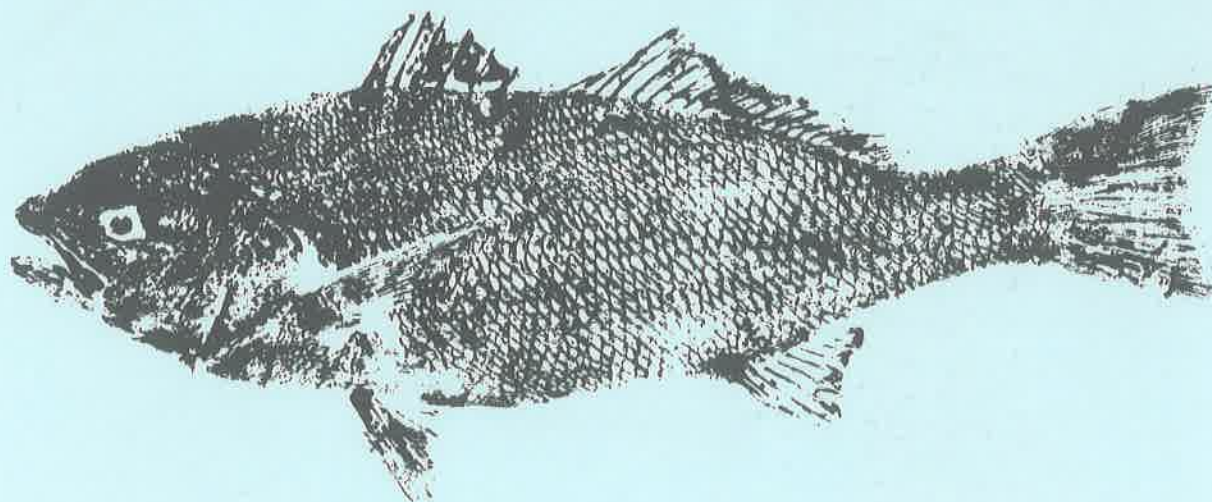
Materials

Obtain a very fresh fish—flounders, bluegills, or rockfishes are good to start with. 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:

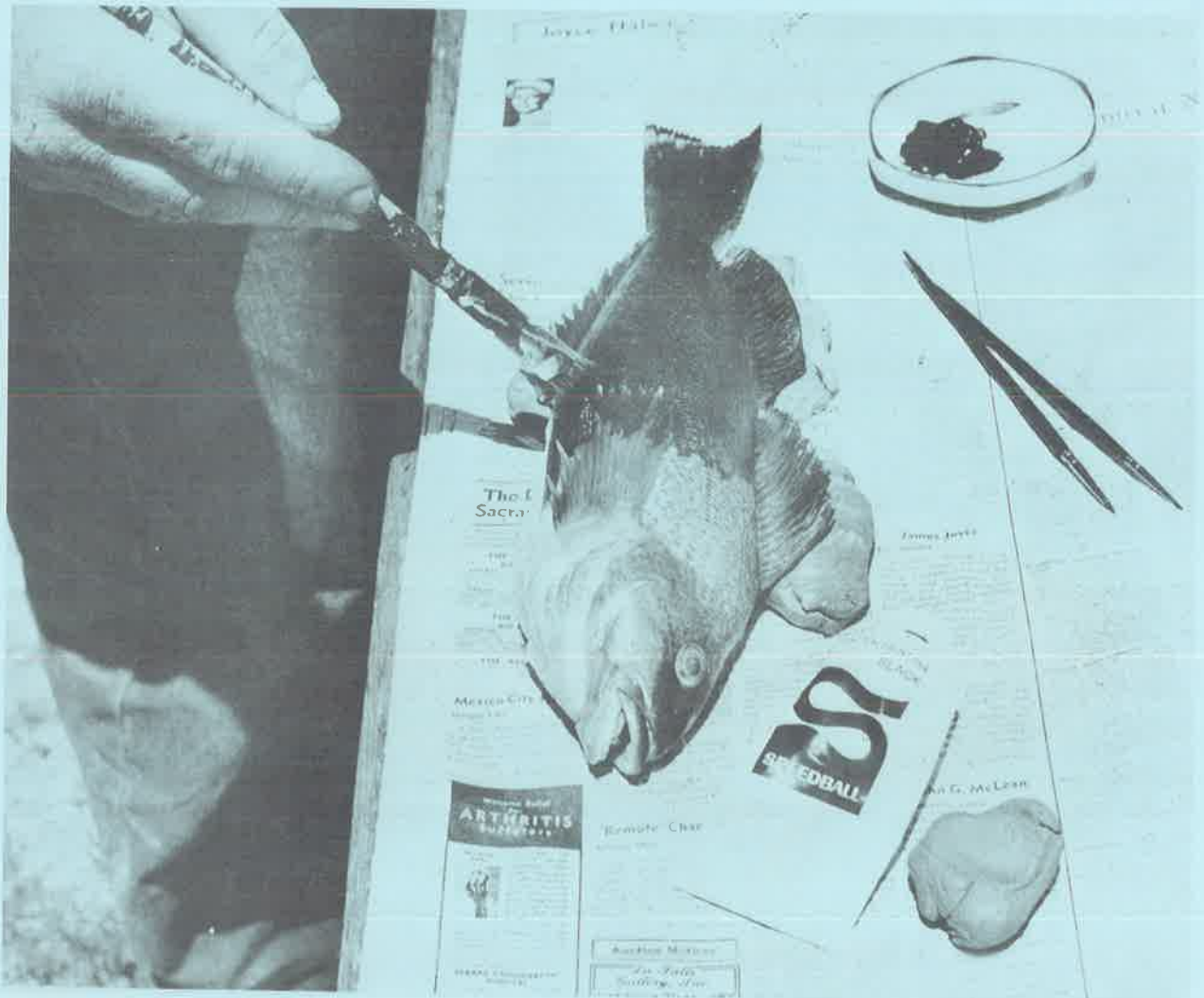
- * newspaper
- * plastic modeling clay
- * pins
- * water-base ink (linoleum block ink is best)
- * a stiff ½-inch brush
- * a very small brush
- * rice paper, newsprint, or other moisture-tolerant paper

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 newsprint 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.





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The authors are Christopher M. Dewees, Extension Marine Resources Specialist, and Jon K. Hooper, Staff Research Associate, Davis.

The University of California's Cooperative Extension programs are available to all, without regard to race, color, or national origin.

4-H MARINE SCIENCE

Leaders' Manual



Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

4-H-7016

PRINTED JUNE 1982

Written by the 4-H Marine Literature Development Committee:

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PERFORMANCE OBJECTIVES

Each 4-H member should complete at least 8 out of the 11 following objectives:

1. Put together a beach safety kit and list seven beach safety tips.
2. Explain to others basic concepts of oceanography such as tides and waves.
3. Identify the most common seashore plants and animals.
4. Name at least ten food products from the sea.
5. Prepare a low cost seafood dish.
6. Describe one important local commercial fishery.
7. Rig and use recreational fishing equipment.
8. Do at least one type of marine-oriented art or craft.
9. Identify and discuss at least one marine policy issue.
10. Name at least five marine careers and the qualifications for these careers.
11. Name and describe to others one presently exploited ocean energy resource and one potential ocean energy resource.

At the end of this publication there is a list of additional publications that will provide more in-depth information on marine resources. Other marine resources information will be developed, so check with your local 4-H Youth Advisor or Marine Advisor about new and useful materials.

CONTENTS

Introduction: Why Study the Marine Environment . . .	5
How to Use the Leaders' Manual . . .	5
Resources Available to 4-H Marine Resource Leaders . . .	6
Beginning Unit	
Introduction and Beach Safety . . .	7
Oceanography: tides and food chains . . .	9
Marine Biology: tidepools . . .	11
Marine Biology: tidepool field trip . . .	12
Food from the Sea: squid and product treasure hunt . . .	12
Fisheries: Armstrong reel and surf fishing . . .	14
Ocean Arts and Humanities: beach arts . . .	17
Marine Politics: environmental policy . . .	18
Marine Public Service: habitat improvement and public education . . .	19
Career Exploration . . .	19
Intermediate Unit	
Introduction and Safety: boating safety . . .	19
Oceanography: plankton, currents, and beaches . . .	20
Marine Biology: algae . . .	21
Marine Biology: birds . . .	22
Food from the Sea: algae and shellfish . . .	22
Fisheries: crabbing, commercial fishing, and aquaculture . . .	23
Ocean Humanities: fish printing and mass media information . . .	24
People and the Marine Environment: Native American and maritime history . . .	25
Marine Public Service: public education . . .	26
Career Exploration . . .	26
Advanced Unit	
Introduction and Safety: hypothermia and first aid . . .	26
Oceanography: drift bottles and food chains . . .	27
Marine Biology: intertidal zonation and marine research . . .	29
Marine Biology: marine mammals . . .	30
Food from the Sea: seafood safety and seafood processing . . .	31
Fisheries: poke pole fishing and commercial fishing methods . . .	32
Ocean Arts and Humanities:	
algae pressing, Native Americans and environmental policy . . .	33
Marine Resources Management: conflicts and marine research . . .	34
Marine Public Service: habitat restoration . . .	35
Career Exploration . . .	36
Other Activities	
Sailing . . .	37
Boat Building . . .	37
S.C.U.B.A. . . .	38
Ocean Energy . . .	38
Selected References . . .	39
Audio-visual Materials . . .	42
List of Cooperative Extension Sea Grant Marine Advisory Program Leaflets . . .	back cover

DON'T Join the Bucket Brigade



LEAVE TIDE POOL LIFE ALONE!

California law extends protection to all animal forms. Enjoy your heritage; don't destroy it by taking more than the law allows. Consult current sport fishing regulations.

4-H MARINE SCIENCE Leaders' Manual

INTRODUCTION—WHY STUDY THE MARINE ENVIRONMENT?

People are intimately tied to the marine environment. Approximately 80 percent of California's residents live in coastal counties, and many of them make their livelihood in such occupations as marine recreation, commercial fisheries, ocean-related energy development, shipping, and the marine sciences. Further, all Californians rely on the sea as a source of food—directly from fish and shellfish, and indirectly as a source of high protein feed for meats such as poultry. The ocean also strongly influences climate by supplying cooling breezes and fog during summer months, by generating storms, and by moderating winter temperatures. California's large agricultural and tourism industries benefit greatly from the moderating effects of the Pacific Ocean. Millions of Californians utilize the coast for recreation. California is truly a marine-oriented state, and it is important that our citizens increase their knowledge about the marine environment.

The purpose of the 4-H Marine Resources Project is to promote wise management of marine resources by increasing California youths' awareness of the marine environment. This Leaders' Manual provides three units, each with ten activities designed to fulfill performance objectives. With increased knowledge about the marine environment, today's youth will be able to make wiser decisions about marine issues.

HOW TO USE THE LEADERS' MANUAL

The manual is divided into Beginning, Intermediate, and Advanced Units. Each unit has activities for ten 4-H sessions (approximately 1 year of 4-H meetings). The resources available for each activity (publications, slide sets, etc.) are listed at the end of the manual. In some subject matter areas where available resources don't exist, additional teaching ideas are supplied to assist the leader.

Because of the great variation in the ages, interests, and needs of 4-H youth groups, this project is designed to be very flexible. Often, more than one activity is suggested for each session. Choose the activities your group prefers, and don't feel restricted to the basic outline of the workbook. If the interests and capabilities of your 4-H group are varied, you can select activities from any of the three units or put together new learning activities that meet your needs and utilize local resources. Several of the activities discussed in this manual were developed by creative 4-H marine science groups. Many of the activities can be adapted to the freshwater environment and resources available to inland counties.

Often, marine education is dominated by sciences such as biology, geology, and oceanography. We feel that people's relationship to the sea is important. Many of the activities in this manual highlight the importance of the marine environment in the arts, literature, Native American culture, and environmental policy making. It is important to provide a marine element in many aspects of youth education.

RESOURCES AVAILABLE TO 4-H MARINE RESOURCES LEADERS

The Sea Grant College Marine Advisory Program, a part of UC Cooperative Extension, has developed numerous publications and audio-visual aids that are utilized in the 4-H Marine Resources Project. These materials are available through your 4-H Youth Advisor in your county's Cooperative Extension (Farm Advisor's) Office. All the publications and audio-visual materials used in this manual's activities are available through your County Cooperative Extension Office unless otherwise noted.

Cooperative Extension's Marine Advisors and Marine Specialists are another valuable resource. The Marine Advisors are located in coastal counties, and three Specialists are located on the UC Davis Campus; another UC Specialist is located at California State University at Long Beach. These people can supply information on local marine education resources, and they can help your group get started.

There are numerous other sources of good marine information and activities. The California Department of Fish and Game has a Conservation Education Program that includes materials on marine topics. A few individuals might give talks or help arrange activities. Offices are located in Bishop, Blythe, Eureka, Fresno, Long Beach, Menlo Park, Monterey, Morro Bay, Rancho Cordova, Redding, Sacramento, San Diego, Stockton, and Yountville. A list of Department of Fish and Game publications is available from the Office of Procurement, Publication Section, General Services, P.O. Box 1015, North Highlands, CA 95660.

There are numerous other potential sources of marine materials, activities, and expertise that could help you develop your local 4-H Marine Resources Project. Some of these are listed below.

1. The National Marine Fisheries Service has offices in La Jolla, Terminal Island, and Tiburon. They are good sources of fisheries information.
2. Universities and colleges have staff and students interested in marine subjects. Some campuses with particularly active public marine education programs are: University of California at San Diego (Scripps Institution of Oceanography), Santa Barbara (Marine Science Institute), and Santa Cruz (Long Marine Lab); Humboldt State (Fred Telonicher Marine Laboratory), Moss Landing Marine Laboratories, College of Marin, UC Bodega Bay Marine Laboratory, and Long Beach State (Southern California Ocean Studies Consortium).
3. County, state, and national parks in coastal areas often have educational materials, facilities, and programs.
4. Other governmental agencies such as the U.S. Fish and Wildlife Service, Army Corps of Engineers, State Department of Boating and Waterways, and the Bureau of Land Management have available environmental education materials and programs.
5. Environmental organizations such as the Oceanic Society are a good resource.
6. Many school districts have marine education programs. Schools in San Diego, Orange, Los Angeles, Alameda, Contra Costa, Sacramento, and Marin Counties are especially active.
7. Members of local sportsfishing, scuba, and yacht clubs can be helpful.

8. Representatives of local marine industries can supply insight into their industries and the career outlook. Some examples include commercial fishing, seafood processing, boatyards, marinas, environmental consulting firms, and oil companies.
9. The Southwest Marine Education Association, a chapter of the National Marine Education Association, is a good source of ideas and contacts through their journal, "Currents." Information on the Association is available from Ruth Symonds, 5400 Halbrent Avenue, Van Nuys, CA 91411.
10. An "Inventory of Non-Technical Marine Resources, Publications, and Audio-Visual Materials" is available from Sea Grant Communications, 418 Administrative Services Building, Oregon State University, Corvallis, OR 97331. Ask for PASGAP Publication No. 5.

BEGINNING UNIT

Session I—Introduction and Beach Safety

- I. **Performance Objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Name seven beach safety tips.
 - b. List four items in a beach safety kit.
 - c. Name four dangerous marine animals and explain why they may be dangerous.
- A. This is the introductory meeting. Help everyone get to know each other. Discuss what you would like to accomplish during the year. Have the group set goals for the year.
- B. Discuss beach safety. Several of the group's activities will be at the seashore and building good beach safety habits will carry over into future years. The seashore is an interesting but potentially dangerous place. Care and planning can lessen the danger.

BEACH SAFETY TIPS

1. Use a "buddy system" so all participants operate in pairs. It is advisable to have several adults along as helpers for each group of 4-H members on the beach.
2. When near the surf, don't allow anyone to turn their back to the ocean—a large breaker could sweep you off your feet. If swept off your feet, grab and hold onto the nearest rock if possible. If swept out to sea, don't fight against the current; drift or swim with or across the current until help arrives.
3. Keep a life ring (or inner tube) and a 40-foot rope in a handy spot on the beach and mark it with a red flag.

4. For tidepool trips, check the tide book for the times and heights of the tides. Stay aware of the time and tide level so you won't be trapped on the outer part of a reef.
5. Don't allow anyone to run or jump on algae-covered rocks. They are extremely slippery.
6. On trips to rocky areas, don't wear shorts or bathing suits because there are many sharp edges on rocks and many abrasive organisms such as barnacles. Be sure to wear rubber-soled shoes or boots because the rocks are wet and slippery.
7. Take along a first-aid kit.
8. Dress warmly, especially in northern California, because our coastal waters and climate can be quite cool. Subnormally low body temperature (hypothermia) reduces alertness and increases the probability of an accident.
9. Protect your skin from excessive exposure to sun and wind.
10. Know how to spot and avoid rip currents, especially if you plan to be in the water. Ninety percent (90%) of all lifeguard rescues are made of people caught in rip currents. Rip currents tend to be near jetties, piers, coves, and rock groins. Rip currents often have brown, murky waters that are choppy and foam-covered. Look at people and objects in the water; if they are floating out to sea, they are probably in a rip current.

If you get caught in a rip current, don't panic and don't fight the current. Determine which way the long shore current is moving and swim in a 45-degree angle toward shore, swimming with the long shore current. Another way out of a rip current is to swim in at a 90-degree angle to the current until you are out of the rip; then swim toward shore. If you can't get out of the rip current, yell and look for help.

- C. Put together a beach safety kit for future field trips. Some items to include are: a first-aid kit, life-rings or inner tube, a 40-foot rope, drinking water, and waterproof matches. You may want to add other items, such as warm clothes and blankets, depending on the nature of your trip.
- D. Discuss dangerous marine animals, such as jellyfish, using the following reference: Halstead, B.W. 1970. *Poisonous and Venomous Marine Animals of the World*. U.S. Government Printing Office, Washington, D.C. (available at many libraries).

Session II—Oceanography

- I. **Performance objectives.** After completing this session's activities 4-H members should be able to:
- Answer correctly all seven tide table questions;
 - Give two examples of marine food chains.
- A. Teach the group how to understand and use tide tables. Tide tables are usually available through local marine business such as sporting goods stores, bait shops, and boating equipment dealers for free or a minimal charge. Newspapers often print tide tables.

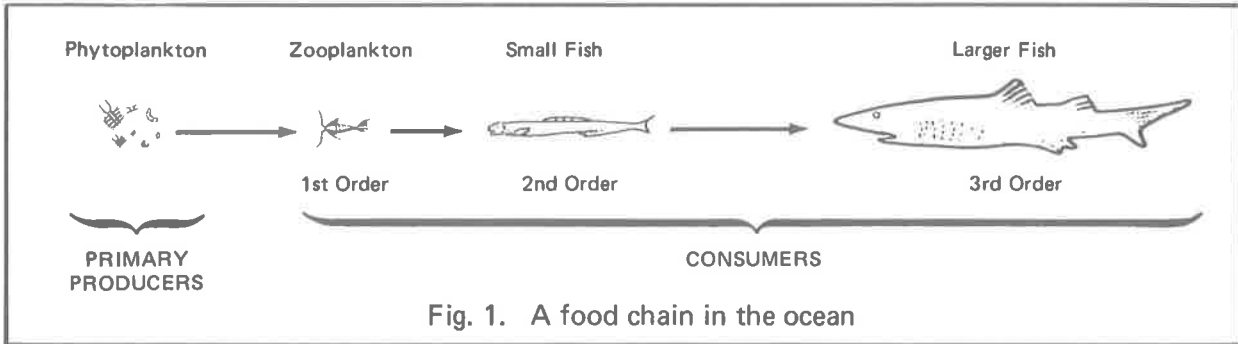


Fig. 1. A food chain in the ocean

Knowledge of tides is essential to people who make a living or enjoy recreation at the coast. For example, ability to use a tide table is necessary to determine the best fishing or clamming tides or to plan a boating trip to take advantage of the tidal current.

California has mixed tides, which means that there are two high and two low tides of unequal heights. Tide tables will show the time (0000 = midnight, 1200 = noon) and height of the tide.

Most tide tables have appendices that give the differences in times and heights of high and low water at various locations along the coast. Some tide tables also include tidal current tables which give time and flow rate of incoming and outgoing tides as well as the time of slack current. Tidal current information is especially useful to boaters.

For a more complete explanation of tides, consult one of the textbooks listed under Oceanography at the end of this publication. Another good reference is "Understanding Tides" (SG 25). It is available from Sea Grant Communications, 418 Administrative Services Building, Oregon State University, Corvallis, OR 97331.

The following tide table quiz can be used to test and enhance the 4-H members' ability to use tide tables.

Tide Table Quiz

- What are mixed tides? How many high and low tides are there per day on the California Coast?
- How is 3:20 a.m. written in the tide table? 7:30 p.m.?
- Which is the lower tide: -1.1 or 1.1?

4. Find what the tides are on your birthday.
 5. Find a good day for a tidepool field trip. Why is it good?
 6. Why are tides important to boaters?
 7. List the time and tide level for all four tides today.
- B. Another activity for the group is to place a pole or mark on an existing structure in the intertidal zone and watch the water rise and fall throughout the tidal cycle. Compare the observed difference between low water and high water with the difference listed in the tide table. If you can't get to the seashore, graph the tides out of the tide tables for a week on graph paper. Notice how the times of high and low water change each day.
- C. A third oceanography activity is to utilize U.C. Cooperative Extension Leaflet 2255, "Biological Oceanography," to discuss ocean food webs and the transfer of energy from primary producers (phytoplankton) to higher order consumers (zooplankton and fish). To illustrate the interdependence of the organisms involved, play the food chain game described below. Predator-prey relationships are often more complex and dynamic than illustrated by this game.
- D. Play the "food chain game." (Adapted from: Bagnall, N. 1980. *Children's Literature and the Sea*. Texas A&M Sea Grant College Program [TAMU-SG-80-401].)

Materials:

- Cloth streamers, about 2" × 18" in three different colors.
- 24 to 30 plastic sandwich bags, and plastic produce bags.
- Dried beans or styrofoam packing material.
- Scoreboard and magic marker.

Leader's instructions:

1. This is an outdoor game to illustrate a food chain and to show how it can change.
2. Mark the sandwich bags with two strips of tape or magic marker at one-inch intervals from the bottom.
3. Mark the produce bags approximately two-thirds from the bottom.

Members' instructions:

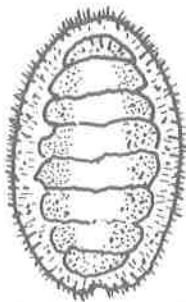
1. Set the boundaries for the playing area and a 5-minute time limit.
2. Divide into three teams: anchovies, mackerel, and tunas (or a food chain of your choice). Tie a different colored streamer to the wrist or belt to identify team members.
3. Anchovies and mackerel have plastic sandwich bags to represent their stomachs. Tunas, which are larger, use plastic produce bags.
4. Spread the beans or styrofoam packing material, which represent plankton, around the area.

5. Anchovy stomachs are filled when the beans or styrofoam reaches the first line on the sandwich bag. Mackerel stomachs are filled when the captured anchovy stomachs reach the second line on the bag. Tuna stomachs are filled when the captured mackerel stomachs reach the line on the produce bag.
6. Players tagged are out of the game.
7. One of each species must survive to maintain the food chain. Survivors are those left in the game at the end of the time limit whose stomachs (or bags) are filled to the line indicated. Record the number of survivors on the scoreboard.
8. After the first game, players can change one rule to see if they can balance the system so there will be survivors in each group.

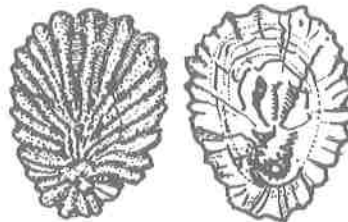
Session III—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Select a good tidepool field trip time by consulting a tide book.
 - b. Explain laws protecting tidepool organisms.
- A. Plan a tidepool field trip. Look for a convenient date with a low tide. Minus tides are best, but with any tide less than 1.0 feet there will be many interesting organisms to see. Select a rocky intertidal area by consulting local experts.

Chiton



Limpet

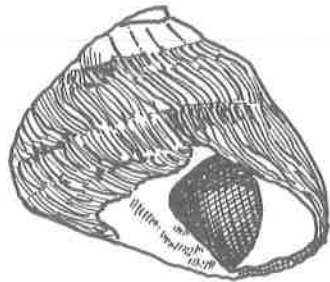


- B. Discuss field trip tips. These include reviewing and using beach safety tips and taking along equipment such as a hand lens, binoculars, tidepool identification books, notebook and pencil, a camera, and extra clothes and shoes.
- C. Using U.C. Cooperative Extension Leaflets 2246, "Ecology of the Intertidal Zone", and 2549, "Identifying Intertidal Plants and Animals", and other references if desired, discuss tidepool ecology and conservation. Review the laws about protection of tidepool organisms in the Sportsfishing Regulations. Put emphasis on observing; California law prohibits collecting almost all tidepool organisms. California tidepool resources are limited and could be ruined by collecting and disturbing by the thousands of visitors each year.
- D. Show and discuss the slide-cassette tape set "Introduction to Intertidal Plants and Animals". It is available from Visual Media, University of California, Davis, CA 95616, (916) 752-0590. This slide-tape set will introduce the members to the common organisms they will encounter.

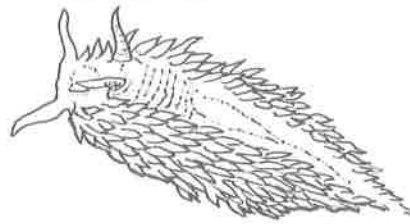
Session IV—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Locate and identify five intertidal animals and three intertidal plants.
 - A. Take the group on the tidepool field trip. Give members Extension Leaflet No. 2549, "Identifying Intertidal Plants and Animals", and other note paper to record notes about the organisms discovered. Don't collect organisms; enjoy observing them.

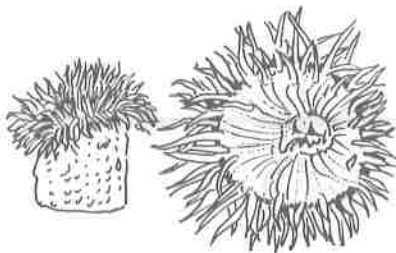
Turban Snail



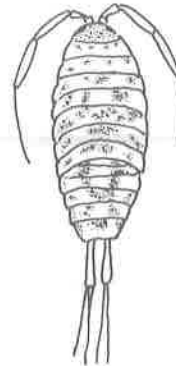
Nudibranch



Sea Anemone



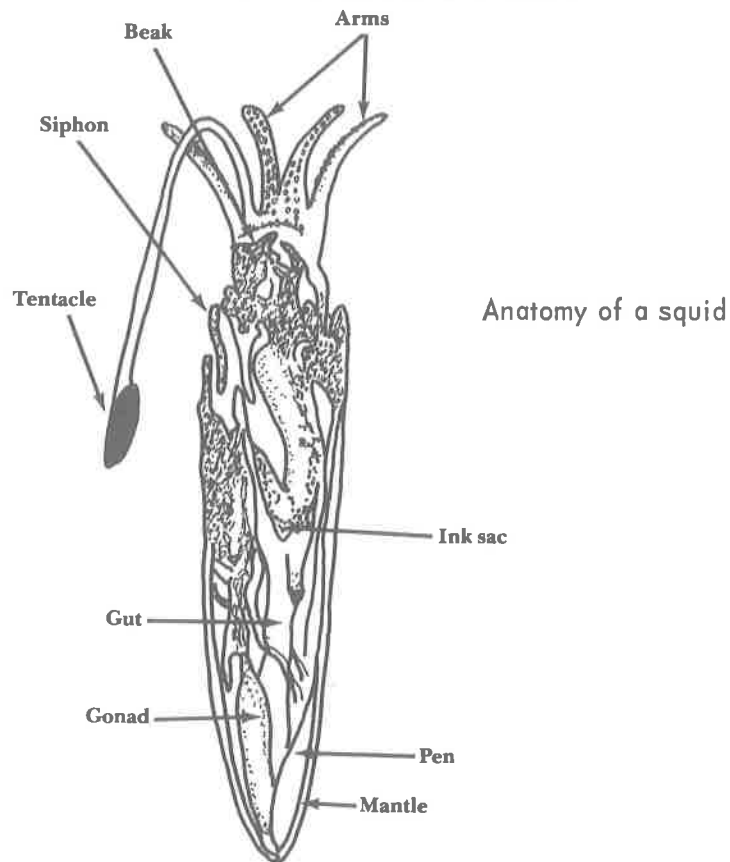
Rock Louse



Session V—Food from the Sea

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Clean and cook squid;
 - b. List thirty seafood products.

- A. Using U.C. Cooperative Extension Leaflet 21112, "Catching, Cleaning and Cooking Squid", obtain and have the members prepare squid for eating. Squid is a good example of a tasty, economical, underutilized seafood. Squid is being used more and more as a substitute for scarce and expensive abalone.



- B. Take your members on a "Supermarket Seafood Treasure Hunt". The object of this activity is to make the members aware of the many different seafood products available. In an average supermarket, the members should find a minimum of 30 seafood products. Some of the areas to look are the meat counter, frozen food section, canned food, pet food, gourmet section, soups, and delicatessen. The members can either work together to compile a list or divide up into teams. Comparing prices of different products and discussing where and how these seafood products were caught would add depth to the activity.

Session VI—Fisheries

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
- Construct, rig, and use simple fishing gear.
- A. Find out about and discuss fishing licenses and regulations. In California, everyone 16 years of age and older must possess a license when fishing except from public piers, jetties, and attached breakwaters. Booklets containing sportsfishing regula-

tions are available from anywhere fishing tackle and bait are sold. Review the regulations for fishing in your area and have a group discussion about the reasons for these regulations.

- B. Construct and use Armstrong fishing reels for a fishing trip. This is a low cost, easily-built device which can be made from recycled materials. It can be used from a pier, boat, or shore. An alternative, if you don't want to construct fishing gear, is purchasing simple, inexpensive droplines from a tackle shop.

Materials:

One size 10 tin can (often available from restaurants and food service businesses).

One board $\frac{3}{4}$ " \times $1\frac{1}{2}$ " \times 6".

Four galvanized shingle nails size 3d ($1\frac{1}{4}$ ").

100 feet or more of line 10- to 40-pound test dacron or braided nylon line, or size 9 nylon seine twine—use the heavier line if fishing in rocky areas.

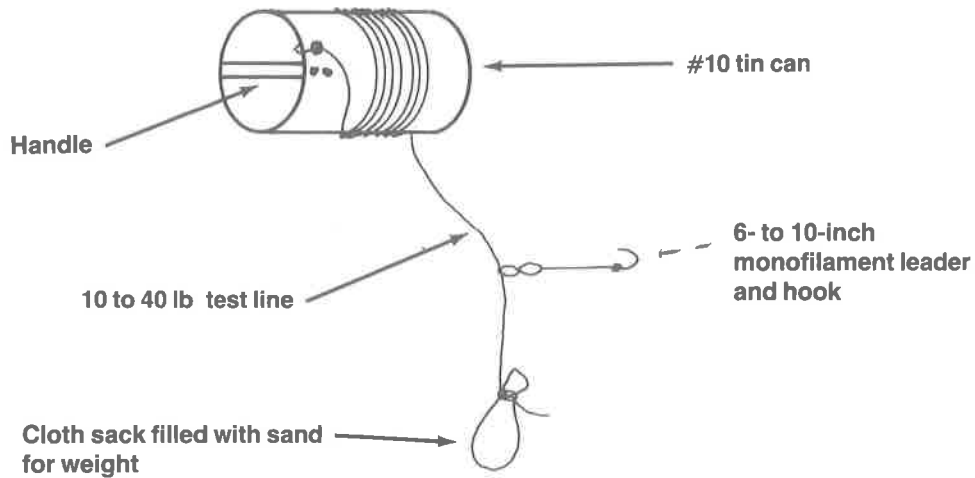
One 10-inch monofilament leader for hooks—leaders are 2- to 4-pound test (lighter than the main line).

One or two size 2 to 6 hooks for pier fishing—size 6 to size 2/0 for rocky areas.

One weight made with a 6" \times 6" piece of heavy cloth to contain sand (see instructions, which follow).

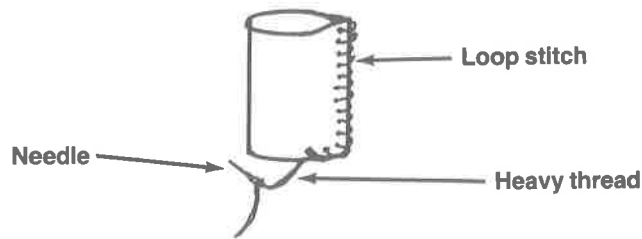
Building the Armstrong Reel:

1. Wash the can and remove label. Drill or punch a small hole in the lip of the open end of the can to secure the fishing line.
2. Plane or sand the edges of the board (handle) to make it slightly rounded for a comfortable grip.
3. Insert the handle across the opening of the tin can. It should fit snugly. Turn the can on its side and nail the handle in place with two nails on each side.
4. Attach the fishing line to the hole in the lip to secure it. A $\frac{1}{2}$ " split ring can be used in the hole to prevent wear on the line. Most tackle shops carry split rings. Wind the line around the outside of the can.
5. Tie a loop using an overhand knot about 15" from the end of the main line. Attach a 6- to 10-inch monofilament leader and hook to the loop in the main line. Tie the cloth sack filled with sand to the end of the main line. Vary the amount of sand according to the strength of the ocean current.



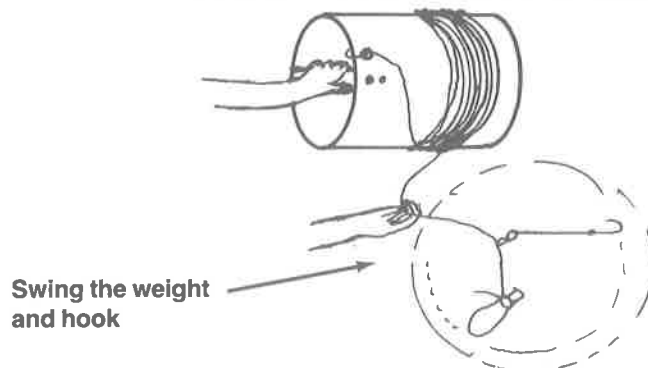
Making Cloth Sack Weights

1. Make the cloth sack weight with a 6" × 6" piece of cloth. Recycled denim trouser scraps make good sack material, but any strong cloth will do. Fold the cloth in half and sew the side and one end with heavy thread. Use the loop stitch or a sewing machine.



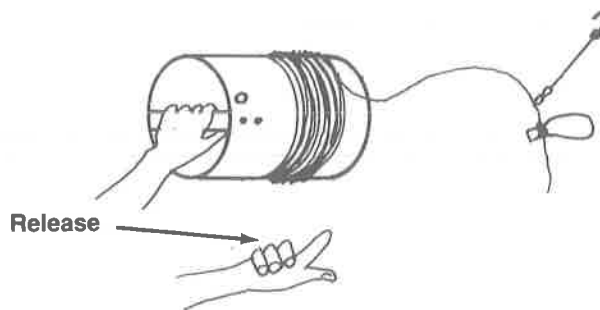
Turn the sack inside out after sewing. The sack is filled with sand and acts as an expendable weight. If it is caught on a rock and tears, you lose only sand. Make several sacks to take fishing.

How to Use the Armstrong Reel



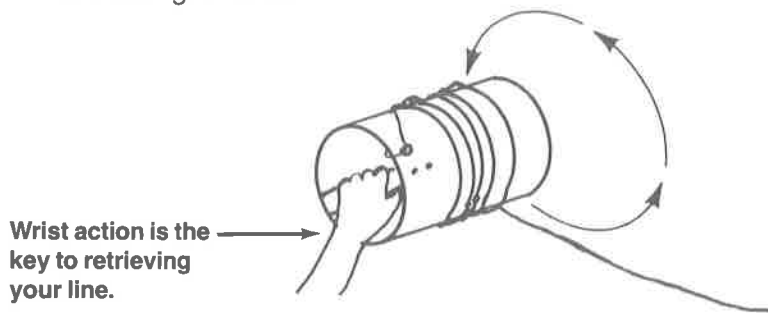
1. Right-handed persons should grasp the *handle* of the Armstrong reel with the *left* hand. The line should be held in the right hand ready for casting. Left-handed persons should reverse this procedure. Point the end of the can toward the area you want to fish.

2. Swing the sack-weight and hook in a circular motion and release. With practice, you will be able to release most of your line and accurately hit the area you wish to fish.



Reeling In

Retrieve the line by using a circular wrist motion with the left hand while guiding the line back on the can with the right hand.



Fishing Tips

The Armstrong reel, which is guaranteed to develop a strong arm if used each day, can be used on piers, boats, and the shore. Consult with local fishing experts and your local fishing tackle shop about where to take youngsters fishing. Select a location with a high probability of success, regardless of the size of the fish, rather than a locale with only a few large fish.

One of the best times to fish is on the early morning incoming tide. Check your tidebook for a mid-morning high tide. The best baits include: shrimp, marine worms, mussels, clams, squid, and pieces of anchovy. Make sure everyone dresses warmly and wears tennis shoes, especially when fishing on the rocks. Take a gunny sack for your catch. Keep it wet and shaded. Keep only the fish you plan to eat and return all others to the ocean alive. Nearly all of the fish you catch are delicious. Consult the references under Recreational Fisheries at the end of this manual for sources of fishing information.

(Adapted from "The Armstrong Fishing Reel", Santa Barbara County Cooperative Extension Publication by John Richards, UC Area Marine Advisor.)

- C. Obtain and view "The Grunion Story" movie. It is available from the Department of Fish and Game regional headquarters in Redding, Sacramento, Yountville, Fresno, and Long Beach (addresses are listed under "Audio-Visual Materials" at the end of this manual). Grunion are small (6") silversides and spawn on southern California beaches on the nights of the highest tides.

- D. In southern California, plan and participate in a grunion fishing or viewing trip. Check with your local fishing tackle shop or California Department of Fish and Game Office about the best nights and times for fishing. Check the sportsfishing regulations concerning seasons. Grunion can only be captured with your bare hands. Keep only as many as you plan to eat.
- E. In northern California, plan and participate in an outing to catch herring (winter months) or surf smelt (rest of the year). Check with local tackle shops about the best times, locations, and gear. Surf smelt are captured in nets in the surf on beaches, and herring are caught while spawning in rocky areas in southern California's bays. Check the sportsfishing regulations.

Session VII—Ocean Arts and Humanities

- I. **Performance objectives.** After completing this session's activities 4-H members should be able to:
 - a. Create a beach casting.
 - b. Create a sand painting.
- A. Have the members do beach castings either at the beach or in sand-filled containers.

Materials:

Plastic basins or buckets.
Plaster of Paris packed in watertight bags.
Shells, driftwood, sticks, stones, and other objects.

Methods:

Dig a shallow area in wet, firm sand (about one square foot) and create any design you want by molding the sand and decorating with the collected objects. Mix the plaster with equal amounts of sea or fresh water and plaster. Mix gently until plaster has dissolved; excessive mixing will cause the plaster not to harden. Slap the side of the container to bring air bubbles to the surface.

Blow on the bubbles to burst them. Pour the milkshake-thick mixture onto the design. If there is enough plaster left, other youngsters can fill their molds. Stop as soon as the plaster begins to harden in your container; rinse out container and mix a new batch.

Before the plaster is too hard, have the makers initial their casting for future identification. When the plaster has hardened, carefully remove the casting from the mold and brush off the sand. The castings can be mounted on canvas or burlap-covered boards or hung as they are using picture hangers. Explore creative ways to use the beach castings for decorations.

(Adapted from "Beach Casting: You Don't Really Need a Beach to do It" by Katie Sallos. National 4-H News, June-July, 1974, pp 22-23.)

- B. Make Sand paintings. This can be done at home or at the beach.

Materials:

White glue.
Cardboard pieces or paper plates.
Pencils and a brush.
Sand (several colors and/or textures preferable).
Tempera powdered paints (optional).

Methods:

On a piece of cardboard or paper plate, draw a simple design. If tempera colors are used, mix them with the sand. With white glue paint the portion of the interior of the outline that you want in one texture or color of sand. Sprinkle one color or texture of sand over the picture. Let dry. Brush off excess sand. Repeat the process for each texture or color of sand used. Simple designs are best.

(Adapted from “4-H Ocean Adventures” by Vicki Osis and Don Giles, Oregon State University Cooperative Extension.)

- C. Collect flotsam and jetsam as well as non-living natural marine items along the beach. Try to figure out where these items came from. Discuss the problem of ocean litter. Discuss the currents that carried these items to that beach. Discuss the power of waves and how the shapes of the items on the beach have been changed by the ocean’s forces.

Session VIII—Marine Politics

- I. **Performance objectives.** After completing this session’s activities the 4-H members should be able to:
- a. Explain one ocean public policy issue to others.
 - A. Collect and discuss newspaper clippings on ocean public policy issues. This activity will increase the participants’ awareness of the importance of ocean affairs. Some examples of topics include: offshore oil development, pollution, coastal land use planning, local marine recreation opportunities, seafood products, habitat protection, and international maritime incidents. Additional information on offshore oil development is contained in the Ocean Energy Unit, listed under “Additional Activities.”
 - B. Invite a speaker to discuss an important marine issue or legislation. Speakers on timely issues may be available through local government agencies, educational institutions, conservation organizations, or industry.
 - C. Make a world map with territorial limits and fishery economic zones drawn in. Discuss possible conflicts

Session IX—Marine Public Service

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Assist with a habitat improvement project.
 - b. Assist in preparation of a marine education display.
- A. Organize a seashore cleanup project. There may be marshes, beaches, and bays in your area that are visually degraded by trash. Consult with local officials who manage the area to plan your project. Possible coordination of efforts with other youth groups or service organizations should be explored as well as opportunities for recycling the discarded materials.
- B. Plan and prepare a marine education display. Your local 4-H Youth or Marine Advisor may be able to help with this project. The display should present well documented information about marine resources. Some ideas for display topics include: local fisheries, biology of local marine organisms, underutilized seafood products, 4-H marine projects, and marine issues. A well prepared display could be placed in a location with substantial public exposure such as banks, fairs, stores, schools, and libraries.

Session X—Career Exploration

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Name five marine careers and their qualifications.
- A. Brainstorm with the group to come up with a list of marine careers and the type of background needed to qualify for these careers. Do these careers exist in your area? Why are the members interested in these careers? What careers do you think will exist in the future.
- B. View and discuss one of the films about a marine career listed at the end of this manual.

INTERMEDIATE UNIT

Session I—Introduction and Beach Safety

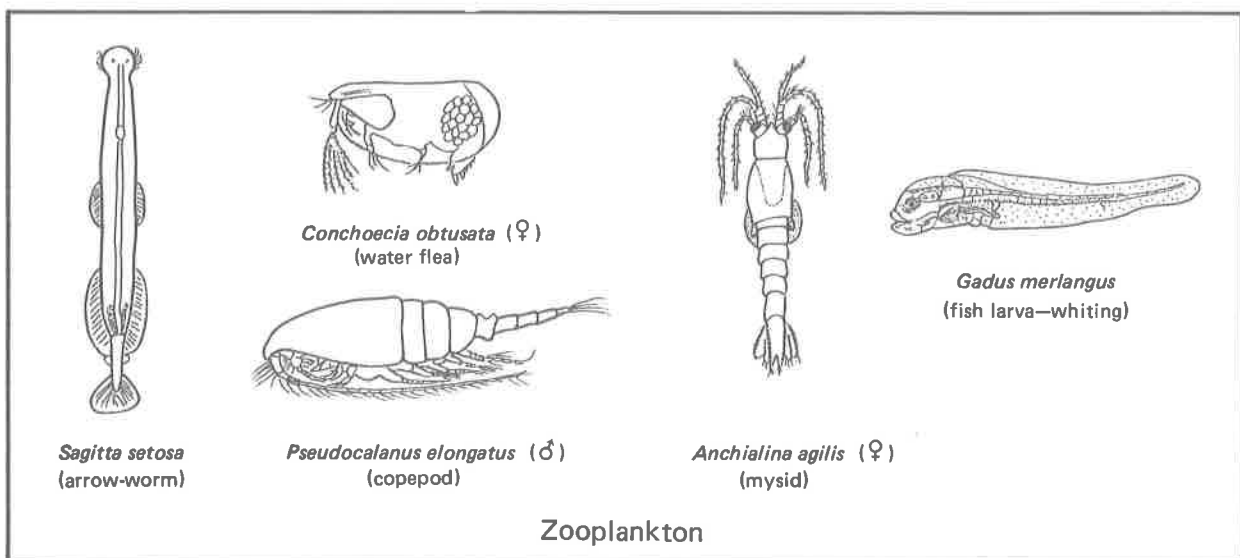
- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. List eight beach safety tips.
 - b. List five causes of boating accidents and explain how they can be avoided.
- A. This is the introductory meeting. Help everyone get to know each other. Discuss what the group would like to accomplish this year. Have the group set goals.

- B. Review the beach safety rules outlined in the Beginning Unit. Check or put together the beach safety kit.
- C. Invite a speaker to demonstrate marine safety equipment such as life preservers, life rafts, and marine safety procedures such as the prevention of hypothermia and water safety. Speakers are often available through local Coast Guard Auxiliaries/ Power Squadrons, yacht clubs, Red Cross, Sheriff's Departments, safety equipment manufacturers and retailers.
- D. Discuss boating safety. A list of basic publications on boating safety is available from the Department of Boating and Waterways, 1416 Ninth Street, Sacramento, CA 95814.

Session II—Oceanography

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Collect and identify three types of zooplankton.
 - b. Explain upwelling to others.
 - c. Demonstrate the differences in sand particles between beaches.
- A. Using the instructions in Leaflet 2557, "Sampling Plankton", construct and use a plankton net.* View the zooplankton (animal plankton) collected with a hand lens or a dissecting scope. Plankton are the tiny plants and animals that serve as food for larger animals. This activity will help members understand ocean food webs. Try to identify a few of the common types of zooplankton using the guides listed in "Sampling Plankton" or other identification guides available through your library.

*(All leaflets referred to are U.C. Cooperative Extension Leaflets unless otherwise identified.)



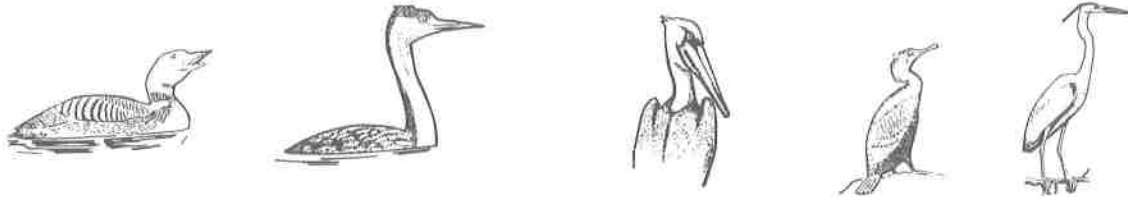
- B. Study ocean currents. Learn about their causes, types, and location. Have the group make a world map with all of the major ocean currents on it. Oceanographic texts listed at the end of this manual will show the major currents. Check for them at your library. Study the major currents off the California coast. Using Leaflet 2939, "Upwelling in California Coastal Waters", learn about upwelling. Discuss the effect of upwelling on weather, water temperature, fishing, and marine life.
- C. Using Leaflet 2554, "Ocean Currents", do the exercise demonstrating the effects of salinity and temperature in ocean waters. Are there local areas where differences in salinities or temperatures might occur.
- D. Make a sand collection, using clear plastic pill bottles (purchased from a druggist) or small plastic bags. Collect sand from different beaches and label the containers. Sands will vary from beach to beach because they come from different sources. Examine the sand with a magnifying glass or hand lens to see the different types of sand particles (quartz, jasper, etc.) and compare the relative composition of the sands from different beaches. Discuss why sand from different beaches is different. Another activity is to set up a beach sand exchange with 4-H groups or others in different parts of California or the United States. A film which will help in understanding the dynamics of beaches is "Beach, A River of Sand" available from Extension Media Center, University of California, Berkeley, CA 94720.
- E. Using the Ocean Energy Unit described under "Additional Activities" have the group draw and discuss potential ocean energy resources using currents, salinity, and temperature differentials.

Session III—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Identify and press three species of marine algae.
 - A. Learn about the different types of algae and their utilization. Leaflet 21110, "Marine Algae", presents a general introduction to marine algae identification and utilization. The references at the end of that leaflet will supply more in-depth information for intermediate members.
 - B. Using Leaflet 2556, "Pressing Algae", collect, identify, and press algae. Consult the sportsfishing regulations about algae collecting laws. The group can make an educational display of their algae pressings or frame them individually for decorations or gifts.

Session IV—Marine Biology

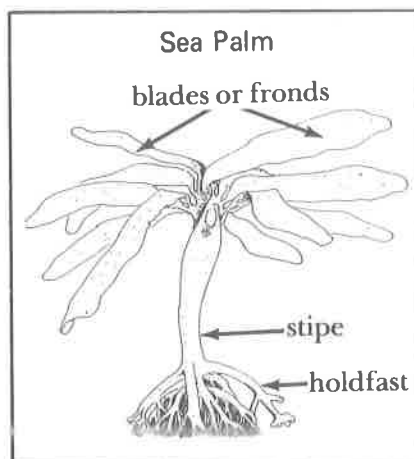
- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Identify ten species of seashore birds.



- A. Learn to identify common seashore birds. Leaflet 2550, "Identifying Seashore Birds", and bird identification guides available in most libraries will help the beginning birder. The slide-tape cassette set on "Seashore Birds", available from Visual Media at University of California, Davis, CA 95616, will help in preparation for a field trip.
- B. Take a field trip to a bay, marshland, or beach to view and identify seashore birds. Take along binoculars, your bird identification materials, and a clipboard with Leaflet 2550 and additional paper to record your sightings. It is best to go with someone who knows birds well. Often the local chapter of the Audubon Society or other environmental organizations will organize trips and bird counts. Early morning is usually best for bird watching, and many seashore birds are most visible at low tide when they feed along mudflats.

Session V—Food from the Sea

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Prepare one food dish from marine algae.
 - b. Explain paralytic shellfish poisoning to others.



Seaweed Parts

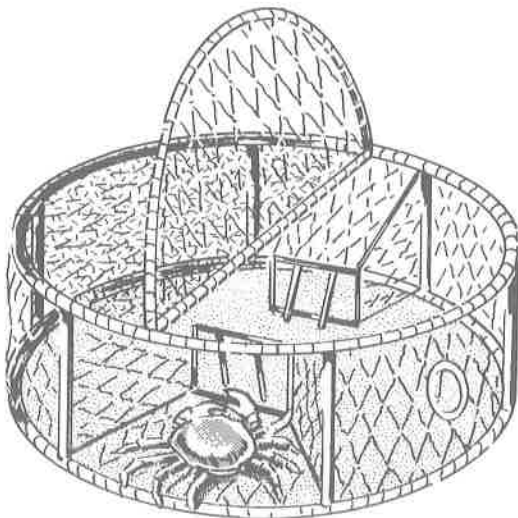
- A. Make and eat the seaweed bread and/or other algae-based foods from recipes in the "Marine Algae" Leaflet 21110. Other sources of marine algae recipes include:

Abbott, I.A. and W. Williamson. 1974. *Limu*. . . Pacific Bot. Garden (2nd Edition).
 Loggins, P. 1975. *The Uncommon Cookbook*. Sea Grant Bulletin #8. University of Maine: Orono, Maine.
 Madlener, J.C. 1977. *The Seavegetable Book*. Clarkson-Potter Pub. Co.: New York, New York.

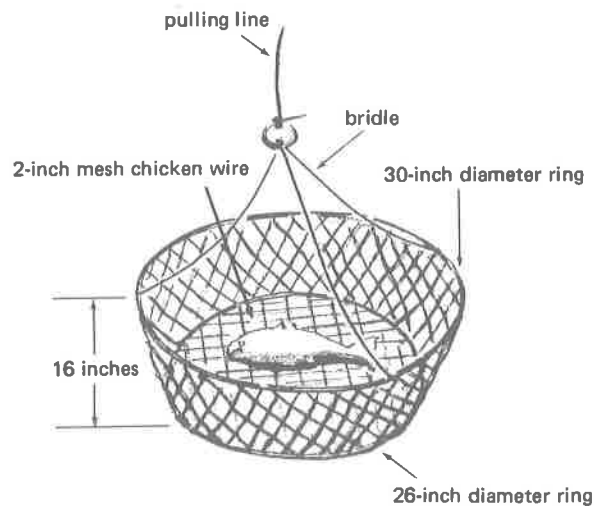
- B. Organize and/or participate in a food festival with marine foods. This could be a 4-H event, an event planned with the Cooperative Extension Home Economist, or a fair.
- C. Learn about paralytic shellfish poisoning by reading Leaflet 21117, "Paralytic Shellfish Poisoning and Red Tides". Discuss the precautions necessary to ensure that you are harvesting shellfish that are safe to eat.
- D. Learn about new marine products. Visit a seafood market and ask about new and unusual products.

Session VI—Fisheries

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
- Construct and use a crab or crayfish trap.
 - Describe four major types of commercial fishing methods to others.
 - List five types of fish and shellfish produced by aquaculture.



Crab pot



Crab hoop net

- A. Construct and use crab or crayfish traps. Leaflet 2546, "Catching and Cooking Crabs", supplies a trap design, fishing hints, and cooking instructions. If you live in an inland area, crayfish can be trapped in many lakes and streams. Check with your local fishing tackle shop about designing crayfish traps. Cylindrical crayfish traps can be made out of small-mesh chicken wire with a funnel-shaped entrance at each end. Be sure to check the sportsfishing regulations for seasons, size limits, bag limits, and gear restrictions. Cook and eat the crabs or crayfish you keep.

- B. Learn about commercial fisheries through films and videotapes. Invite a commercial fisherman to talk about his industry. Some available films and videotapes include:
 - "Oregon Trawler"—16 mm color, sound
 - "Making Waves"—four 15-minute, ¾-inch cassette videotapes with question sheets.
 - 1. "Commercial Bottom Fishing"
 - 2. "Seafood Processing"
 - 3. "Coastal Estuaries"
 - 4. "Oyster Farming"

(Available from Sea Grant MAP Extension, University of California, Davis, CA 95616.)

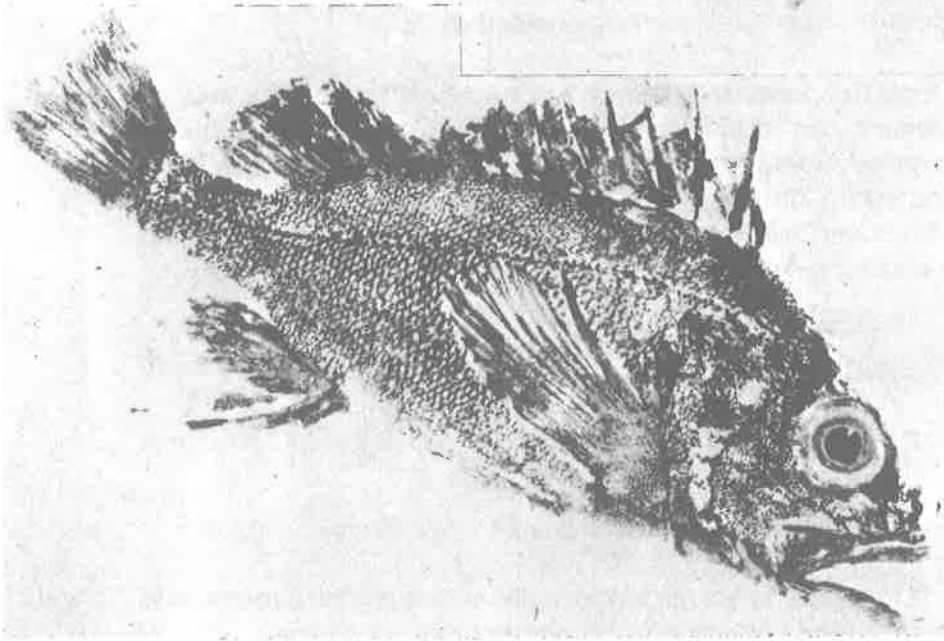
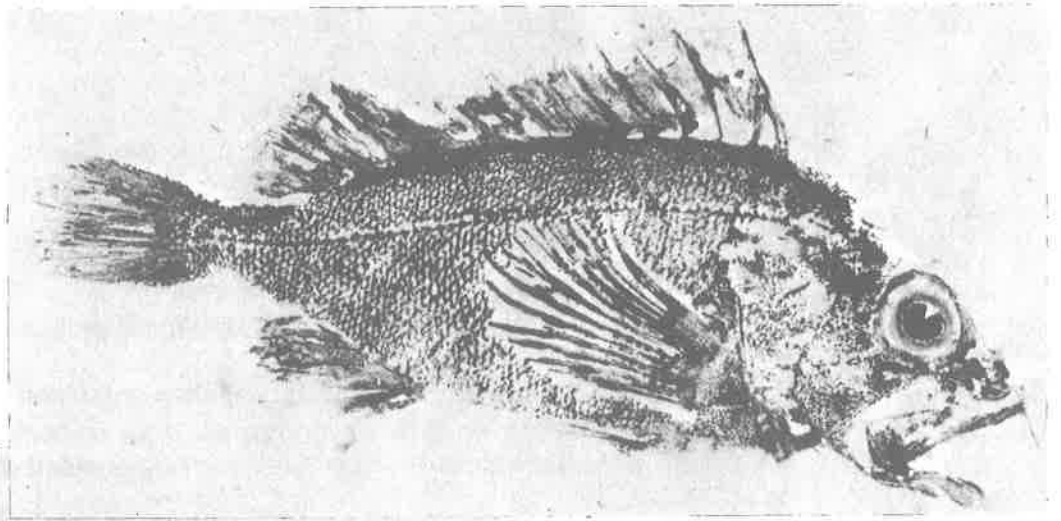
- C. Visit a hatchery to learn about aquaculture and fisheries. The California Department of Fish and Game and other government agencies operate hatcheries throughout the state. Contact the one nearest you to find out about hours, best seasons, and public education programs. Some private aquaculture companies may allow visitors. They are usually listed in the phone book. Several films on hatchery operations are available from the Department of Fish and Game. These are listed at the back of this manual.

Session VII—Ocean Arts and Humanities

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Create a fish print.
 - b. Explain both sides of a marine policy issue to others.

- A. Make fish prints using the techniques described in Leaflet 2548, "Gyotaku—Japanese Fish Printing". This activity will teach the members about external fish anatomy. The fish prints can be used for displays at fairs, as home decorations, or as gifts. Using fish caught in a group fishing trip is a good idea.

- B. Use the mass media (television documentations, magazine articles, local talks) as a source of information about marine issues. For example, collect newspaper and magazine clippings on marine issues for a month. Have the 4-H group discuss the programs or articles. Do they present a balanced argument with documented facts?



Session VIII—People and the Marine Environment

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Simulate fisheries regulations and their impact on fish populations.
 - b. Give one example of Native Americans' historical use of marine resources.
- A. Do the activities contained in Leaflet 2553, "Marine Resource Laws and Regulations". Discuss how the activities relate to current commercial and sportsfishing regulations. Environmental variability, economics, fishermen behavior, and politics combine to make resource management complex. List reasons and cite examples showing that this leaflet's activity greatly simplifies the real world situation.
- B. Visit museums or invite a speaker to discuss maritime history or Native Americans' utilization of marine resources.

Session IX—Marine Public Service

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Assist local organizations with a public service project.
 - A. Participate in local bird counts which are often organized by local Audubon Society chapters, schools, or other environmental organizations. Use the skills acquired from your earlier Marine Biology Session on seashore birds.
 - B. Offer to assist your local Cooperative Extension Marine Advisor with public service projects. Marine Advisors can be contacted through the Cooperative Extension offices in coastal counties. Some types of public service projects that have been done include: marine education displays at open houses, underutilized seafood demonstrations at fishermen's festivals and fairs, assisting at county fairs, and providing training to beginning 4-H Marine Project groups.

Session X—Career Exploration

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. List ten marine careers and their qualifications.
 - A. Organize and/or participate in a career fair that includes ocean-related careers. This can be either a 4-H event or part of your school's career day.
 - B. Invite a speaker to talk about their marine career. Some common types of careers include: boat repairmen, fishermen, marine biologists, shipping, Navy and Coast Guard, energy development, and marine recreation businesses.
 - C. Read and discuss the helpful publication "Today's Youth in Tomorrow's Sea". It is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Another helpful reference is "Careers in Oceanography: Romance versus Reality" by John McManus (Neritic Enterprises, P.O. Box 5485, Santa Barbara, CA 93108).

ADVANCED UNIT

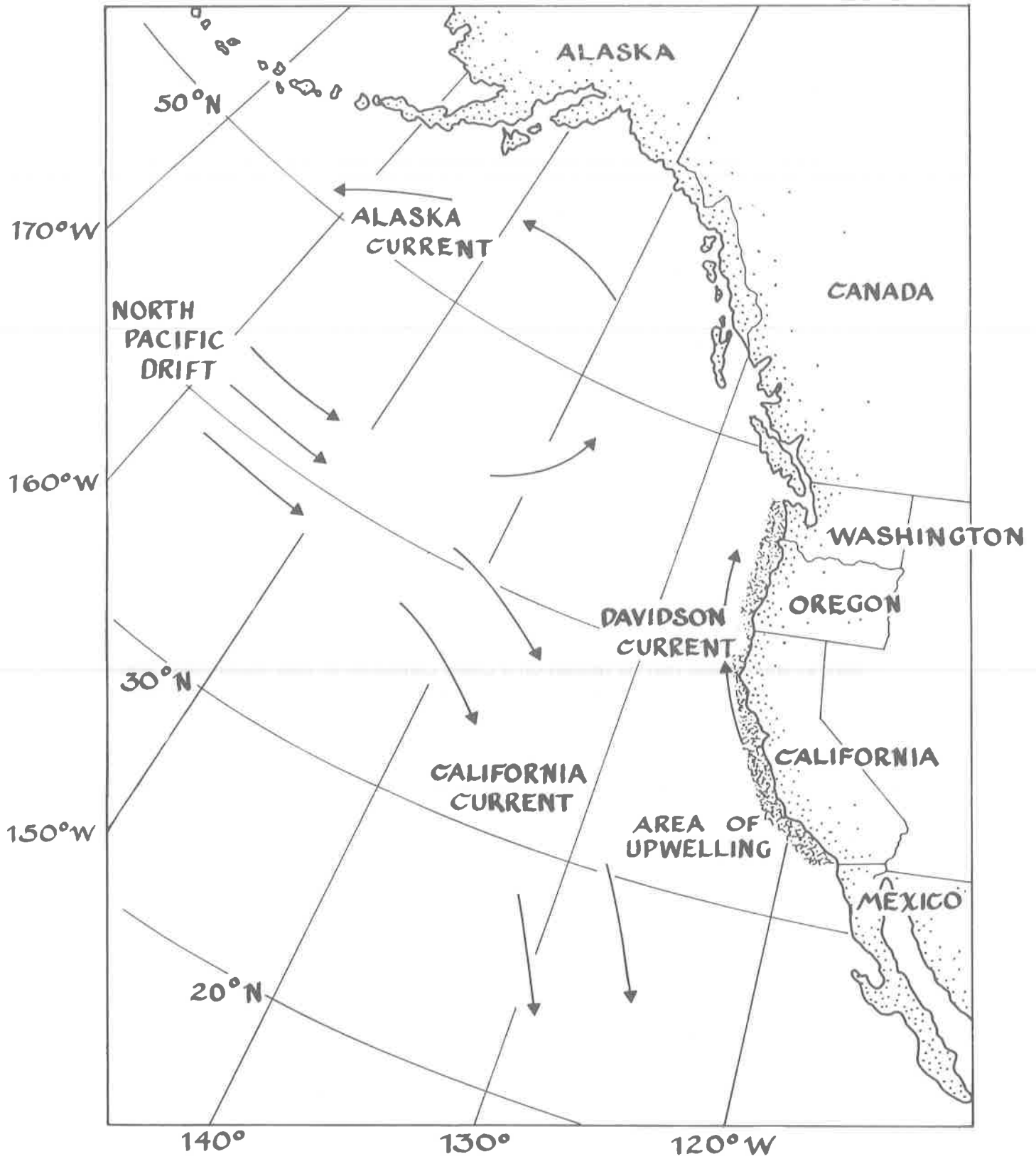
Session I—Introduction and Beach Safety

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. List nine beach safety tips.
 - b. Define hypothermia and demonstrate the H.E.L.P. and HUDDLE positions.

- A. This is the introductory meeting. Help everyone get to know each other. Discuss what the group would like to accomplish during the year. Have the group set goals.
- B. Use the slide set “Survival in Cold Water” to learn about combatting the effects of hypothermia. The slide-tape set is available from Visual Media, University of California, Davis, CA 95616, (916) 752-0590. If you have a swimming pool available, the group can practice the procedures outlined in the slide set.
- C. Invite a speaker to talk about first-aid with an emphasis on marine medical problems.
- D. Review the beach safety rules from the Beginning Unit. Check or put together your beach safety kit.

Session II—Oceanography

- I. **Performance objectives.** After completing this session’s activities the 4-H members should be able to:
 - a. Diagram the major currents in the North Pacific Ocean.
 - b. Identify five prey items from fish stomachs.
 - c. Compare the food habits of two species of fish.
- A. Closely following the instructions in Leaflet 4-H-7004, “Using Drift Bottles to Measure Ocean Currents”, conduct a study of coastal currents. Chart the results and discuss them. Periodically, a summary of all of the 4-H drift bottle experiments will be sent to you. These can be plotted on a chart, compared to your experiment, and discussed. Be sure that the members send thank you letters to those who return the cards. The results of your study can make an attractive educational display or a good report.
- B. Use Leaflet 2255, “Biological Oceanography”, to learn more about ocean food webs. Collect stomachs from fish caught at piers or on boats. Examine and record the types of food items found in different types of fish. Use the fish and invertebrate identification keys listed at the end of this manual to determine the types of food consumed. Identify the food items as best as you can; don’t worry if you can’t figure some of them out. Compare the food habits of different types of fish. What can you say about the habits of the fish from their stomach contents?

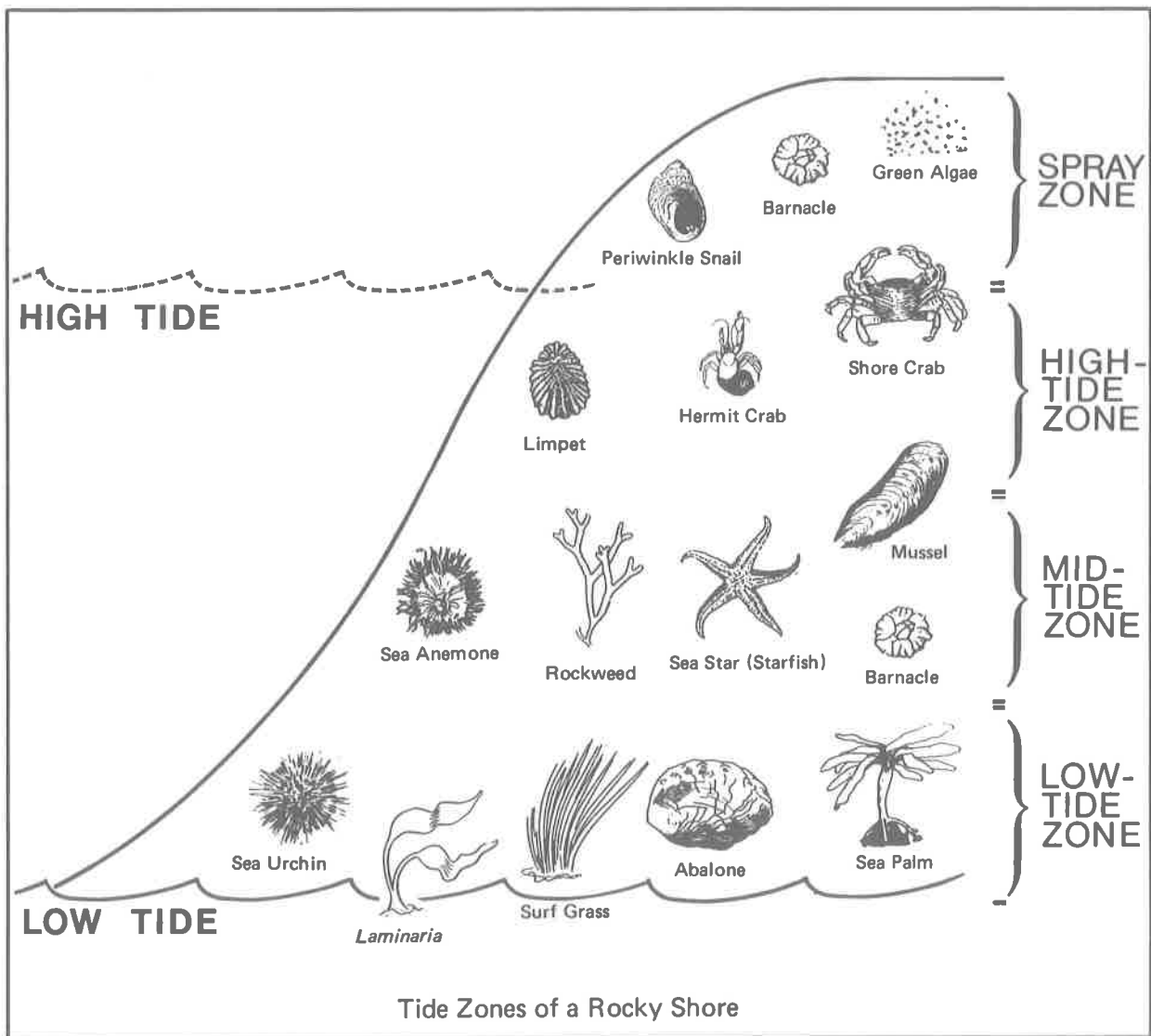


Major currents of the northeastern Pacific Ocean.

Session III—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Statistically analyze the distribution of one organism across the four intertidal zones.
 - b. Describe one marine research project to others.

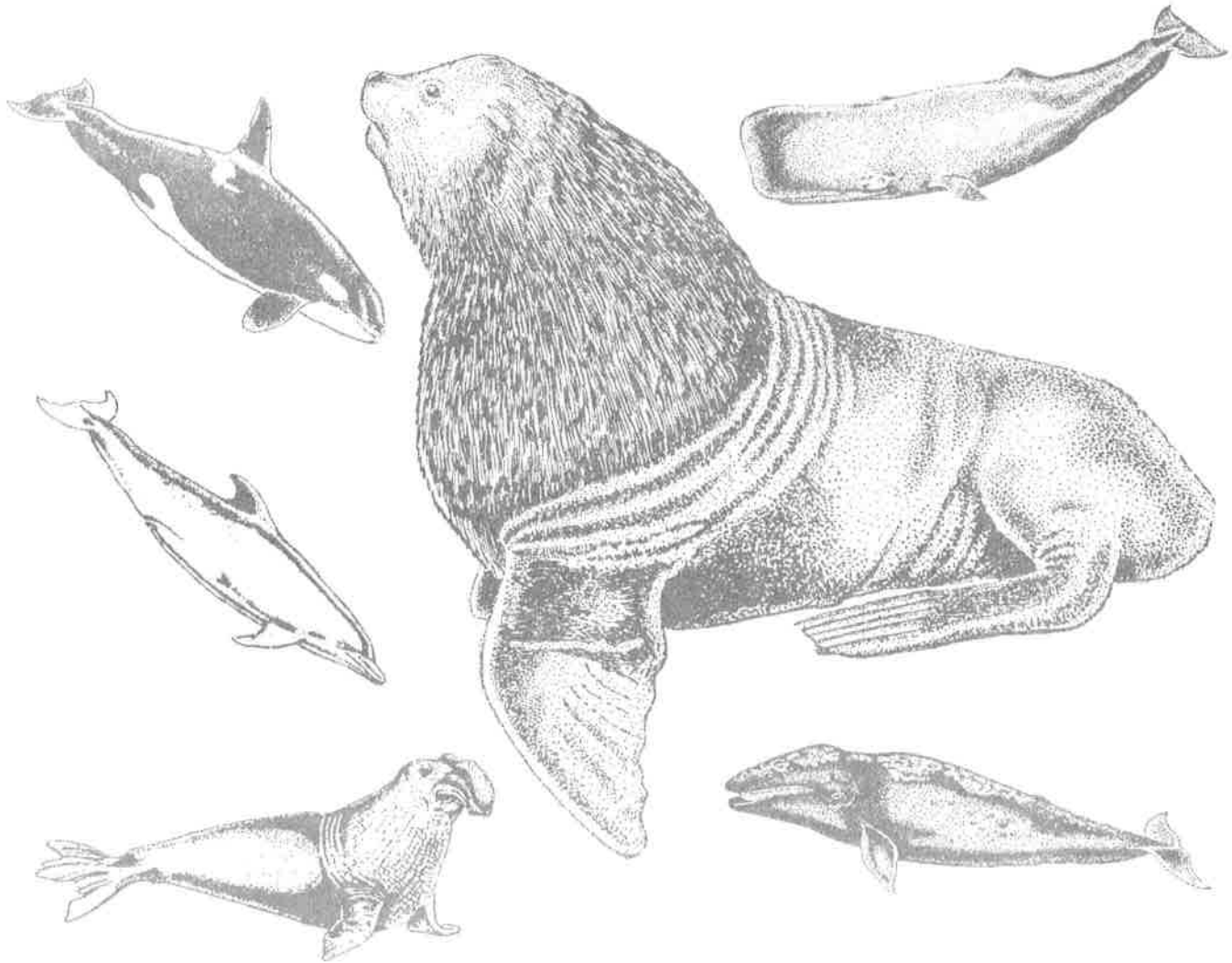
- A. Do the activity outlined in Leaflet 2551, "Intertidal Zonation". This will give the advanced members a deeper understanding of the unique ecology of the intertidal zone as well as a very basic introduction to the use of statistics in research. This should be a challenging exercise.



- B. Learn more about marine research through speakers, films, and publications. If you live near a university or college campus, find out when marine scientists are going to give presentations about their research. A list of technical publications about current University of California Sea Grant research is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Obtain the list and order a few publications of interest to you. Another source of current marine research information is journals in large libraries. Journals such as *Oceanography and Limnology*, *Marine Fisheries Review*, *California Department of Fish and Game*, *Copeia*, *Ecology*, and *Fishery Bulletin* contain technical papers. Magazines such as *Oceans*, *Sea Frontiers*, and *Outdoor California* present popular articles summarizing marine research. Read and discuss articles of interest.

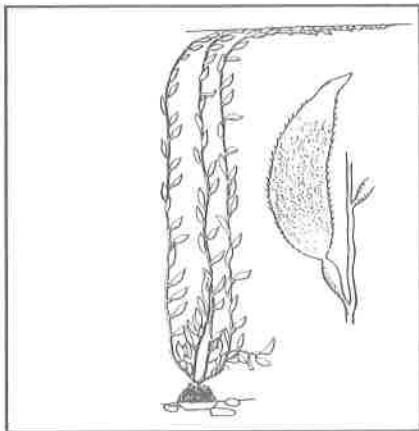
Session IV—Marine Biology

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
- a. Identify three species of marine mammals.
 - b. Describe the life history of one marine mammal to others.
- A. Learn the identification of and stimulate interest in marine mammals. Leaflet 2274, "Marine Mammals", will supply much of this information plus useful references. A more thorough booklet, "Marine Mammals of California", is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Have each member of the group select an animal or group of animals of their choice and have them give a brief report to the group.
- B. Plan and participate in a whale-watching trip. The gray whale, *Eschrichtius robustus*, makes the longest known migration of any mammal. They make a 12,000-mile round trip between Arctic waters and the lagoons on the Pacific coastline of Baja California. The gray whales migrate close to shore, and are visible from boats and rocky headlands. Numerous sportsfishing vessels run whale-watching trips during the winter months. Check with local sportsfishing landings, environmental groups such as the Oceanic Society, or the yellow pages for local trips. The whales can be seen from shore also. Rocky headlands all along the coast are the best spots. Take along binoculars. The best months are December through May. The whales migrate southward during December, January, and February to their Mexican breeding grounds. By late May they usually have completed their migration northward to feed in the Bering Sea and Arctic waters.
- C. Visit one of the public or private marine exhibitions. Examples include Marineland, Steinhart Aquarium, Sea World, Cabrillo Marine Museum, and Marine World/Africa, U.S.A. These exhibits often have educational displays about marine mammals, and you will get a chance to view them close up.



Session V—Food from the Sea

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Prepare one food dish from marine algae.
 - b. Use two methods of home preservation of seafoods.



Giant kelp, *Macrocystis pyrifera*, a brown alga.

- A. Prepare seaweed pickles or other seaweed recipes contained in Leaflet 21110, "Marine Algae".

SEAWEED SWEET PICKLE RECIPE

4 cups of rings or rectangles cut from fresh stems of kelp
¾ cup white vinegar
1½ cups sugar
1 teaspoon whole cloves
1 tablespoon mixed pickling spice

Remove the outer skin of the kelp with a vegetable peeler and slice into thin rings, or cut into longitudinal strips and then into rectangles. Soak the cut kelp in fresh water for three days, changing the water several times a day to remove the bitter-tasting salts.

Enclose the spices in a cheesecloth bag and place in simmering vinegar and sugar for five minutes. Remove spices and pour the hot syrup over the sliced kelp. Let stand overnight.

On the following day, remove syrup and heat to boiling. Cook in covered pot to save energy. Place kelp slices in hot jars, cover with boiling syrup and seal, or store the pickles in a covered crock.

For dill seaweed pickles, handle the kelp in the same manner, but substitute your favorite dilling process for the above syrup.

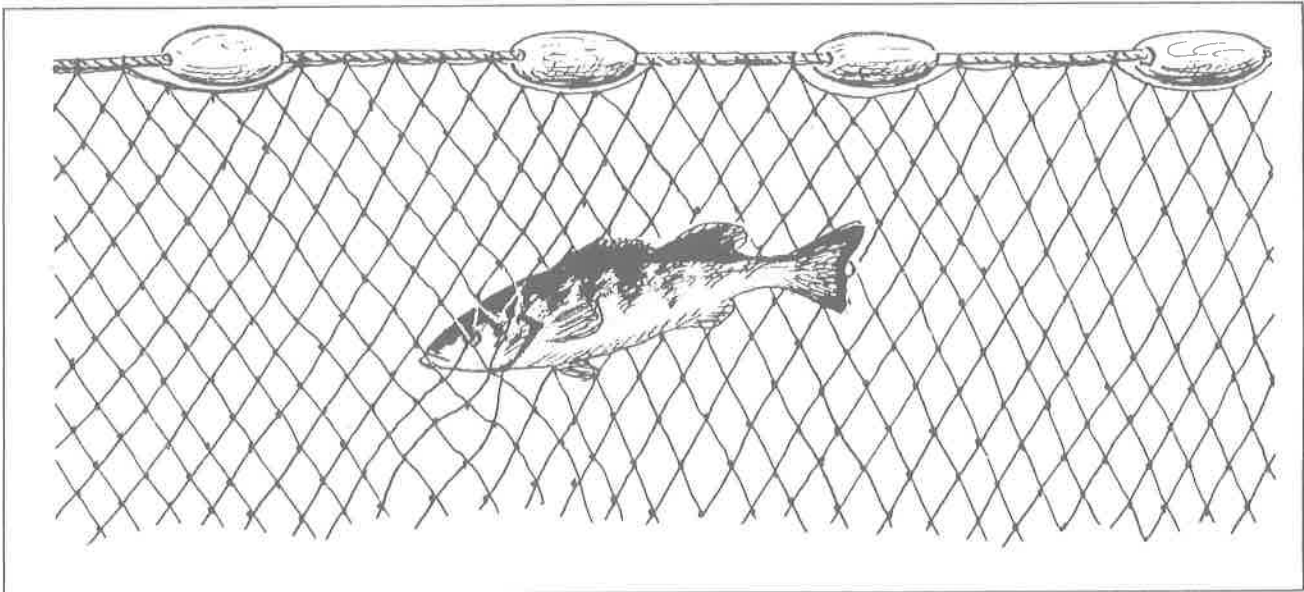
(From: "4-H Ocean Adventures", Cooperative Extension, Oregon State University.)

- B. Learn about safe handling of seafoods. Read and discuss Leaflets 21119, "Safe Handling and Storing of Seafoods"; 21120, "Seafood Myths and Misconceptions"; and 21111, "Buying Quality Seafood".
- C. Visit a seafood-processing plant and a fish market to learn how different kinds of fish are unloaded, processed, and sold.
- D. Construct and use a fish smoker. Learn about smoking fish from Leaflets 2669, "Smoking Fish at Home"; and 21121, "Smoked Shark and Shark Jerky". Compare the different types of fish you smoke.

Session VI—Fisheries

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
- Rig and use a poke pole.
 - Draw a fish and label all fins, lateral lines, and nostrils.
 - Sketch three types of commercial fishing gear and describe how they function to others.
- A. Using Leaflet 2555, "Poke Pole Fishing", construct and use poke poles. Poke pole fishing is an inexpensive way to fish rocky nearshore waters. All that is needed is a long bamboo pole, a piece of heavy wire, and a fish hook. Because the fishing is in rocky intertidal areas at low tide, be prepared to get wet, and be sure to observe your beach safety rules. You are likely to catch greenlings, perch, rockfish, blennies, and cabezons.

- B. Using instructions in Leaflet 2548, "Gyotaku—Japanese Fish Printing", make fish prints out of the fish you catch with your poke poles or use fish from another source. Use the fish printing activity to learn more about the fishes' external anatomy.
- C. Invite a commercial fisherman or a professional fishing guide to your meeting to discuss his lifestyle, fishing methods, and gear. Perhaps you can visit his vessel for the meeting. The film "Oregon Trawler" and the videotape "Commercial Bottom Fishing" are available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Both films illustrate fishing methods and lifestyle. Other films and publications listed at the end of this manual will help you learn more about commercial fishing.



- D. Take a field trip to a harbor which has a fishing fleet. Note the differences between recreational and commercial fishing vessels. Note and try to identify the different types of commercial fishing vessels (i.e. troller, trawler, etc.). Look for different types of fishing gear such as gill nets, longlines, traps, etc. Photograph or draw the different types of gear and vessels. Useful references for this activity include Leaflet 2272, "Major Commercial Fisheries of California", and *Fisheries of the North Pacific* by Robert Browning (Pacific Northwest Publishing, Anchorage, Alaska).

Session VII—Ocean Arts and Humanities

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
- Identify and press five species of marine algae.
 - Describe one local marine policy issue to others and recommend at least one possible solution.
 - Describe one use of marine resources by Native Americans.

- A. Do the algae pressing activity described in Leaflet 2556, "Pressing Algae". The group can use this method to start a collection of local marine algae. Framed, pressed algae also make attractive decorations or gifts.
- B. Learn about and discuss Native Americans and their relationship with the marine environment. Local libraries and museums, especially natural history museums, are good sources of information. Discuss current utilization of marine resources by Native Americans such as their subsistence fisheries for salmon and marine mammals.
- C. Have a group discussion or brainstorming session about man's use and/or abuse of the marine environment. You can make the discussion cover man's interaction with the marine environment in general, or you can focus on specific issues such as power plant or factory siting, coastal wetlands, coastal land use planning, fishing regulations, etc. Supply each member with a pencil and paper and have them write down and then share their thoughts with the group.

Session VIII—Marine Resources Management

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. Simulate a hearing on sea otter management.
 - b. List three reasons for and against restricting the sea otters' range.
 - c. Debate one marine policy issue.



- A. Have the group play the sea otter simulation game which is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. The game places the players in the roles of the different interest groups concerned with sea otter and shellfish fishery management in California. The members act out a simulated hearing on whether the range of the sea otter should be restricted. The game gives the members an understanding of the many viewpoints about marine mammal—fishery conflicts. A summary of the issues involved is included with the game (summary from “California’s Environment Newsletter”, #59: January-February, 1981, U.C. Cooperative Extension, Ray Coppock and Roy Rauschkolb, Editors).
- B. Debate an important marine issue. Have the group pick a topic, divide up into debate teams, gather information on the issue, and debate the issue. Some of the topics under Activity “C” of Advanced Unit VII would make good debate topics. Viewing the film “Mammals of the Sea” would be an excellent discussion starter.
- C. Discuss current marine research. Have each member select a topic of their own and have them find out about current research through local marine researchers or through library magazines and journals such as *Outdoor California*, *Oceans*, *Marine Fisheries Review*, *Fisheries*, *Copeia*, *Journal of the Fisheries Research Board of Canada*, *Oceanography and Limnology*, and *California Fish and Game*. Information on current University of California Sea Grant College research is available from Sea Grant MAP Extension, University of California, Davis, CA 95616. Each member can then give a brief report about the research and its relevance.

Session IX—Marine Public Service

- I. **Performance objectives.** After completing this session’s activities the 4-H members should be able to:
 - a. Assist local organizations with a marine project.
 - A. Participate in a habitat restoration project in cooperation with the appropriate agency. If you have a local Cooperative Extension Marine Advisor, he or she may be able to direct you toward a suitable project. Many state agencies (Department of Fish and Game, etc.), environmental groups, and local governments are involved in habitat restoration or enhancement projects.
 - B. Assist in a local marine research project. Local researchers may need help in taking measurements or monitoring research projects. Check with your Marine Advisor, college researchers, environmental groups, or government agencies about areas in which you can help.

Session X—Career Exploration

- I. **Performance objectives.** After completing this session's activities the 4-H members should be able to:
 - a. List five locations for academic or vocational training in the marine field of interest to them.
 - b. Identify five potential ocean-related summer jobs.
 - c. Write a resume and fill out a job application.
- A. Find out about schools offering marine training. An excellent reference for this is "University Curricula in the Marine Sciences and Related Fields". This is available at libraries or for free (limited supply) from Office of Sea Grant, NOAA, 6010 Executive Boulevard, Rockville, MD 20852. If there are local community colleges or universities offering marine courses, find out more about their programs.
- B. Find out about vocational training for marine careers. Land-based skills such as engine repair, hydraulics, welding, boat building, energy-resource management, business administration, cooking, and refrigeration are examples of valuable skills for marine careers. Read "Today's Youth in Tomorrow's Sea" for ideas on careers (available from Sea Grant MAP Extension, University of California, Davis, CA 95616).
- C. Explore ocean-related summer jobs. This is a way to find out if you enjoy working on or near the ocean. Some examples of summer jobs are fishing boat deckhand, seafood processing, seasonal help for government agencies, marine construction, and marine recreation (sailing instructor, boat maintenance, etc.). In some cases you may want to work as a volunteer just to gain experience. "Hands-on" experience is an important factor to your future employers.
- D. Improve job application skills. Learn about and practice writing resumes, interviews, filling out applications. Critique each other's job application skills. Use the skills to find summer jobs.

OTHER ACTIVITIES

Additional activities have been suggested as we developed this Leaders' Manual. Because these are major activities that would take up the bulk of a project year, they have been listed separately. In some cases the added resources needed for these activities may make it necessary to undertake some fund-raising activities.

Sailing

The sport of sailing teaches valuable skills, develops confidence, and illustrates the importance of teamwork. Sailing instruction is often available through yacht clubs, city recreation departments, scouting organizations, universities, and parents who actively sail. Sailing instruction and practice can be done periodically during the school year or for intensive one- or two-week sessions during the summer. Water and boating safety skills should be emphasized. The publications listed under "Safety" at the end of this manual should be helpful.



Boat Building

There is a growing interest in building small skiffs and dories. Such long-term projects will teach valuable wood-working skills as well as an appreciation for traditional boat design. A completed boat could be used for boating activities by the group, or it could be sold to recover expenses for materials. The key to this project will be locating a skilled boat builder or wood worker to instruct the group. Ideas for boat designs and plans can be found in periodicals such as *Wooden Boat Magazine*, *National Fisherman*, and in books on boat design (at your local library).

S.C.U.B.A.

Many youths and adults are attracted to the ocean by diving. S.C.U.B.A. diving instruction is available through dive shops, schools, recreation departments, and other organizations. Be sure that you use only instructors who are certified to teach S.C.U.B.A.. Swimming skills and water safety instructions are essential.

Ocean Energy

The ocean is an important energy resource. We currently extract much of our oil from reserves located offshore. Today our society is trying to resolve conflicts between the economic benefits of offshore oil extraction, and the environmental risks involved in use of this resource.

Utilization of alternative ocean energy resources is still primarily in the research and development stage. These resources include energy derived from waves, currents, temperature differentials, water pressure, and water salination. Some of these energy sources will become more important in the future as our petroleum reserves dwindle and become more expensive. An understanding of present ocean energy issues and potential new energy sources is important to California citizens.

An Ocean Energy Unit encompassing several sessions has been developed by Carolyn Cook Grassi. This unit will be helpful to 4-H groups who would like to take an in-depth look at ocean energy problems and potentials. It is available from Sea Grant MAP Extension, University of California, Davis, CA 95616.

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AUDIO-VISUAL MATERIALS

Available from: Sea Grant MAP Extension
554 Hutchison Hall
University of California
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"Oregon Trawler" (describes commercial bottom fishing).
"From the Edge of Extinction" (sea otter management).
"Silvers for San Francisco Bay" (describes salmon enhancement project).
Four ¾" videotape cassettes

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Available from: Motion Picture Library
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"Mammals of the Sea" (marine mammal conflict) #27-819.
"Canning and Freezing Fish at Home" (describes methods) #27-109.

Available from: California Department of Fish and Game Regional Offices.*

- "To Save a Heritage" (overview of the Department of Fish and Game).
- "Up the Down Stream" (Feather River Salmon Hatchery).
- "From the Edge of Extinction" (sea otter management).
- "Life at the Edge of the Sea" (tidepool conservation).
- "Science Gets the Facts—The Anchovy Project" (anchovy fishery management).
- "Fish in the Sea" (Fish and Game ocean sportfishing projects).
- "The Grunion Story" (grunion spawning and hatching).
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Available from: Extension Media Center
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(A fee is usually charged. Send for a list of films and prices.)

- "Beach, A River of Sand" (beach dynamics).
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- "Fish Out of Water" (grunion biology).
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- "Plankton and the Open Sea" (importance of plankton in food chains).
- "Sea" (marine biology and research).
- "Sea Lions and Fur Seals" (describes behavior).
- "Three Fishermen" (compares lives of fishermen).
- "Waves on Water" (describes sources and structure of waves).
- "What is a Fish?" (describes different types of fish).

Available from: Visual Media
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(Slide-cassette tape sets with scripts. Send for a catalogue showing prices.)

- "Canning Fish at Home" (Spanish and English).
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