THE BLUE-WATER MARINE LABORATORY

WORKING PAPER NO. 24

August 1976

SEA GRANT COLLEGE PROGRAM

University of Hawaii
Honolulu, Hawaii

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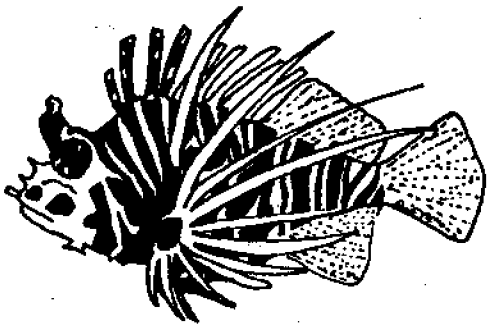


THE BLUE-WATER MARINE LAB
c/o Sea Grant Programs
2540 Maile Way
Honolulu, Hawaii 96822
(808) 948-8444

Aloha! May we introduce you to the University of Hawaii's Blue-Water Marine Lab -- a four-hour marine educational experience aboard the 65-foot motor-schooner Machias.

WHAT IS THE BLUE-WATER MARINE LAB?

A marine educational experience centered around a four-hour cruise aboard the research schooner Machias. An opportunity for students to become aware and to gain an understanding of their Hawaiian marine environment through direct involvement in a wide variety of activities at sea. A University of Hawaii program sponsored by Sea Grant, the Office of Marine Affairs and private foundations.

MORE THAN JUST A CRUISE...

A program for high school and college students, the BML adopts a unique open-ended approach designed to enrich the learning experience of students who have an interest in the sea. Special curriculum materials have been developed to encourage student initiative, responsibility and interaction. The total experience is spread over a period of weeks; preparing for the cruise and then continuing with follow-up activities is every bit as important as the cruise itself. An instructor-student ratio of 1:5 allows for a high degree of individual attention. The D.O.E. offers credit to selected high school students who serve as cruise instructors; college and university students may also advance their education by participating in the program as instructors. While everyone learns a little about sailing and seamanship, students may wish to concentrate their efforts on particular areas of study during the cruise. One can approach the study of the sea from the viewpoint of the natural scientist by delving into oceanography and research methods; the social sciences, fine arts and humanities offer an entirely different but equally rewarding perspective. In any case, the BML staff is eager to help each class design a cruise tailored to its specific needs and desires.

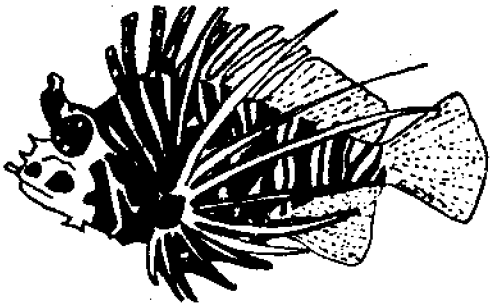
A CAPITAL SHIP FOR AN OCEAN TRIP...

The Machias has sailed throughout the South Pacific, logging a colorful history of research and adventure. Designed after the famous New England schooner Blue-Nose, the Machias is a 65-foot, 70-ton, staysail-rigged schooner especially equipped for oceanographic research. Throughout the school year, ship and crew sail inter-island to major ports on Hawaii, Maui, Molokai, Lanai, Oahu and Kauai where students come aboard for four hours of fun, adventure and learning. By special arrangement the proposed cruise schedule may be altered to accommodate unusual cruise requests (extended cruises, night cruises, unusual sampling equipment, etc.).

HOW MUCH AND HOW MANY?

The four-hour (half-day) cruise will cost each group or class $90.00. A maximum of 25 persons can be accommodated on each cruise, and 2 additional places are reserved for professional guests (school officials, legislators, etc.).

FOR INFORMATION ABOUT THE PROGRAM'S SCHEDULE AND ITS PEOPLE, CONTACT:
Mr. Douglas Pendleton, Associate Director, or
Ms. Claire Nakayama, Administrative Officer
Blue-Water Marine Laboratory
c/o above address or telephone



THE BLUE-WATER MARINE LABORATORY
UNIVERSITY OF HAWAII
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Honolulu, Hawaii 96822
Telephone: (808) 948-8444

The Blue-Water Marine Laboratory is an ocean-going cruise program for secondary and post-secondary students in the State of Hawaii.

The program is sponsored and funded by the Office of the Marine Affairs Coordinator of the State of Hawaii, Sea Grant, student lab fees, the Department of Education of the State of Hawaii, and private foundations.

Classes of 25 students from public and private schools board the 65-foot research schooner Machias for a four-hour cruise. Each class pays a lab fee to help defray program costs.

Sailing 12 days per month, 7 months per year, the ship is scheduled for 10 cruises per month originating on Oahu, and approximately 8 cruises per month originating on one of the five other major Hawaiian islands.

Program objectives are to help Hawaii's students become more aware and more informed about the marine environment. (Most students in Hawaii cannot swim, have never been on a boat, and know virtually nothing about the marine environment.)

Although several types of cruises are available, the "backbone" of the program is the INTRODUCTORY CRUISE:

Students form five "teams" of approximately 5 students each before the cruise. Each team performs exercises and tasks centered on one of the 5 study areas:

1. GEOLOGY -- Students in this team obtain a sediment sample which they observe, sieve, identify, photograph and preserve. They use the sonar depth finder (fathometer) to obtain sea floor contours (bathymetry).

2. PLANKTON -- The plankton team uses 333-micron and 44-micron plankton nets to capture a surface sample. This sample is then identified, photographed, and preserved for later classroom study.

3. NAVIGATION -- Using the ship's compass and a pelorus, the navigation team uses fixed points on land (such as a mountain peak or radio tower) to determine the ship's position on the ocean. Celestial and Polynesian navigation are discussed. The team plots the course of the ship throughout the cruise.

4. WATER QUALITY -- Water samples are collected by the water quality team at various points during the cruise (harbor, in-shore, off-shore, surface and subsurface). When samples are taken from the Nansen bottles, students measure such parameters as temperature, salinity, oxygen concentration, as well as phosphate and nitrate concentration. A bathythermograph gives students an idea of how temperature changes with depth.

5. BENTHOS -- The benthos team studies the life on the bottom. Using an otter trawl, the team captures specimens, observes and identifies them, and either preserves them or takes a few back to their classroom aquaria for further study. (Most of the capture is returned to the sea.)

All activities in each study area are coordinated by a CRUISE INSTRUCTOR, a specially trained high school student, who receives science credit each semester through the Department of Education for his/her participation in the program (see CRUISE INSTRUCTOR TRAINING PROGRAM below).

The four-hour cruise has three major components: 1. the introduction (30 minutes), 2. the sampling (2 hours), and 3. the sailing (2 hours):

THE INTRODUCTION -- Thirty minutes before departure, the class arrives. The CRUISE LEADER, a Marine Option Program student at the University of Hawaii, who is responsible for the program at sea, greets the class and invites them on board. He (or she) introduces the class to the schooner, maritime terminology, and safety at sea. He then introduces the teams to their cruise instructor (CI).

THE SAMPLING -- As the ship pulls out of the harbor, the CI's begin introducing their teams to the equipment they will be using, answering questions, and generally getting acquainted. Our approach to the two-hour sampling portion of the cruise is strictly HANDS-ON! With the CI advising, guiding, and coaching, the students collect the samples, handle the equipment, record the data, identify and photograph the specimens, and care for their catch. In addition to appropriate collecting gear, the ship is also equipped with an OCEAN LAB, complete with dissecting microscopes, electronic gear, keys, and photographic as well as preserving apparatus. Students are encouraged to keep animals and plants alive in the ON-DECK AQUARIUM.

THE SAILING -- After the scientific portion of the cruise is completed, everyone can relax and enjoy the waves, wind, and island scenery. Students and CI's discuss their scientific findings, ask questions about life at sea, learn to tie knots, or exchange sea stories. If the wind and weather are

willing, students lend a hand in setting the sails. The main engine is shut down and everyone experiences the thrill of open-ocean sailing. Often a school of porpoises will accompany the schooner back to port.

Four hours after lines were cast off, they are made fast again as the Machias glides into port with her cargo of passengers, samples and a few good additions to the students' collection of sea stories to last a lifetime . . . . or at least until the next cruise.

A CRUISE INSTRUCTOR TRAINING PROGRAM is offered during the summer months by the Blue-Water Marine Laboratory. During this intensive training program, high school cruise instructor trainees are taught the fundamentals and basic skills of oceanography, marine technology, sailing, seamanship, small boating safety, small boat handling, advanced lifesaving and water rescue, marine first aid, SCUBA diving, interpersonal communications, physical conditioning and BML shipboard teaching techniques. Students completing the program receive Department of Education credit for the course.

BLUE-WATER MARINE LABORATORY
University of Hawaii
2560 Campus Road, George Hall 230
Honolulu, Hawaii 96822
Telephone (808) 948-8444

DESCRIPTION OF THE CRUISE INSTRUCTOR PROGRAM

Introduction. The CRUISE INSTRUCTOR PROGRAM is part of the Blue-Water Marine Laboratory (BML) of the University of Hawaii. Cruise instructors (CIs) are students who teach other students about the marine environment while at sea aboard the research schooner R/V Machias. The CI program is the only one of its kind in existence.

The purpose of the program is to give high school juniors and seniors a basic knowledge, skill, awareness, and appreciation of the marine environment. This is accomplished through a variety of marine experiences centered on "cruise-instructing" other students at sea.

The program emphasizes the development of personal qualities in its CIs such as leadership, team work, communication skills, decision-making, responsibility, self-confidence, self-awareness, personal discipline, and safety awareness.

The CRUISE INSTRUCTOR PROGRAM is three semesters in length. Each semester is separate from, yet prerequisite to, each following semester.

The Summer Course. The summer training course is an intensive eight-week training program where CI trainees learn the fundamentals of becoming a cruise instructor. Content of the course includes obtaining a basic understanding and working knowledge of oceanography, marine biology, oceanographic instrumentation, boating safety, seamanship, sailing, lifesaving, first aid, communication skills, and physical fitness. The instructional format includes lectures, labs, and field exercises. The summer will climax with an inter-island ocean expedition aboard the R/V Machias.

The Department of Education co-sponsors the summer program and awards one credit in science to students who pass the course. Enrollment is limited to fifty students.

Eligibility for the Fall and Spring Courses. Once a student has passed the summer training course, he or she is eligible to apply for the fall cruise instructor course. This course is open to juniors and seniors, males and females, from both public and private high schools.

The Fall Course. In the fall course, students apply their knowledge and skills at sea as cruise instructors. CIs are a vital component of the BML CRUISE PROGRAM. Each CI spends approximately twelve days at sea per semester. Responsibilities include teaching one of several groups formed from a class of students who participate in the four-hour cruises. Cruises are offered to secondary schools throughout the state.

In addition to their at-sea cruise instructing, CIs are also required to attend onshore activities which enrich their appreciation and knowledge of the

sea. The DOE offers science credit to students who pass the fall course.

The Spring Course. During the spring course, cruise instructors continue to instruct on board as they did during the fall. However, the enrichment portion of the course is modified to encourage students to become more involved in marine-related issues and more independent in forming opinions on those issues. The DOE offers science credit to students passing the spring course.

CI Support. Because part of a CI's experience requires him or her to be an instructor at sea several days each semester, some sea days will unavoidably overlap with regular class days. To cope with requirements of the CI program as well as on-campus academic demands, each CI must obtain the sponsorship of one of his or her school faculty members. This "sponsor" acts as the CI's guardian for academic affairs on campus.

A close working relationship must be established among the BML staff, the cruise instructor, the CI's parents, and the sponsor. These people constitute the CI's "support team" which becomes particularly important during the academic year.

Academic Standards. Students applying to the cruise instructor program are required to have--and to maintain--a grade point average which is acceptable to all those on the "support team."

Applications and Information. Students desiring more information on the CRUISE INSTRUCTOR PROGRAM should contact the Blue-Water Marine Laboratory at the University of Hawaii at Manoa:

BLUE-WATER MARINE LABORATORY
University of Hawaii
2560 Campus Road, George Hall 230
Honolulu, Hawaii 96822
Telephone (808) 948-8444

AN OPEN LETTER TO ALL TEACHERS WHOSE STUDENTS WILL BE COMING ON A BLUE-WATER MARINE LABORATORY CRUISE:

We are enclosing a preliminary draft of the new cruise preparation manual. The sections on the five scientific areas studied on the cruise are complete units that can be circulated among the students, so that you can form groups before the cruise, according to student interest.

We realize that each teacher's background, interests, and available reference materials vary. Thus we have attempted to write the manual at a basic level, and encourage all teachers to amplify the material whenever possible.

We urge you to return the manual to us after the cruise with your and your students' suggestions for improvement. We would like to write a revised version during the summer of 1976 for use during the 1976-77 year.

Thank you ,

The Staff of the Blue-Water Marine Lab.

THE BLUE-WATER MARINE LABORATORY

INTRODUCTORY SCIENCE CRUISE ABOARD

THE RESEARCH SCHOONER MACHIAS

PURPOSE

To provide students in Hawaii with a pleasurable and educational experience concerning marine-oriented natural science, social science or humanities, seamanship and sailing.

The Blue-Water Marine Laboratory staff hopes that this marine experience will help you to become more and appreciative of our Hawaiian waters, and more concerned with their care and preservation.

WHY COME ON THE CRUISE?

(1) It's fun and exciting to discover all the ocean-related activities that are available to the people of Hawaii.. Even if you already know about swimming, surfing, snorkeling or scuba diving, come aboard and learn the basics of sailing and seamanship, and probe into the mysteries of oceanography.

(2) As a student in Hawaii and a voter-to-be, you should be informed about the ocean that surrounds these islands. The present and future of this state is tied very closely to the ocean. In the past, ignorance and carelessness by people have done much damage to our marine environment.

WHAT WILL YOU DO ON THE CRUISE?

I. Introduction (1/2 hour)

You will meet the cruise leader, the cruise instructors, and the ship's crew, and learn their duties and responsibilities. The cruise instructors are high school students who have passed an intensive training program in swimming, snorkeling, water safety and first aid, seamanship, boating

safety, sailing techniques, and basic oceanography. This training program is given every summer by the Blue-Water Marine Laboratory staff, and is open to all interested and qualified students. Although the cruise instructors will supervise, you will operate the sampling equipment, make the observations, and collect the data during the cruise.

II. Science (2 to 2-1/2 hours)

There are five areas of study during the cruise, and the students will be divided into teams which specialize in each area. However, all the students will be able to find out what all the other groups are doing some time during the cruise. The teacher should divide the class into teams before the cruise.

TEAM 1 -- NAVIGATION

(3 - 5 students)

OBJECTIVE:

To use fixed points on land (such as a mountain peak) or fixed structures on land (such as a radio tower) to determine the ship's position on the ocean. Celestial and Polynesian navigation will also be discussed. Navigation is extremely important at sea as there are no street signs, and if you can't ask a fish for directions, you should know how to get your ship to where you want to go without getting lost!

EQUIPMENT:

(1) Compass - used to obtain the heading (direction by compass degrees) of the ship.

(2) Pelorus - used to obtain the bearing (position by compass degrees) of an object on land.

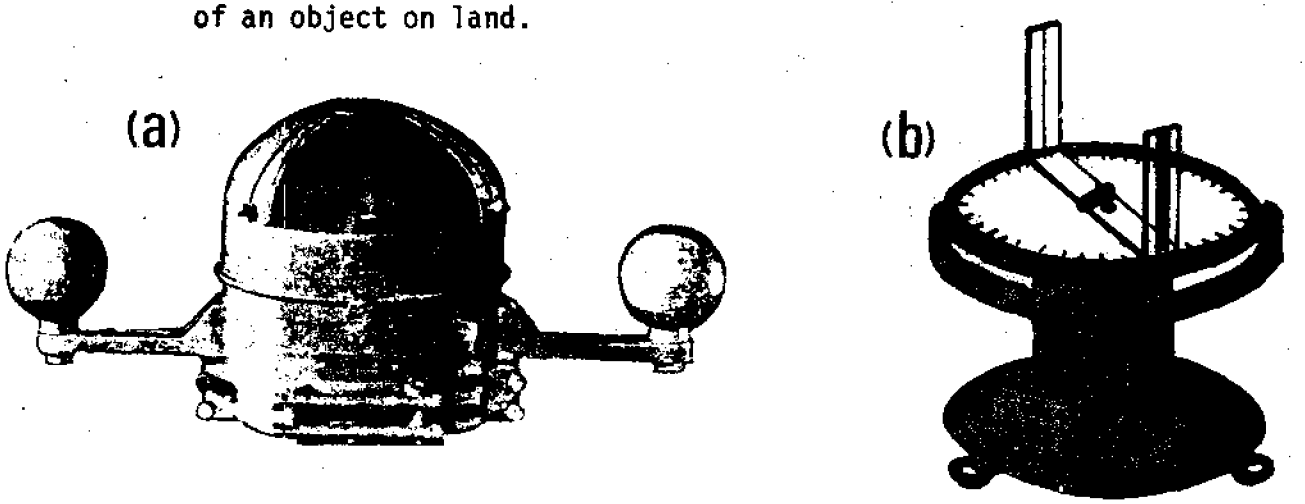

Figure 1. (a) Ship's compass, and (b) Pelorus

(3) Chart - a map of the ocean with latitude, longitude, and depths, used to plot the ship's position and course.

(4) Parallel rules - used to plot position lines on the chart.

(5) Sonar depth finder - used to measure the depth of the ocean beneath the ship to confirm the calculated position.

(6) Radar - also used to confirm the ship's position.

ACTIVITIES AND RESULTS:

The navigation team will prepare and keep a copy of the navigational chart showing the ship's course and the events of the cruise.

SCRATCH PAPER FOR NAVIGATION TEAM

TEAM 2 -- GEOLOGY
(2 - 4 students)

OBJECTIVE:

You will obtain a sediment sample (and often animals that live in the sediment) from the ocean floor, which you observe, sieve, identify, photograph, and preserve. You will also use the sonar depth finder (fathometer) to obtain a "picture" of the ocean floor (bathymetry).

We study the ocean floor to learn about the history of the oceans, our islands, and the interior of the earth. Much of the sediment on the ocean floor is composed of shells from plants and animals that once lived in the water above. By examining the different types of sediment, we can learn about the plants and animals that lived in the ocean millions of years ago. We also learn about industrially important metals that lie on the ocean floor.

EQUIPMENT:

(1) Shipek grab sampler - used to collect sediment samples.

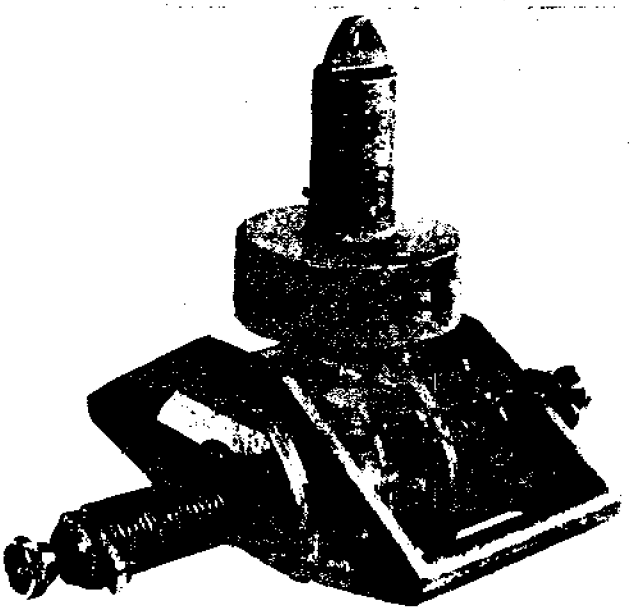

Figure 2. Shipek grab sampler

EQUIPMENT (continued):

(2) Sieve set - used to separate sediment samples into various sized particles for easier study.

(3) Dissecting zoom microscope - used to observe the samples.

(4) Polaroid camera - used to photograph samples through the microscope.

(5) Sediment keys - written descriptions used to identify components of samples.

(6) Preserving liquids, bottles, labels - used to keep samples for later study or reference.

ACTIVITIES AND RESULTS:

The geology team will prepare and keep a data sheet, preserved specimens, and photographs of selected sediment samples.

SCRATCH PAPER FOR GEOLOGY TEAM

TEAM 3 -- PLANKTON

(3 - 6 students)

OBJECTIVE:

You will capture, identify, photograph and preserve plankton, which are plants and animals that float on or near the ocean surface. Often plankton are too small to be seen without a microscope. The tiny plants in the plankton (called phytoplankton) use a special process (photosynthesis) to change sunlight energy and chemicals in the ocean water into food energy (sugars) in their cells. This energy, which all life needs to survive, is passed along the ocean food chain as the phytoplankton are eaten by the zooplankton (animal plankton), which are eaten by small fish, which are eaten by bigger fish, which you eventually eat. (This is a very simplified version of a food chain.) So without the tiny phytoplankton, there would be no other life in the ocean.

EQUIPMENT

(1) Plankton net - used to capture plankton from the sea surface.

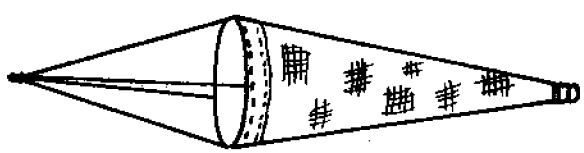

Figure 3. Plankton net

(2) Dissecting zoom microscope - used to observe the plankton.

(3) Polaroid camera - used to photograph the plankton through the microscope.

(4) Plankton key - written and illustrated descriptions used to identify different kinds of plankton.

(5) Preserving liquids, bottles, labels - to keep plankton samples for later study and reference.

ACTIVITIES AND RESULTS:

The plankton team will prepare and keep a data sheet, preserved plankton specimens, and photographs of selected plankton.

SCRATCH PAPER FOR THE PLANKTON TEAM

TEAM 4 -- BENTHOS

(6 - 9 students)
Team should be divided into sub-teams of 2 or 3 to study (1) invertebrates, (2) vertebrates, and (3) algae

OBJECTIVE:

You will capture, observe, identify and photograph plants and animals collected from the sea floor (benthos means bottom-living). Samples usually include algae (like "limu" and "ogo"), invertebrates (animals without backbones like starfish, shrimp, sponges, and crabs), and vertebrates (animals with backbones like fish and turtles). You will preserve some samples to keep; and may also have live specimens if you have aquaria for them.

There are several important reasons why we should study the sediments and benthos on the ocean floor. Man-made structures like sewer outfalls and telephone cables can alter or destroy the benthos, and these changes also affect the life in the water above.

Some benthic animals live on sandy bottoms, and others live on muddy or rocky bottoms. If you were trawling for a special plant or animal (fishermen use trawls to catch crab and lobster), and you had studied the sediment and benthos, you would know the right place to look.

EQUIPMENT:

(1) Otter trawl net - used to capture benthos samples.

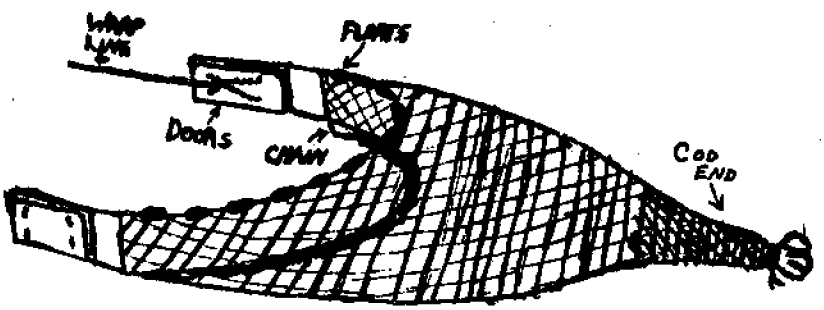

Figure 4. Otter trawl net

(2) Dissecting zoom microscope - used to observe small live benthos.

(3) Polaroid camera - used to photograph benthos through the microscope.

(4) Fish, invertebrate, and algae keys - written and illustrated descriptions to identify benthos caught in the otter trawl net.

(5) Preserving liquids, bottles, labels - to keep benthic samples for later study or reference.

ACTIVITIES AND RESULTS:

The benthos team will prepare and keep a data sheet, preserved benthic specimens, live specimens (if available), and photographs of selected benthos.

SCRATCH PAPER FOR THE BENTHOS TEAM

TEAM 5 -- WATER QUALITY

(4 - 6 students)

OBJECTIVE:

You will collect samples of sea water with a Nansen bottle. In the ship's laboratory you will perform several basic chemical analyses of your water samples -- oxygen concentration, salinity ("saltiness"), phosphates and nitrates. You will also measure temperature changes at different depths in the ocean, and turbidity (whether the water is cloudy or clear) near the ocean surface.

Oxygen is needed by all plants and animals to "breathe" (called respiration), so measuring the oxygen concentration in the ocean water is one way to locate marine life, whether it is plankton or fish.

Temperature and sunlight in the ocean affect the life processes of the plankton, and since plankton are essential to the marine food chain, they also affect all the other life in the ocean.

EQUIPMENT:

(1) Nansen bottle - used to collect ocean water samples.

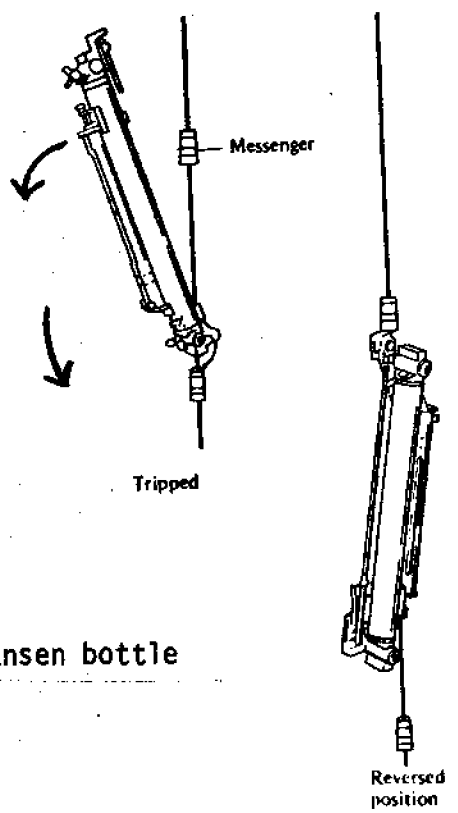

Figure 5. Nansen bottle

EQUIPMENT (continued):

(2) Oxygen meter - used to measure the concentration of dissolved oxygen in sea water.

(3) Refractive Salinometer - used to measure the concentration of salts in sea water.

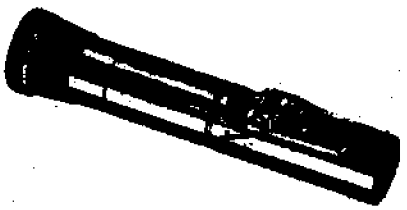

Figure 6. Refractive salinometer

(4) Bathythermograph - used to measure changes in temperature at different increasing depths in the ocean.

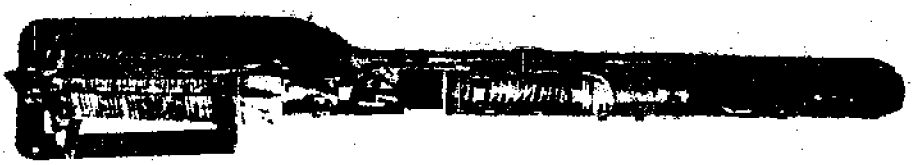

Figure 7. Bathythermograph

(5) Secchi disk - used to determine how clear the ocean water is.

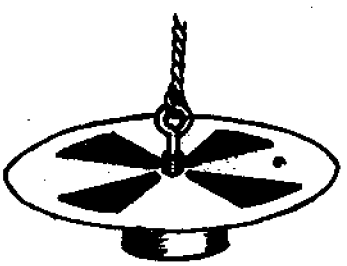

Figure 8. Secchi disk

ACTIVITIES AND RESULTS:

The water quality team will prepare and keep a data sheet. Students may take sea water samples back to class if they bring their own containers.

SCRATCH PAPER FOR THE WATER QUALITY TEAM

III. SAILING (1 to 1-1/2 hours, weather permitting)

After the scientific portion of the cruise in completed, everyone can relax and enjoy the waves, wind, and island scenery. You can discuss your scientific findings, ask questions, learn to tie knots, or exchange sea stories. If the wind and weather permit, you will help to set the ship's sails, and the main engine will be shut down, so everyone can experience the thrill of open ocean sailing. Maybe a school porpoises will come to visit, or a lucky student fisherman will catch a mahimahi for dinner!

Four hours after the lines were cast off, they are made fast again as the Machias glides into port with her cargo of passengers, samples, and a few good additions to your collection of sea stories to last a lifetime.

SUGGESTED EXTRA READINGS FOR CRUISE PREPARATION (BASIC TEXTS)

GENERAL: The Oceans, Sverdrup, Johnson, & Fleming (advanced; for reference)

Life in the Sea, Gunnar Thorson

Oceanography, M. Grant Gross (mostly physical oceanography)

The Frail Ocean, Wesley Marx

This Great and Wide Ocean, R. E. Cohen

NAVIGATION: How to Navigate Today, M. R. Hart

GEOLOGY: Oceans, Karl Turekian

Anatomy of an Island, W. Kyselka

PLANKTON: Nature Adrift, Fraser

The Open Sea, Alister Hardy

BENTHOS: Invertebrate Zoology, Barnes (advanced; for reference)

The Many-Splendored Fishes of Hawaii, Gar Goodson

The Life of Fishes, N. B. Marshall (advanced; for reference)

Seaweeds at Ebb Tide, M. Guberlet (advanced; for reference)

WATER CHEMISTRY:

Oceans, Karl Turekian

"Why the Sea is Salt," F. MacIntyre, Scientific American, November 1970, p. 104.

GENERAL MARINE PERIODICALS:

Oceans

Sea Frontiers

Skin Diver

Scientific American (special oceans offprints)

Sea Magazine

Fishes (Time-Life series)

Figure 9. The Blue-Water Marine Lab's R/V *Machias*

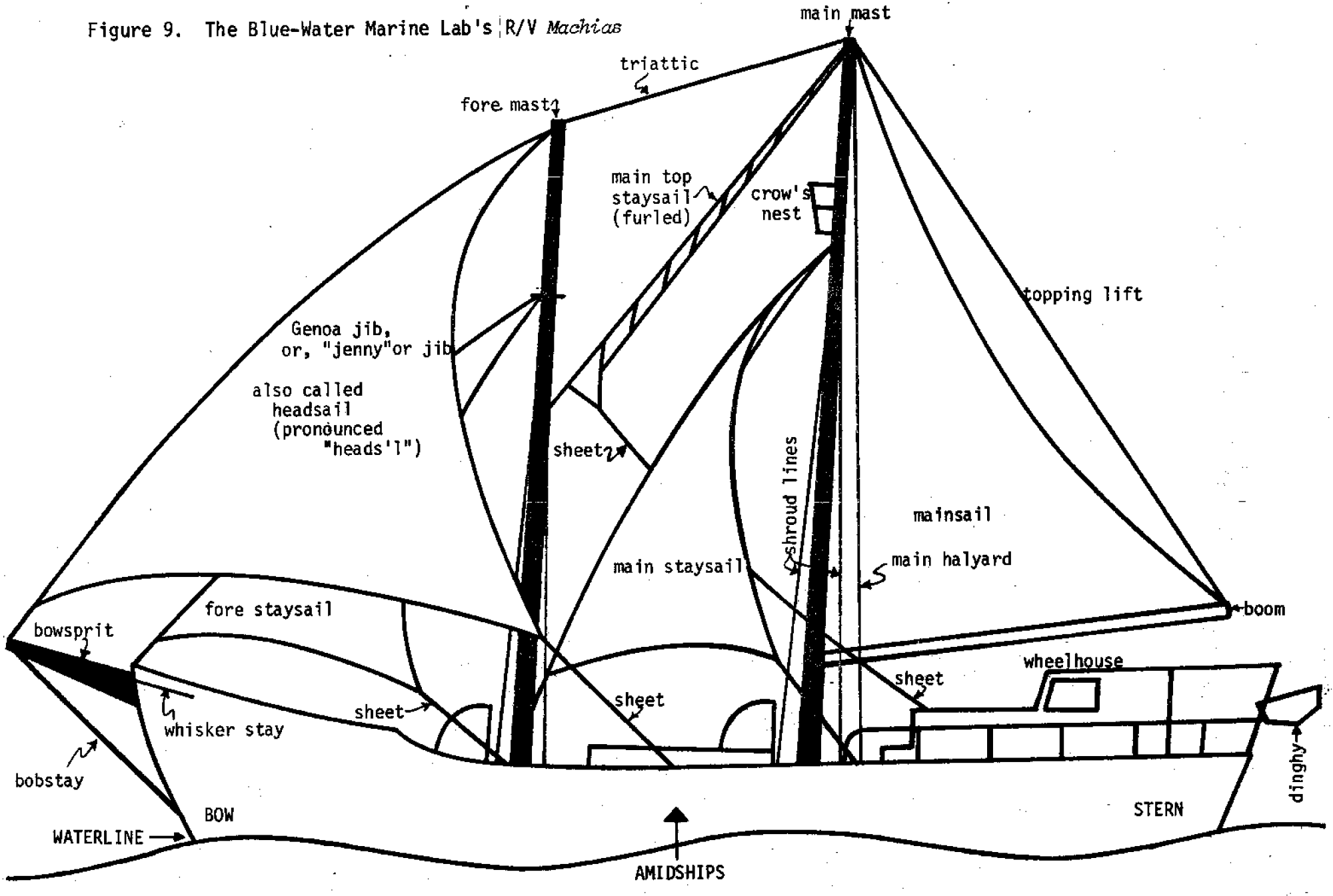

Figure 10. Diagram of top view of R/V *Machias*

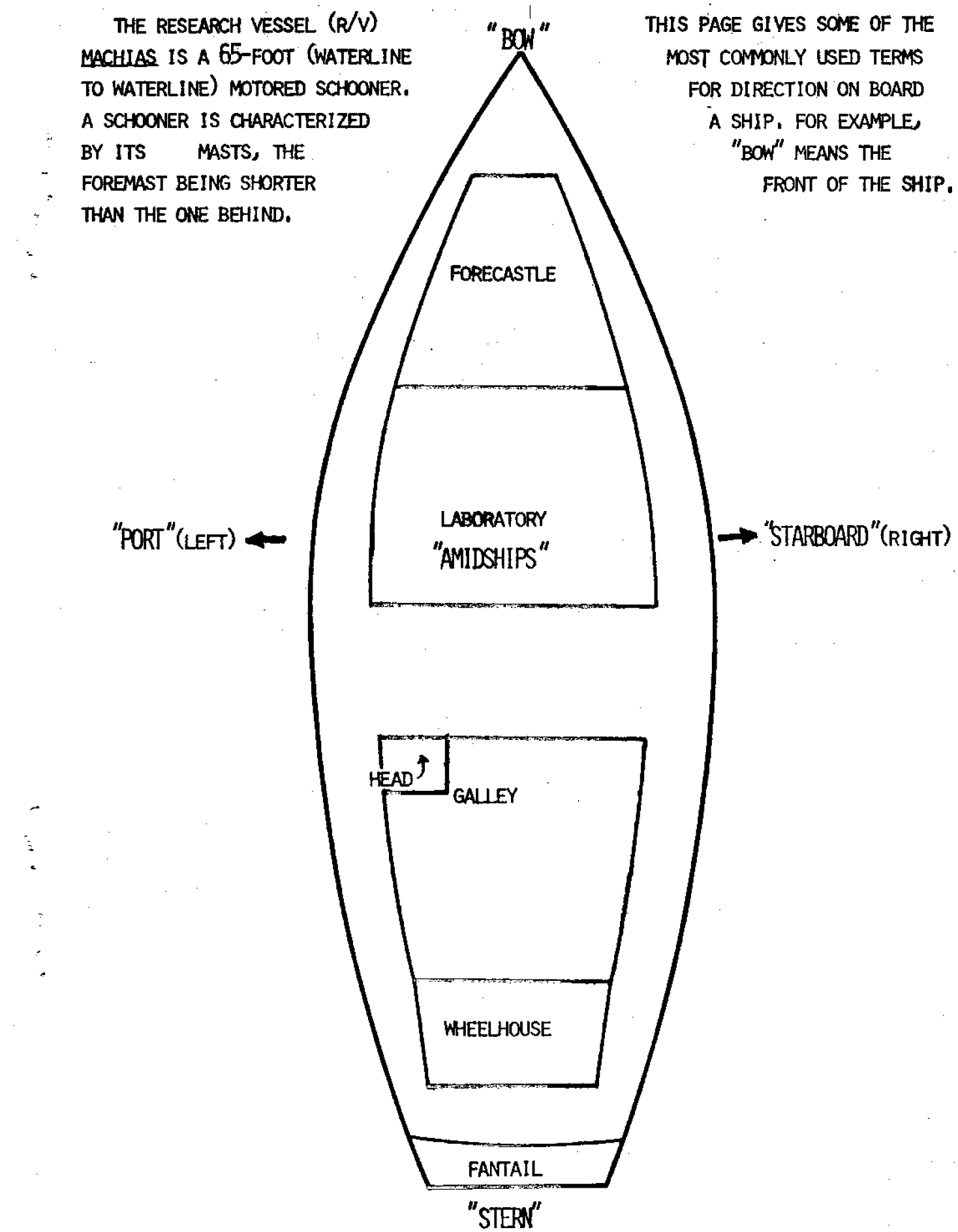

Figure 11. Oceans lab on board R/V *Machias*