

SEA EDUCATION ASSOCIATION



ORGANIZATION AND OPERATIONS MANUAL

FOR SEA SEMINARS

**SEA EDUCATION ASSOCIATION, INC.
P.O. BOX 6
WOODS HOLE, MA 02543
www.sea.edu**

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FOR *SEA Seminars* aboard *Corwith Cramer* and *Robert C. Seamans*

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WOODS HOLE, MA 02543

(508) 540-3954

www.sea.edu

PREFACE

This manual is designed to serve as an instructional and reference guide during your *SEA Seminar*. Please study this manual carefully before joining the vessel and refer to it when aboard.

SEA Seminars on board SEA's vessels are carefully organized to ensure the success of SEA's purpose: to foster a knowledge, understanding and appreciation of the oceans by providing challenging and enriching academic programs that offer the opportunity to live, work, and study at sea. As on any sophisticated vessel, life on board ship is structured according to age-old, proven traditions, and by requirements specific to their work. It is tightly scheduled and demanding, and, for most participants, requires some getting used to.

"Normal" patterns of sleep/work/recreation must be reorganized to fit the 24-hour needs of a vessel at sea. With up to 39 other participants and staff aboard, close relationships will be inescapable, requiring an enthusiastic commitment of energy and cooperation to sustain the good morale needed for a productive voyage. There is continuous activity through the day and night whether conducting experiments or working on deck. Participants experience a constantly changing schedule. Sleeping and working on a 24-hour watch schedule requires patience and management of sleep and free time. The world will be in constant motion and, for most, it will take a day or two to get "sea-legs" and feel comfortable at sea.

Although it will be plainly obvious once on board, participants should recognize in advance that each person's duties consist of real responsibilities affecting the safety and welfare of the vessel and those on board. Indifference or negligence on the part of anyone places additional burdens on shipmates. The sea is no place for someone who is not prepared to take his/her role seriously and participate fully in the common effort. Everyone pitches in when necessary. By working together and helping out when needed, the voyage can be an unforgettable and rewarding time.

The description of the organization and operation of SEA's vessels in this manual is for the information and education of those who assist the scientists and crew of the Sea Education Association vessels in responsibilities related to carrying out the academic program.

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PART ONE -- THE *SEA SEMINAR*

I. ORGANIZATION

The mission on board SEA's vessels is educational. All participants will be involved in every operation of the vessel with the goal of learning about the oceans and increasing awareness about ocean systems and their impact on human populations. Activities during the *SEA Seminar* are organized into two major areas of responsibility: scientific and nautical.

A. Scientific

The Chief Scientist is in charge of the vessel's scientific program and sets the science watch schedule, decides the vessel's itinerary in coordination with the Captain, and supervises the collection of all data. He or she does not stand a watch and is on call at all times.

The Chief Scientist is assisted by Science Watch Officers, permitting the lab to be staffed 24 hours a day. They are responsible, under the direction of the Chief Scientist, for on-watch instruction and for giving lectures and demonstrations during regularly scheduled classes.

B. Nautical Science

The Captain is in charge of vessel's operations and has the ultimate responsibility for the safety and welfare of the vessel, her crew, and all participants. He or she does not stand a watch and is on call at all times.

Three Deck Watch Officers, an Engineer (and often an Assistant Engineer), a Steward, and an Assistant Steward assist the Captain. Several deckhands are also often on board to assist during *SEA Seminar* programs.

The Deck Watch Officers rotate so that one is in charge of the vessel at all times. In addition to being responsible for the safety and navigation of the vessel, they teach the students assigned to their watches. Watch Officers have collateral duties as well. One is designated Bosun and is in charge of the vessel's maintenance program. Another, designated Navigator, is in charge of navigational gear and charts, and a third, designated Safety Officer, is responsible for fire and safety equipment.

The Engineer directs the engine room.

The galley and the internal cleanliness of the vessel are the responsibility of the Steward.

The Captain is the Medical Officer on board unless otherwise specified.

All the crew assisting the Captain combine their regular duties with on-the-job teaching and lectures.

II. SCHEDULES

A. First Day Routine

When you first arrive on board, report to the crewmember in charge on deck. You will be shown where to stow your gear. When this is done, report back on deck and lend a hand wherever needed. Sailing day is a busy time for everyone. Once you have reported aboard, do not plan to leave the vessel again.

Normally, the vessel anchors for the first night. Before the evening meal, there is an orientation briefing. The staff is introduced, their roles and responsibilities are explained, and the vessel's scientific mission is discussed. After the briefing, students are divided into three watches and begin orientation to key areas of the vessel. For at least the first 18 hours of the program there will be a comprehensive orientation to all departments of shipboard life.

B. Watches

A ship does not sleep at night. The operations of the vessel must be carried out around the clock. To accomplish this, staff and participants are divided into three watches. Each watch runs the vessel during the period it is on duty.

On board SEA's vessels, each participant averages eight hours of watch each day, but the watches are rotated so that a participant does not stand the same watch two days in a row. Day watches are six hours long, and night watches are four hours long. You will report to your watch assignment ten minutes prior to the watch turnover.

Example: If you were assigned to "A" watch, your watches would be the ones underlined.

Day 1	<u>0700-1300</u>	<u>A WATCH</u>
	1300-1900	B WATCH
	1900-2300	C WATCH
	<u>2300-0300</u>	<u>A WATCH</u>
Day 2	0300-0700	B WATCH
	0700-1300	C WATCH
	<u>1300-1900</u>	<u>A WATCH</u>
	1900-2300	B WATCH
	2300-0300	C WATCH
Day 3	<u>0300-0700</u>	<u>A WATCH</u>
	0700-1300	B WATCH
	1300-1900	C WATCH
	<u>1900-2300</u>	<u>A WATCH</u>
	2300-0300	B WATCH etc.

C. Rotation of Duties

On most vessels, crewmembers have jobs that do not change. Since SEA's ships are teaching and research vessels, and you are aboard to learn all the jobs on the vessel, your duty assignment will change nearly every time you go on watch. You will work in the lab, on deck and in the galley many times during your cruise.

To ensure that this happens as fairly and uniformly as possible, a numerical rotation has been built into the watch schedule. On the first day you will be assigned a **watch number**. With this number you can find your assignment on any day by consulting the watch list on the bulletin board. A sample of this list is given below. Look for your watch (A, B, or C) to find when you are on duty, and look for your number to find what you will be doing.

WATCH LIST

<u>DAY</u>	<u>TIME</u>	<u>WATCH</u>	<u>LAB</u>			<u>DECK</u>			<u>GALLEY</u>
1	0300-0700	A	1	2	5	3	4	7	6
	0700-1300	B	9	10	12	8	11	14	13
	1300-1900	C	15	20	21	16	17	18	19
	1900-2300	A	3	5	7	1	2	6	4
	2300-0300	B	8	12	14	10	11	13	9

Example: If you were assigned to A Watch and your number was 2, you would be working in the lab from 0300-0700 and on deck from 1900-2300 on the first day of the cruise.

III. LIFE AT SEA

Ashore, at the end of the day and on weekends, you can get away from your teacher or boss, classmates or co-workers, and relax at home and enjoy yourself.

At sea, on a ship the size of SEA’s vessels, you cannot get away except by climbing into your bunk and drawing the curtains. Twenty-four hours a day, work and recreation go on in the same confined space with the same group of people. This calls for courtesy, cooperation and personal discipline. You must give up, for the length of the cruise, some things that you take for granted ashore. Experience has shown that a few points need to be stressed.

A. Drugs

SEA has a “zero-tolerance” policy for illegal drugs. Use or possession of illegal drugs will result in immediate dismissal from any SEA program. Absolutely no illegal drugs are permitted at any time on shore or at sea.

SEA vessels have been searched for illegal drugs. If drugs are found aboard, the Captain can lose his/her license and SEA can lose the vessel and programs. Anyone found in possession of illegal drugs at sea will be put off the boat as soon as practical. This policy is not negotiable. Due to the possible legal consequences, the Captain is entitled to search a student’s personal belongings in any case of suspected violation.

B. Alcohol

Private stocks or unauthorized consumption of liquor are dangerous to safety and morale and are not permitted on SEA's vessels. Unauthorized use onboard is cause for disciplinary action up to and including immediate dismissal.

C. Your Space

Your bunk is your space while on board. It is important to remember that all other areas of the vessel are shared by all. Therefore, everyone must strive to contain his/her personal belongings in his/her space.

D. Courtesy

Courtesy is essential no matter what mental or physical state you may be in. Quietness is a virtue on board ship. Due to the watch system, one third of the ship's company may be asleep at any given time. Respect their need for quiet. Personal electronic equipment (ipods, cell phones) may not be used on board. However, musical instruments are always welcome. Profanity and offensive behavior are an infringement on others and are not acceptable on board SEA vessels.

Table manners must be at their best. Meals are served family style so everyone is expected to conduct himself/herself in a civilized manner at the table. Shirts must be worn at the table.

E. Cleaning

With up to 40 participants and staff aboard the vessel a regimen of cleanliness must be maintained in order to keep all shared quarters livable, workable and pleasant. To this end a cleaning schedule has been devised which ensures daily and weekly attention to the below-decks area of the vessel.

1. Galley Clean-up

Galley clean-up normally takes place during mid-watch (2300-0300). A person on that watch who has been assigned galley duty cleans the galley and any special areas designated by the Steward. General tasks are emptying the garbage, cleaning all the bulkheads and counters, and sweeping and scrubbing the soles (floors).

2. Dawn Clean-up

The below-decks area is cleaned each morning after breakfast by those who were on watch during the dawn watch (0300-0700) that day, and is supervised by the Assistant Scientist and Mate. The dawn clean-up consists of cleaning each head (bathroom) thoroughly, sweeping and mopping the soles from bow to stern, emptying waste cans, and stowing any loose gear. The entire watch participates in this activity.

3. Field Day

At the end of each voyage, everyone on the ship pitches in on Field Day. Field Day is the thorough scrubbing of all areas of the vessel. The vessel is divided into three areas and each watch is assigned an area to clean. Field Day generally takes two hours and can be fun as it provides a break from the normal routine, shows immediate results and is often rewarded with snacks!

It cannot be stressed strongly enough that the cleanliness of the vessel directly influences the health and general mood of the entire ship's company - the job may not always be the most enjoyable, but it is the most important for morale.

F. Medical Problems

A staff member with appropriate training is appointed vessel's Medical Officer and treats minor complaints. All injuries, however slight, must be reported to the Medical Officer. All prescription medicine must be given to him/her when reporting aboard. Medicines may be given back, or may be kept and dispensed as needed. A stock of equipment, over-the-counter and prescription medication is maintained securely in the aft cabin. SEA works with a specialized service of licensed physicians available by satellite phone for consultation from the ship.

Any serious illness or injury is referred to a shore side facility. Students are responsible for medical costs incurred in this connection.

G. Seasickness

Most will experience seasickness at the outset and in some cases it will persist for longer periods. The important thing is to keep drinking and eating, even if it is only water and soda crackers, and to keep doing your job. If things do not seem to improve, check with the Medical Officer; medications are available which may help. Ginger tea, pressure point bracelets, and motion sickness tablets can also prove helpful in battling seasickness.

H. Smoking

Smoking is not permitted by students enrolled in the high school programs.

Smoking is permitted only on the after-deck to leeward. Take care near the boomkin and aft deck boxes where the outboard gasoline is stored. Check with ship's crew regarding proper disposal practices.

I. Safety

If people are careless, a vessel can be dangerous. No amount of rules and protective equipment can replace caution and common sense. SEA staff is chosen for their experience, and their concern is to prevent injuries. Check with them, listen to their advice, and read and obey Standing Orders.

Some aspects of safety have been mentioned elsewhere. They are summarized here for your convenience. Please study this section carefully.

1. Falling Overboard

If this happens at night and no one notices, the chances of recovery are slim. That is why we insist that you:

- * Do not sit on the rails.
- * Notify the Watch Officer if you leave the deck at night.
- * Get permission before going aloft or out on the bowsprit.
- * Always keep one hand for yourself and one for the vessel.
- * Use safety harnesses when required.

2. Burns

An extensive third degree burn requires hospitalization - not just medical knowledge. The galley is the major danger area, the engine room second. Follow all safety instructions when working in these areas.

3. Falls

- * Hold on to ladder rails, and face the rungs when going up or down.
- * Hold on to standing rigging when climbing ratlines.
- * Do not walk under a person working in the rigging.
- * If working aloft, all tools must be tied to you and your tenders must wear hard hats.

4. Lines

- * Lines under strain can injure if not properly handled.
- * Do not cast off a line until you understand the strain it is under.
- * Do not cross in front of the windlass or winches when in use.
- * Do not step on a loose line. It will roll, or worse, a moving bight may pull you off your feet and into a block or over the side.

5. Miscellaneous

- * Captured heel shoes must be worn in the lab, galley and engine room at all times. Shoes are also required while standing watch in any capacity. Closed toe shoes must be worn by lab watch during ANY equipment deployment.
- * Sunburn can incapacitate a person. Always wear sunblock on exposed skin. Hats are highly recommended.
- * Rings, long fingernails, loose hair, and loose shirtsleeves and shirttails can be responsible for serious injuries at sea.
- * Keep lids tight on all chemical containers in the lab. Large amounts of chemicals should not be stored in the lab. Use only the amount necessary.
- * Memorize the location of every fire extinguisher on the vessel.
- * Pay attention to the danger areas when the hydrowinch is in operation.

J. Conservation

Doing hard work with limited resources in a hostile environment has led to traditions of skill, pride, craftsmanship, and conservation, all of which we lump under the term "seamanship." A mariner, whether he or she is a deckhand, lab technician, captain or scientist, regards it as high praise to be called a good seaman by his or her peers. Much of the instruction you receive during your *SEA Seminar* is geared to developing in you the qualities of seamanship.

Conservation means not wasting. In this sense, sailors have always been conservationists regarding with wonder, and sometimes contempt, the wastefulness of people ashore compared with their frugal lives as mariners. Any vessel is a miniature of the "spaceship earth." Once it leaves port, it is a closed system of non-renewable resources where one makes do with what one has or improvises.

Our irreplaceable resources at sea are PEOPLE, WATER, FUEL, FOOD, EQUIPMENT and SUPPLIES. At the outset of a cruise, there is enough to go around, plus a margin of safety, but there is none to waste. Therefore, it is vitally necessary to conserve and not waste. We average 2-3 gallons of water per person, per day at sea. During a typical day on land, you may use up to 70 gallons! If you consciously try to be frugal with the vessel's resources, you will take a big step toward earning the right to be called a seaman. Learning that you can rely on yourself and can do without the wastefulness of a "throwaway" society will teach you something you can use all your life, at sea and ashore. It is a lesson that is valuable in today's world.

K. Fun

Most manuals that describe courses stress subject matter and the amount of work involved. Often no one remembers to mention that there is also a lot of fun involved. SEA programs are difficult and demanding, but are also tremendously enjoyable. Woven into the fabric of work and study are impromptu gatherings, adventure and exploration, and the satisfaction that comes from doing a difficult task well.

PART TWO -- SCIENTIFIC OPERATIONS

I. SCIENTIFIC PROGRAM

A. Scientific Objectives

The research goals of the Chief Scientist and the on-going scientific mission of SEA determine the scientific objectives of each cruise. The itinerary of the cruise is built around these objectives by the Chief Scientist in cooperation with the Captain, the Dean, and the President of SEA.

The Chief Scientist coordinates and directs all scientific work. All stations are conducted to collect samples and information pertinent to the scientific objectives. The process of collecting and analyzing oceanographic data while on station and during lab watch is supplemented by regular lectures and demonstrations.

B. Science Plan

The Chief Scientist, in coordination with the Captain, will work out a daily plan for implementing the scientific program. This plan includes the positions for oceanographic stations and lists the data to be collected at each station. This plan is posted in the lab and near the chart table.

C. Science Watches

Science watch standers should report to the lab, ready to relieve the off-going watch, at least ten minutes in advance of the watch change. They should each have a knife and, at night, a flashlight. The lab watch is "on call" to assist the deck watch in handling sails; watch standers should therefore have clothing handy for going on deck.

The lab is a place of business and must be kept clean and tidy. Equipment must be kept stowed when not in use; many instruments are delicate and can be irreparably damaged if they fall. No personal gear may be left in the lab.

D. Oceanographic Records and Resources

1. Science Log

The scientific activities of the cruise are recorded in the Science Log. Hourly entries are made of sea surface temperature, sea surface salinity, current speed and direction, chl-a fluorescence, CDOM fluorescence, barometric pressure, water depth, taffrail log reading, and geographic position among others. Additional entries are made at each scientific event, such as a station, and at each significant sighting of marine flora or fauna. The Science Log forms a complete record of all scientific activity on the cruise, and must be kept carefully and accurately. It is not the place for lighthearted remarks, cartoons, etc.

2. Data Sheets

Certain activities, such as stations, require specialized forms called Data Sheets. Such activities are summarized briefly in the Science Log (identified by a station number) and are recorded in detail on appropriate Data Sheets that carry the same station number.

3. Laboratory Manuals

A suite of reference notebooks are kept in the lab providing detailed instructions for scientific operations and analyses, calibration curves for instruments, sample calculations, conversion tables and other relevant background information. Students should consult these notebooks and a scientist before operating any equipment or processing collected samples and data.

E. Stations

A station is a location where data are collected, either underway or hove to. An accurate position must be obtained for each station.

A successful station requires advance planning and smooth coordination of deck and lab personnel. Science and Deck Watch Officers should confer at the beginning of the watch to ensure that this takes place. The Science Watch must prepare in advance all data sheets, gear, jars, pencils, flashlights, etc. before reaching the location of the station. The Science and Deck Watches work together to get the vessel hove to, the appropriate day shapes or lights rigged, and the gear over the side. No gear may be put over without the Deck Watch Officer's permission.

When on station, the Deck Watch and Science Watch continue to cooperate in maintaining the correct wire angle. The Deck Watch Officer should be informed when the station is near completion so preparations can be made to get underway without delay. The watches work together in getting the gear aboard and stowed, and in getting the vessel underway again.

F. Safety

Oceanography, like other sea-going work, can be dangerous. Many operations involve handling heavy gear on a pitching, rolling deck, working with wet electrical equipment and dealing with dangerous chemicals.

- * Keep everything well lashed down, and put everything away when no longer needed.
- * Be extra careful handling glass jars containing specimens and especially those containing chemicals. Be sure lids are tight.
- * Scientific staff only are permitted in the locker where concentrated acids and other dangerous chemicals are stowed.
- * Appropriate Personal Protective Equipment (eg: gloves and goggles) must be worn when working with any chemical.
- * Contact lenses should not be worn while working with volatile chemicals.
- * Stay away from the hydrowire when it is under strain. No one is allowed in the deck area which lies inside the angle formed by the lead block. Think of the wire, with tons of strain on it, as a slingshot and you will understand why.
- * Vigilance is an absolute necessity when operating the hydrowinch. It is a great temptation for students to pay little attention while tediously spooling large quantities of wire. This must be guarded against at all times.
- * Shoes should be worn in the lab to protect against broken glass, spilled chemicals, etc. Closed toed shoes must be worn when deploying equipment.
- * The neuston boom and hardware on the J-frames often require outboard work. Notify the Deck Watch Officer, wear a safety harness, and use extreme caution to prevent being injured or knocked over the side.

II. OCEANOGRAPHIC OPERATIONS

A. Making a Station

An oceanographic station is any location where data collection is performed. Sometimes this is accomplished without interrupting the normal movement of the vessel--surface stations or weather observations, for example. Generally, however, it involves maneuvering the vessel in order to modify its speed and drift so that equipment put over the side will remain clear of the hull and especially the propeller. This means that sophisticated vessel handling and a diversion in the vessel's progress is involved. Stations must be carried out efficiently in order to better ensure that the vessel can meet its schedule.

B. Vessel Handling

In order to deploy any scientific equipment, the vessel must be maneuvered in a way that minimizes risk to the equipment and the vessel, while maximizing sampling efficiency. Science gear deployed on the hydrowinch wire is led over the port side. If under sail, the sail trim and the helm must be adjusted so that the vessel maintains the proper speed and/or position relative to the wire. If the vessel is under power while sampling, there is a danger of fouling the wire in the propeller. In this situation, appropriate adjustments to the helm, engine speed and/or propeller pitch must be made to safely position the vessel clear of the wire.

C. Gear Handling

Handling heavy oceanographic equipment aboard a rolling, pitching vessel at sea is fraught with potential danger to personnel, vessel, and equipment. It requires seamanship of a high order. Consult the staff in all cases before attempting to operate the machinery.

D. Winches

Gear is usually set or lowered over the side on a wire rope or cable that is payed out and retrieved by a winch. SEA's vessels are each equipped with these winches:

1. Hydrographic Winch

Located amidships, the hydrographic winch carries approximately 5000 meters of 1/4" wire rope (known as "wire"). The hydrographic winch has a continuously variable winch speed. Wire goes from the winch through an instrumented block (pulley). The block has an electronic sensor which records the lowering or retrieval rate, and the amount of wire out. Some instruments record the depth as they are lowered; for others, depth can be calculated from the angle (measured with an inclinometer) and amount (length) of wire.

Operating the hydrographic winch involves skill and responsibility. The vessel's staff will brief you on setting up the meter wheel, reeving wire through the block, paying out and retrieving gear, calculating sampling depth, level-winding wire on the winch, and other safety issues.

Lowering and retrieving speeds are important. For example, if gear is lowered too fast, the wire will overrun and the slack will form kinks which can break the wire when the strain is resumed. Be conservative! Remember that vigilance is required when operating the winch, especially when tediously spooling in or out large quantities of wire.

a. Danger Areas (see diagram at right)

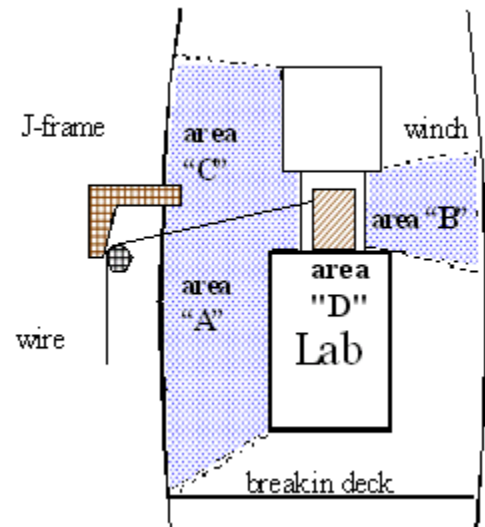
Area "A" - between wire and break in deck. This area is prohibited to all personnel when there is gear trailing aft (e.g. plankton tows). Members of the Science Watch should be in this area only:

- i) when the winch is stopped and the brake is on.
- ii) to attach or remove gear from the wire. **Reason:** a failure of the block would allow the wire to spring into this region.

Area "B" - on the starboard side of the winch. Individuals should pass through quickly. **Reason:** wire failure would most likely occur at the meter block, whipping wire back over the winch

Area "C" - between the wire and the J-frame control.
This area is prohibited to all personnel except the winch operator and the J-frame operator.

Area "D" - on the lab house top. A wire failure might cause recoil onto house top area



b. Operating Personnel (see diagram)

i. Winch Operator

He/she must have a hand on the controls at all times when gear is descending and ascending, and must stay at the station throughout the period that the winch is in operation. The operator should have no other duties when running the winch. The operator is also responsible for reading the meter wheel.

ii. J-frame Operator

He/she stands in Area "C" to run the hydraulics for the J-frame.

iii. Wire Sight Person

During a tow, when gear is trailing aft, a member of the Science Watch stands at "D" and continually sights the wire angle. He/she informs the deck watch when the vessel is moving too slowly or too quickly. Ascending wire is watched for kinks, broken strands, and the gear itself. Upon sighting gear, shout "Sight" to meter reader and "Surface" as the gear breaks the surface of the water. During stations when the vessel is hove to and the wire angle is straight down from the meter wheel block, stand forward of the J-frame in Area "C" to sight the wire.

NOTE: Meter wheels are not always accurate. Gear has often been lost because the meter reader figured that the gear was 100 meters away by the meter wheel, only to find that the wheel had slipped. Exact timing of ascent and descent is recommended as well as a careful watch on the wire.

2. Auxiliary Winch

This winch is located on the starboard aft deck, where it is used to deploy towed sampling instruments, as well as towed or vertically deployed electronic probes, such as the CTD. This winch has a capacity of 1000 meters of 1/8" wire rope, with variable speed control and an accurate wire payout meter. It also provides sufficient capabilities to act as a backup to keep the scientific program in operation in the rare case that the main hydrowinch is inoperative.

3. Vessel's Windlass

It is located on the foredeck and is driven by its own diesel engine (CC)/Electric motor (RCS). This is by far the most powerful winch on the vessel. It can pull the heaviest of loads slowly by fair-leading large synthetic lines through snatch blocks to its capstan heads. It is used for oceanographic gear only upon failure of the hydrographic winch or for other emergencies.

E. Sampling Procedures

1. Physical and Chemical Sampling

a. Surface Sampling

Water from the surface is collected on a regular basis, or as directed by the Chief Scientist, to measure temperature, salinity, pH, alkalinity, nutrient and chlorophyll *a* content, and the concentrations of microtar and microplastic among others. The water is collected via clean flowing seawater systems that runs continuously or with a clean plastic bucket that is secured to the vessel with a line and lowered just beneath the surface. If using a bucket never wrap the line around your hand or fingers.

b. Sub-surface Sampling

i. CTD

The Conductivity-Temperature-Depth Recorder (CTD) is an oceanographic sampling instrument with electronic sensors to continuously measure salinity, temperature and depth in the water column (Figure 1). The data is stored internally and can be accessed by connecting the CTD to a computer. We carry a suite of instruments that can be attached to the CTD. These include Chlorophyll-a fluorometers, CDOM fluorometers, oxygen sensors, Photosynthetically Available Radiation (PAR) sensors, and transmissometers. With depth ratings as great as 3000 meters, these instruments are the primary workhorse for studying physical parameters of the upper water column.

ii. Carousel Water Sampler with Niskin Bottles

The Niskin bottle is a PVC plastic cylinder with spring loaded PVC caps to close off both ends that is used to collect water samples from beneath the surface (Figure 2). Twelve bottles and the CTD are attached to an aluminum frame called a carousel. As the entire carousel is lowered through the water, the end caps of the Niskin bottles remain open, allowing water to pass through freely. After reaching the desired depth, the carousel is retrieved. As each bottle reaches the desired sampling depth, determined by the CTD, the Auto Fire Module (a waterproof computer programmed while on deck) releases the end caps and closes the bottle. When the carousel reaches the surface, all the bottles have closed, sampling water at the desired depths. The carousel is brought back on board, secured, and water samples are removed for analysis.

iii. Towfish

The Towfish is a small winged vehicle that can be used to deploy a small CTD down to 300m below the surface. It has lower resolution than the SeaBird CTDs used on the carousel, but has the advantage that it can be used while the ship is underway, using the small BT or auxiliary winch. Before use, the Towfish is programmed by attaching it to the lab computer with a cable. While deployed, every two seconds it measures and stores the depth, the temperature, and the salinity. The Towfish is useful for underway surveys, and can be lowered and raised repeatedly to sample the water column structure while passing through an oceanic front. It is also small enough to deploy from the small boat for coastal work. Upon recovery, the cable to the lab computer is re-attached, and the data can be uploaded for plotting and analysis.

iv. Secchi Disk

This is one of the simplest oceanographic tools for measuring the transparency of water. The standard disk used for offshore work is a thin, heavily weighted white or black and white disk, 30 cm in diameter. It is lowered into the water on the leeward side of the vessel until it disappears from view. The depth at which it disappears is proportional to the depth to which light penetrates.

2. Biological Sampling

a. Plankton Sampling

The term "plankton" includes the multitude of organisms, both plant and animal, that cannot swim against the ocean currents. Although most plankton are less than one centimeter in length, some, such as large jellyfish, may reach one meter or more in diameter.

"Nekton" include all organisms living in open water or the pelagic habitat that can swim actively against local oceanic currents. Common nektonic organisms include fish, large shrimp, and squid.

i. Neuston Net for Surface Collection

Neuston are organisms found on, or immediately below, the surface of the ocean and are collected by deploying a neuston net (Figure 4). This large rectangular net with 333 μm mesh is set off the side and towed along the surface, half in and half out of the water, in order to collect neuston. Many kinds of fish larvae, for example, rise into the net regularly every 24 hours. SEA has one of the most extensive sets of neuston data, including plastic and tar pollution for the North Atlantic in the world.

ii. Phytoplankton Net

A small (30 cm diameter) conical net with a cod end, made of smaller 63 μm mesh. When the vessel is hove to, this net is streamed off of the aft port taffrail so that it drifts in the upper water collecting single-celled photosynthetic phytoplankton.

iii. Meter Net for Sub-surface Collection

The meter net is a conical shaped net with a mouth opening one meter in diameter that tapers down into a "cod end" of about 10- cm (Figure 5). The net is attached to the hydrographic cable and lowered to a specific depth. The net is then retrieved and collects a plankton sample continuously from the surface to the depth to which it was sent. In order to record the exact volume the net filtered, a "flow meter" is attached at the mouth of the net. Water moving over the flow meter's propeller causes it to spin and its revolutions are recorded. The number of revolutions can then be translated into a distance in meters. Since we know the area of the net mouth, we can then calculate the volume of water filtered.

iv. Two Meter Net

Similar to the meter net but with a larger diameter (2m) and mesh (1 mm), the two meter net catches larger organisms which can avoid the smaller nets.

v. Tucker Trawl

The Tucker trawl is a large system consisting of three nets. Unique among our nets for its ability to collect discrete samples this net requires hard work and dedication to deploy. .

vi. Dip Net

Dip nets may also be used to collect floating algae such as *Sargassum* and its associated fauna. After plankton is collected, they are generally preserved in 10% buffered formalin. The buffer is necessary to protect organisms from acidity during long periods of preservation.

b. Benthic Sampling

"Benthos" are all those plants and animals which live on or in the bottom of the ocean, such as starfish, kelp, sea cucumbers, corals, and many worms.

i. Otter Trawl for Bottom Sampling

SEA carries a small otter trawl for research purposes. The otter trawl is a drag net designed to be towed in fairly shallow water (less than 200 meters) over a smooth mud or sand bottom. The mouth of the net is kept open with otter boards attached to each wing of the net. The boards are hung at such an angle so that they are forced apart by the resistance of the water during trawling. A weighted chain drags on the bottom; a float line keeps the top of the net open. Shrimp, fish, and other bottom-swelling organisms, disturbed by the chain line, swim up and are caught.

3. Sediment Sampling

a. Shipek Sediment Grab

This small grab takes qualitative samples of mud or sand from the bottom (Figure 6). A spring-loaded scoop is clamped open and the grab is lowered rapidly to the bottom. Once it hits the sediment, a weight releases the clamp and the scoop closes.

b. Gravity Corer

This sediment corer is a weighted, long plastic cylinder enclosed in a steel casing, which plunges into the sediment. It collects a sediment sample approximately 10 cm in diameter and 1-2 meters in length.

c. Fisher Sediment Scoop

Deployed with the BT winch, a small sediment sample can be taken with this instrument while the vessel is underway.

d. Rock Dredge

The rock dredge is a stainless steel dredge used to collect coarse-grained sediments on hard or rocky bottoms, such as carbonate banks.

4. Bathymetric Profiling

The Benthos Chirp Sub-bottom profiler (Chirp) is an echo-sounding device primarily used to study the structure of the seafloor. Transducers in the hull emit sound waves which travel through the water and are reflected back when they hit the bottom. These echoes are received by the transducers, the signals are processed and a graph of ocean bottom is then produced by computers in the lab.

The Chirp aboard *Cramer*, and *Seamans* gets its name from the distinctive Chirping sound made by the transducers. The 2-7 kHz frequency range maximizes image resolution (high frequencies) while minimizing attenuation (low frequencies).

5. Shallow-Water/Reef Surveys

When cruise track, student project topics, and weather conditions are appropriate, snorkeling surveys may occasionally be done in shallow water carbonate environments. For reasons of safety and liability, SCUBA diving is not permitted off *Corwith Cramer*, and *Seamans*. Each vessel laboratory has a small hand-held GPS receiver for harbor charting projects as well.

6. Flow-Through Sea Water System

Clean seawater is continuously pumped through a Sea Bird Thermosalinograph for a continuous record of surface temperature and salinity. It's also pumped through a chlorophyll fluorometer for a continuous record of chlorophyll-*a* as well as a CDOM fluorometer and Transmissometer. Data is recorded on a logging computer in the science lab.

F. Laboratory Procedures

The operation of many of the analytical instruments is highly specialized and must be done initially under the supervision of the scientific staff. Details of the procedures are presented in the Laboratory Manuals and participants should read about these procedures and check with the scientist on watch before undertaking any of them. A list of the sampling gear and analytical equipment routinely used aboard *Cramer* and *Seamans* is presented in Appendix I.

The analyses normally undertaken on SEA vessels are for:

Temperature	Dissolved oxygen
Salinity	Extracted Chlorophyll <i>a</i>
In-vivo Chl <i>a</i> fluorescence	Sediment grain size analysis
Phosphate	pH and Alkalinity
Nitrate	Silicate
Bacterial counts	

G. Data Analysis and Word Processing

Desktop and laptop PCs and printers are used aboard *Cramer* and *Seamans* for data collecting and processing. Word processing software allows students to type reports for easy editing. Spreadsheet, statistics and graphics software is used for analyzing, manipulating and graphing data.

PART THREE -- VESSEL OPERATIONS

I. DECK

Standard operating procedures ensure that routine operations are carried out in a uniform and predictable way.

A. Deck Watches

The safety of the vessel rests in the hands of one Watch Officer and three or four participants during normal watches. The Captain and other key staff are always on call, but it is the deck watch that must anticipate problems and deal immediately with situations.

It is difficult for a novice to realize how vigilant a seaman must be. The dangers that threaten a vessel are nearly always hidden and only the experienced expect them. It is thus a great temptation to become careless in routine watch responsibilities - this must be guarded against at all times.

1. Relief of Watches

The on-coming watch must be on deck, ready to relieve the off-going watch, 10 minutes ahead of time. This means that the on-coming watch must be called at least 30 minutes in advance of the watch change. Each watch stander must have a knife, a harness, and, at night, a flashlight. Relieved watch standers may not go below until all deck personnel of both watches are present (except lookout on duty).

The Watch Officer assumes full responsibility for the vessel when the watch is relieved. The Watch Officer will not relieve the off-going watch until all members of the on-coming deck watch understand:

- * The night orders.
- * The vessel's position, course and plans.
- * Anticipated sighting of land, aids to navigation or dangers.
- * Predicted weather.
- * Conditions on deck and below--what sails are set, what lights are displayed, any loose gear, malfunctioning equipment or problems.
- * The plans of the scientific department, and any gear presently in the water.

Once you relieve the watch, you assume full responsibility for anything that is wrong (or right). Do not relieve the off-going watch until you are satisfied. Call the Captain if in doubt.

2. Lookout

At all times during darkness or bad visibility, at least one lookout is stationed in the bow (in bad weather, aft of the lab). The vigilance of the lookout is the vessel's first line of defense. Lookouts may not perform other duties or engage in conversation. Everything the lookout sees or hears is reported to the Watch Officer.

On being relieved, the lookout checks the running lights and reports to the Watch Officer that he/she has been relieved, and that the running lights are burning brightly.

B. Helm Procedures

The helm is relieved hourly (more often in adverse weather). Helmsmanship is the mark of a good seaman, and inattention to the helm can cause serious trouble--even disaster in the case of an unintentional gybe. Helmsmen must therefore pay strict attention to their job at all times.

All orders given by the Captain or Officers are repeated twice--once when received, and again when complied with. This avoids the chance of misunderstanding or of errors being passed on.

Example: Watch Officer: "Come right to 320."
Helmsman: "Right to 320."
Helmsman: "Steady on 320", (when vessel is steady on 320).
Watch Officer: "Very well."

A similar procedure is followed on relieving the helm.

Example: On-coming helmsman: "I am ready to relieve the helm."
Off-going helmsman: "The course is 320."
On-coming helmsman: "Course is 320."
Off-going helmsman: (to Watch Officer, after being relieved): "I have been relieved. The course is 320."

Courses are phrased in digits, e.g. "three, two, zero".

C. Boat Checks

An hourly check of the vessel is made at sea and in port. Its purpose is to detect - and stop - trouble before it starts. This is one of the most important safety measures on board SEA's vessels, and checks should be carried out carefully and thoroughly.

On Deck:

- * Check for loose gear, lashings on boats and equipment, chafe of lines or sails, uncoiled lines.
- * In bad weather, check for open vents, portholes and hatches.
- * At anchor, check anchor bearings, leadline drift.
- * Alongside the dock, check lines and fenders.

Below:

- * Check bilges and engine room.
- * Turn off unnecessary lights and fans.
- * Check for smoke or smell of fire.
- * Check for leaking water taps or heads.
- * Check for loose gear or items improperly lashed down.
- * Log boat check on completion, report any action taken to Watch Officer.

D. Standing Orders

The Captain cannot always supervise the vessel personally, so some of his/her responsibilities are delegated via Standing Orders that state his/her policies. These Standing Orders are written in the front of the Night Order Book and are given here. They are addressed to the Watch Officer.

1. Underway

a. Operational

Notify the Captain whenever:

- i. In doubt.
- ii. A course change is required.
- iii. A sail change is necessary.
- iv. An equipment failure occurs.
- v. Visibility falls below 3 miles.
- vi. There is evidence of adverse weather (e.g. a squall approaching).
- vii. Any vessel will approach within 3 miles. (Do not wait until it has reached 3 miles.)
- viii. The vessel appears to be standing into danger.
- ix. The main engine is to be started (Chief Engineer to be called as well).
- x. The Watch Officer must leave the deck for other than a brief visit to the chartroom.

b. Safety

The Watch Officer is responsible for the following:

- i. Knowing the emergency procedures and signals for Man Overboard, Fire, Collision, and Abandon Ship, and for training the participants on watch in their duties according to the Emergency Station Bill.
- ii. Keeping track of all persons on deck during darkness and heavy weather. Rig lifelines, require harnesses as necessary.
- iii. Requiring persons going aloft or on bowsprit to obtain permission and to wear harnesses.
- iv. Ensuring that a thorough Boat Check is done every hour and logged.
- v. Posting a bow lookout between sunset and sunrise.
- vi. Posting a second lookout and maintaining a radar watch whenever visibility is less than 3 miles. All radar contacts are to be plotted when visibility is restricted.
- vii. Showing proper lights and/or day shapes. Sounding appropriate signals.

c. Navigation

- i. Left hand page log entries are to be made every hour on the hour.
- ii. The vessel's position is to be plotted at least every hour on the hour by the best means available according to Captain's orders.
- iii. The Watch Officer is responsible for being informed about the scientific objectives for the watch and for cooperating as fully as possible with the lab's requirements. He/she should also keep the lab notified of any circumstances which will affect its operation.

2. At Anchor

The Watch Officer must:

- a. Ensure that a continuous deck watch is maintained that will:
 - i. Check and log anchor bearings at intervals required by the Captain.
 - ii. Ensure that soundings and swinging room are adequate.
 - iii. Display appropriate lights and/or day shapes.
 - iv. Maintain boarding ladder and steps in safe condition.
 - v. Check security of small boats alongside or astern.
 - vi. Carry out and log Boat Checks on the hour.
- b. Supervise boat runs ashore in accordance with the announced schedule. All boats and crews must be accounted for at all times.
- c. Keep a watch on weather conditions.
- d. In the Captain's absence, be prepared to take appropriate action in response to the anchor dragging--including getting the vessel underway.
- e. Enforce quiet aboard vessel after 2200 hrs.

3. Alongside

The Watch Officer must:

- a. Ensure that a continuous deck watch is maintained that will:
 - i. Inspect the dock lines for chafe and tension, and fenders for effectiveness.
 - ii. Ensure that the gangway is secure, safe, and well lit after dark.
 - iii. Carry out and log Boat Checks on the hour.
 - iv. Allow no strangers on board without permission, and see that authorized visitors are escorted while on board.
 - v. No visitors are permitted aboard during meals and after 2200 hrs. except by permission of the Captain.
- b. Keep a watch on tide and weather conditions.
- c. In the Captain's absence, be prepared to take appropriate action if vessel must be moved out of danger.

E. Night Order Book

At night the standing orders are supplemented by the Captain's Night Orders. These are contained in the Night Order Book, kept by the chart table. Watch Officers are responsible for reading and carrying out the Night Orders for their watch. Each on-coming watchstander will read and sign the Night Orders before taking over the watch.

The Deck Watch Officer routinely informs the lab of impending changes in course, sails, etc. At the beginning of each watch, he/she confers with the scientist to plan what the vessel will do. As a station is approached, the lab is notified in time to get ready.

Participants on lab watch are normally available to help with sail handling if this is first cleared with the scientist on watch. Similarly, deck watch standers help handle oceanographic gear with the prior approval of the Watch Officer.

During the day, the Captain's instructions are passed to the Watch Officer in person.

II. ENGINE ROOM

Although sailing vessels, SEA's ships depend on their engine rooms for electricity, water, heat and refrigeration. SEA policy is that the vessels sail whenever possible, but for safety and scheduling, the main engine is also needed. The Engineer is in charge of the engine room and all engineering installations aboard. Because *SEA Seminars* are generally only a week to three weeks in length, participants are usually not assigned engine room duty in the watch schedule. Instead, regular engine room checks are included in the deck hourly boat check routine. The Engineer is always on call and will provide instruction on any system as time allows.

Below are the Standing Orders for the engine room. All participants should be familiar with them for safety reasons.

A. Standing Orders

Engine Room Standing Orders

The Engine Room (ER) represents the physical heart of the ship. Without the equipment and machinery in the ER many of our capabilities as a scientific research vessel would be lost and life would become very uncomfortable on board. It is therefore, absolutely essential that we take good care of the ER and perform our duties as engineer with the utmost of vigilance. Make an effort to learn the WHYs and not just the HOWs of the ER so that you can better understand the processes that you monitor and control. The ER can be very intimidating and even scary if you are unfamiliar with the mechanics, but don't despair, it won't stay that way for long.

Life at sea is inherently hazardous, so to make things safer there are certain safety precautions we must take to ensure that we do not get hurt. Just as you will learn the safety rules of jibing the ship or running the hydro winch you must follow these procedures to prevent any accidents from occurring. The following are the standing orders for while you are in the Engine Room:

1. Be alert for smoke, strange smells and unusual noises while in Engine Room. Sound the fire alarm if there is a fire. Inform the engineer of any other anomalies.
2. Identify the source of errant running water and notify the engineer.
3. When any Engine Room Check reading falls outside the posted limit, notify the engineer.
4. Watertight doors and hatches are to be secured at all times, except of course, when in use. Open doors slowly when entering a high traffic companionway.

5. Be aware of loose clothing, long hair, rings and other jewelry that might get caught in moving parts of equipment.
6. Do not bring harness tethers in Engine Room! Remove the tether from the harness and leave it clipped in next to the watertight door.
7. Shoes must be worn at all times in the ER; bare feet are strictly prohibited. Exercise caution when wearing sandals.
8. Be very aware of where you place your head, hands, and feet to avoid injury. Avoid low overhangs, moving parts, and sources of heat. If it's raining outside, dry off before attempting to operate machines or electrical equipment.
9. You must wear hearing protection in the Engine Room when the Main Engine is running. Hearing protection is also strongly recommended for use during engine room checks, or whenever in a machinery space for an extended period of time.
10. No tools may leave the Engine Room without the permission of the Engineer. Return borrowed tools to the exact location where you found them.
11. Before starting any machinery, inform the engineer.
12. When in doubt, ask the engineer.

B. Engineering Night Orders

The Engineer normally works during the day and is on call at night. He/she leaves instructions for night watches in the Engineering Night Order Book, kept in the engine room. Each engineering watch stander must read and sign this when coming on watch.

C. Safety

- * Never leave loose tools or gear out where a roll can topple them.
- * Shoes and shirt must be worn when in the engine room.
- * Wear hearing protection when machinery is running.
- * Do not go behind the face panel of any electrical board.
- * No smoking or open flames. Be very cautious with spilled fuel.
- * Never pump bilges without checking with the Watch Officer.
- * Exhaust manifolds are hot! Be cautious working around running machinery in a seaway.
- * Do not wear rings and tie up long hair and loose clothing.
- * Memorize the location of all fire fighting equipment.
- * Never bring gasoline (outboard fuel) below decks.
- * Keep all paint, brushes and thinner in deck storage locker.
- * Keep all rags in the metal container with the lid tightly in place. No oily rags are to be kept in the engine room or below decks.

III. GALLEY

The health and morale of the vessel's company depend on the people working in the galley. The Steward and Assistant Steward are responsible for the galley, cooking, stores and interior cleanliness. The watch schedule assigns a different participant each watch period as a dishwasher and general assistant.

A. Dishwashing

The watch list provides a dishwasher from each watch. The dishwasher's job is to keep the galley clean at all times, wash the pots and pans used in cooking, assist the stewards, and help prepare morning, afternoon, or midnight snack.

B. Cleanliness

A dirty galley can be a potential health hazard to everyone aboard. Dishes should be washed in hot water and detergent, and should be rinsed in the sanitized water to which a sanitizing tablet has been added. They should then drain dry. Counters and deck must be scrubbed after each meal. Anyone using the head must wash thoroughly before returning to the galley.

Food left out or spilled will attract vermin unless cleaned up at once. Cupboard shelves and the reefers should be inspected daily and scrubbed out once a week.

Everything must be kept in sealed containers. The reefer drain must be kept clear and inspected often. The deep freeze should not be opened by anyone except the Steward or Assistant Steward, and then only when absolutely required.

C. Meal Service

It is the dishwasher's responsibility to set the table. Meals are served family style in two sittings. It is absolutely essential that meals be served on time. The entire schedule of watches, work and classes depends on this. If, for some reason, a meal must be late, the Captain should be notified in advance.

People at the first sitting should not linger, but should clear away when finished so the next sitting can be served. Each person is responsible for scraping and stacking his/her own utensils for the dishwasher, and should assist in removing serving dishes and pitchers. Table gimbals should be locked except when the vessel is rolling and there is food on the table.

Everyone must wear a shirt at the table (no bathing suits), and food handlers must wear shirts and shoes in the galley.

D. Safety

The Galley is one of the most dangerous places on the vessel. Serious burns cannot be treated effectively aboard, and large pots of boiling liquids, or hot, heavy baking dishes pose great hazards on a moving vessel. The stove itself, if improperly handled, is a fire hazard. Observe the following precautions:

- * No one may operate the stove without being checked out first.
- * Learn the location of all extinguishers, and the emergency fuel and power cutoff.
- * Do not leave knives and choppers where they can slide or fall, and do not reach into knife drawers without looking first. You could lose a finger.
- * Always secure cooking pots on the stove with fiddles and be very cautious moving them.
- * In rough weather, guard against hot spills by using partially filled pots.
- * Keep deck and working areas clean; deck gets slippery easily!
- * **Shoes and shirts are required at all times!**
- * Tie up long hair in a scarf or a band.
- * Keep containers in drystores properly lashed down.
- * The gimballed table in the salon will retain its load even in rough weather so long as no one touches it. Attempts to "steady" it will result in spills and possibly severe burns. In very rough weather, people should not sit on the windward side as the table will hit their legs and spill its contents. In calm weather, gimballed tables should be locked.

IV. SEAMANSHIP

A. Sails and Sail Trim

1. Setting Sails

Large sails must be kept under control as much as possible to prevent damage from chafe and luffing. This means that proper trimming and careful steering are essential. During the setting and striking of a sail it inevitably will flog about. This can be minimized a) by making careful preparations before commencing to hoist or lower the sail to ensure that it is accomplished as quickly as possible, and b) by "blanketing" the sail (i.e., hoisting or lowering it behind [to leeward] of another sail).

2. Tacking/Coming About

This maneuver is done by altering course so that the bow crosses through the wind and the sails fill on the other side. SEA's vessels are not particularly close winded vessels (they tack through 120 degrees). As they are large and heavy vessels, it is sometimes necessary to back the headsails to help them through the wind. Once the tack is complete, the backed sail or sails are brought over.

3. Gybing

Gybing is altering course so that the stern passes through the wind and the sails fill from the other side. The gybe actually takes place with the vessel dead before the wind when the sails cross over. It is important to maintain control of all sails, especially the main. This is done by sheeting the main in tight as it gybes, then letting it out quickly.

4. Heaving To

Heaving to means to stop the vessel and maintain its position by setting the sails and helm in opposition. In general, the head sails are backed, reducing the forward motion and the helm is lashed to keep the boat heading up. On board SEA's vessels, the fisherman, jib topsail, and sometimes the jib are lowered. The main is sheeted tight, the staysail and any headsails are backed, and the helm is lashed hard over. As the pressure on her backed sails heads her down, the drive of the main and the helm heads her up again. As wind strengths vary, sail combinations are adjusted to achieve the correct balance.

5. Points of Sail and Sail Trim

All boats sail on apparent wind (wind as it is affected by the forward speed of the boat). The point of sail is determined by which part of the boat the apparent wind is coming over (see Figure 1: Points of Sail). The best trim for a sail is generally just slightly in from the angle at which it first begins to luff. Where more than one sail is involved, it is important that all sails are trimmed so that the sails work well together. Usually this is done by beginning to trim forward and working aft.

Figure 1: Points of Sail

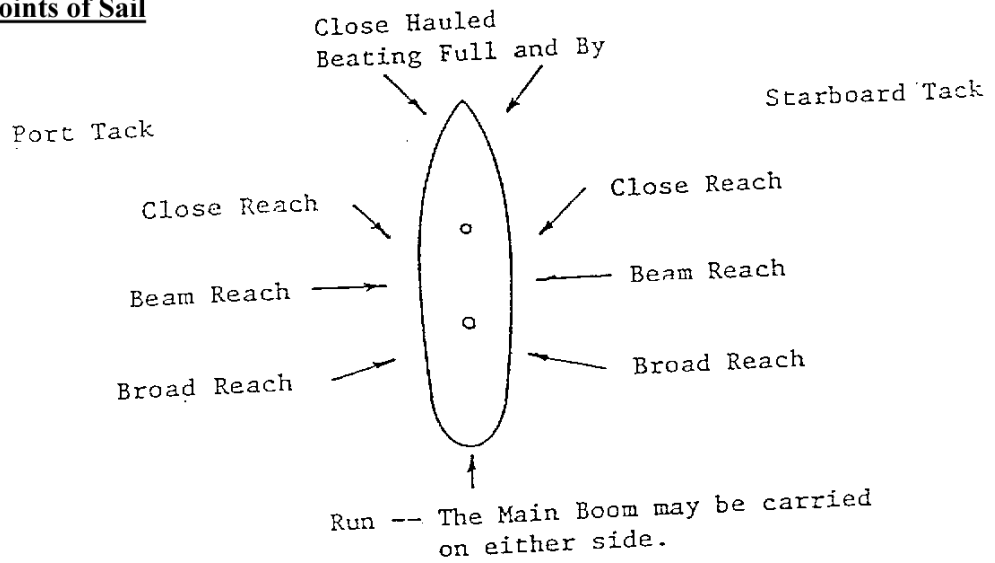
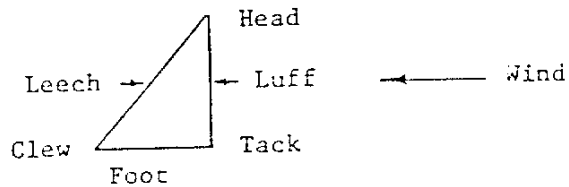
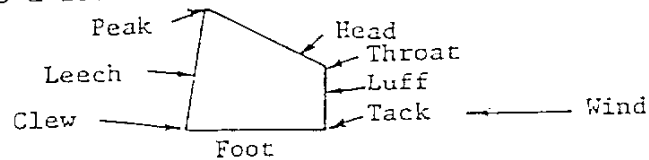


Figure 2: Parts of Sails

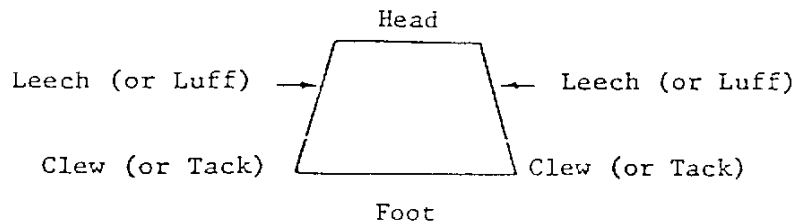
The main, trisail, staysails, jib and jib topsails are three-cornered sails.



The fisherman is a four-cornered sail.



The course, topsail and rafee are true square sails with bi-lateral symmetry the names of whose parts depend upon wind direction.



6. Sail Combinations

Decisions on how much sail and which particular sails (see Figure 2: Parts of Sails) to set depend upon wind conditions and speed desired. The size and location of each sail must be taken into account. In addition to having an appropriate amount of sail set, the sail plan should be balanced.

For example, on a beam reach in a 20 knot breeze, with all fore and aft sail set, one of SEA's vessels speed may approach nine or ten knots. Thereafter, sail is reduced to avoid undue strain on the vessel, or potentially dangerous knockdowns. Which sails are struck, and in what order, depends upon the specific circumstances. There are many ways to alter the vessels' sail plans while still keeping them balanced, and different captains have their own preferences. Generally, we reduce sail in the following order:

Fisherman struck
Jib Topsail struck
Main reefed
Second reef in Main
Jib struck

While it is easy to imagine why it might be dangerous to have too much sail set, sometimes too little sail set can also cause problems. In rough seas, without enough sail set, the vessel may roll excessively which also can cause undue strain on both the vessel and the crew.

It should be remembered that the sails are set and struck according to the particular conditions. The Captain must constantly evaluate and assess the strength and direction of the wind, and what forces he or she would like to apply to the vessel through the sails. Although SEA's vessels have very similar sailing characteristics, they are not identical, and similar weather conditions may call for different actions aboard each vessel. It is therefore not possible to memorize an order in which sails are set and struck, but rather the student must consider the effect desired, the size and location of the sails, and the forces involved.

7. Definitions of Sailing Terms

Standing Rigging: Basically all the stationary rigging, i.e., all stays, shrouds and ratlines.

Running Rigging: All the working rigging, i.e., sheets and halyards, braces, lifts.

Leeward: The side on which the main boom is set (away from the wind).

Windward: The side towards the wind (opposite leeward).

Heading Up: Altering the course of the vessel toward the direction of the wind.

Heading Off : (falling off, bearing off or heading down): Altering the course of the vessel away from the direction of the wind.

B. Linehandling

1. Knots and Ropework

It is important on a vessel when knots are needed that all her crew members be able to tie them quickly and correctly. The following knots and splices are commonly used on board:

Reef knot/Square knot-

Bowline

Sheet Bend

Belaying: making up to a post, pin, cleat

Coiling and Hanging

Splices: eye, short, long

Temporary and sailmaker's (palm and needle) whippings

Clove Hitch

Two Half Hitches

Rolling Hitch

Towboat Hitch

2. Sheets and Halyards

a. Sheets

The word sheet refers to any line used to control the trim (in or out) of a sail. The word sheet is prefixed with the name of the sail it is controlling (e.g. mainsheet).

b. Halyards

Halyards are the lines used to raise the sails. They are lowered by means of downhauls. As with sheets, downhauls and halyards are prefixed with the name of the sail.

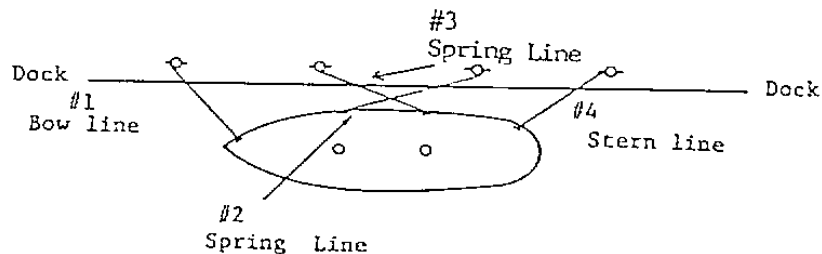
c. Jiggers

Jiggers are used to take up the very last few inches of the necessary tension in the halyard. They consist of a block and tackle attached to one end of a double-ended halyard. Once the free end of the halyard is down and made fast, the other end of the halyard is pulled down with the jigger. Jigger is also prefixed with the name of the sail.

3. Docklines

a. Lines

When SEA's vessels are secured to a dock, the lines used are as follows:



b. Terms

The terms used in handling docklines are as follows:

- Put Out: Use heaving line to get dock line from vessel to dock.
- Take In: Bring line back aboard.
- Slack: Ease out a line to release any tension.
- Surge: Ease out a line but maintain some tension.
- Check: Hold a line, but not to the breaking point; let the line slip as necessary.
- Hold: Take enough turns so that the line will not give.
- Cast Off: Throw off the line from over the bollards or cleats on the dock.

C. Helmsmanship

Steering is not difficult once you get the hang of it. Most beginners over steer, i.e., turn the wheel too far in either direction. A helmsman is considered competent when he/she is able to steer the vessel within 5 degrees of the desired course for an extended period without letting go a spoke.

Helm orders used in maneuvering have specific, universally understood meanings. Whenever steering according to helm orders, you must keep in mind the rudder's position at all times. SEA's ships' wheels require five turns from full lock (on either side) to amidships.

Common Helm Orders:

- "Come Up": Head closer to the wind.
- "Fall Off": Head further away from the wind.
- "Full and By": Steer as near the wind as possible while still keeping the sails full and making way. This requires much skill and judgement from the helmsman.
- "Right (or left) __ (number of) turns": Turn the wheel the desired number of turns and keep it there until otherwise directed.
- "Midships": Bring the rudder amidships from wherever it is.
- "Steady as she goes": Note the heading you are on right now, and steady the vessel on it.
- "Hard right (or left)": Turn the wheel all the way in the desired direction.
- "Shift the helm": Put the wheel over in the opposite direction the same amount.
- "Mark your head?": What is the compass reading right now?
- "What's your course?": What course are you supposed to be steering?
- "Left (or right) easy": Turn the wheel enough to cause the vessel to swing slowly in the desired direction.

V. CORWITH CRAMER AND ROBERT C. SEAMANS SPECIFICATIONS

A. *Corwith Cramer*

LOA: 134 feet
LWL: 87.5 feet
Beam: 26 feet
Gross Tons: 158 GT
Displacement: 270 tons
Rig: Brigantine
Sail Area: 7500 square feet
Mast Height: 110 feet
Main Engine: 500 hp Cummins Diesel
Fuel Capacity: 3500 gallons
Water Capacity: 5650 gallons
Complement: 38 persons
Designer: Woodin & Marean, Inc., Wiscasset, Maine
Builder: Astilleros y Talleres Celaya, S.A.
Bilbao, Spain
Year Built: 1987
Owner: Sea Education Association
Construction: Steel Hull
Composite decks: teak on steel
Steel and aluminum masts



B. Robert C. Seamans

LOA: 134.5 feet
LWL: 90.6 feet
Beam: 25.4 feet
Gross Tons: 211 ITC tons
Displacement: 300 tons
Rig: Brigantine
Sail Area: 8554 square feet
Mast Height: 118 feet
Main Engine: 455 hp Caterpillar Diesel
Fuel Capacity: 6600 gallons
Water Capacity: 2600 gallons (storage); water makers generate up to 1200 gallons/day
Complement: 40 persons
Designer: Laurent Giles, Ltd., England
Builder: J.M. Martinac Shipbuilding Corp., Tacoma, WA, USA
Year Built: 2001
Owner: Sea Education Association
Construction: Steel Hull
Teak Decks
Steel Masts
Aluminum Boom and Yards



C. Navigation Electronics

- * (2) Furuno Radars
- * Furuno AIS transceiver
- * (2) Global Positioning Systems (GPS) units
- * Furuno Fathometer: 600 meter
- * Weather Map Facsimile software
- * Electronic chartplotter
- * Radiotelephones: (2) 150 watt synthesized SSB, 2000-30,000 kHz
(2) 25 watt VHF
(3) 5 watt VHF portable

D. Emergency and Safety Equipment

1. Fire

- * Ansul Smoke detection and alarm system throughout vessel--fixed, automatic/remote
- * Fixed fire suppression systems in engine room, galley and paint locker
- * (20+) portable fire extinguishers (carbon dioxide, dry chemical, and HALON)
- * Fire pumps, fire hydrants each with 50' x 1-1/2" hose, nozzle, and fog applicator

2. Abandon Ship

- * (3) USCG approved inflatable ocean service life-rafts
- * (4) emergency position-indicating radio beacons (EPIRB)
- * Personal Flotation Devices (PFDs), immersion suits, strobe lights, portable VHF radios, flares, dye markers, and other survival and emergency gear

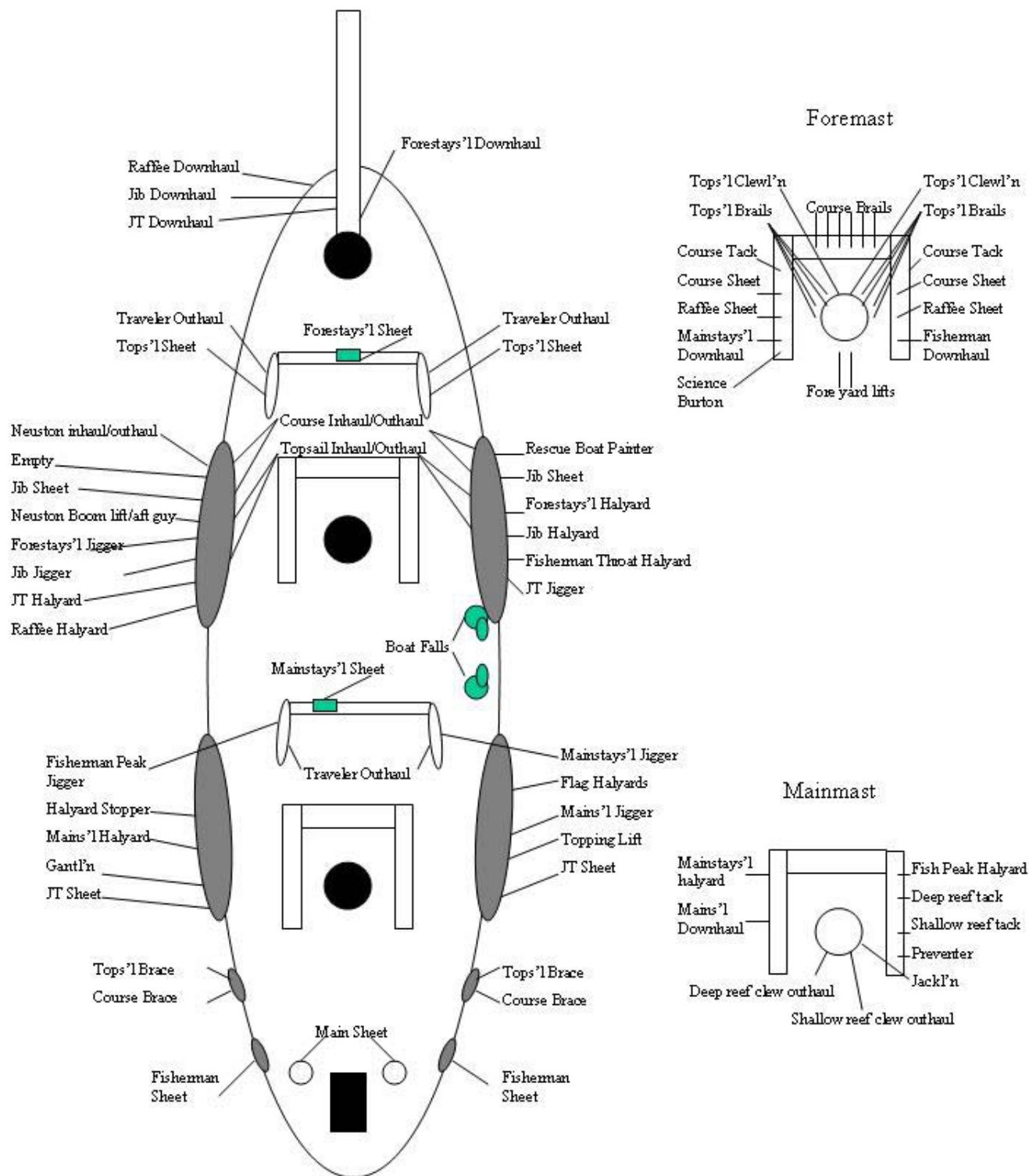
E. Vessels' Boats

- * 7-person rigid inflatable rescue boat with outboard engine
- * 12-person inflatable dinghy with outboard engine
- * Rowing and sailing dinghy

F. Complement

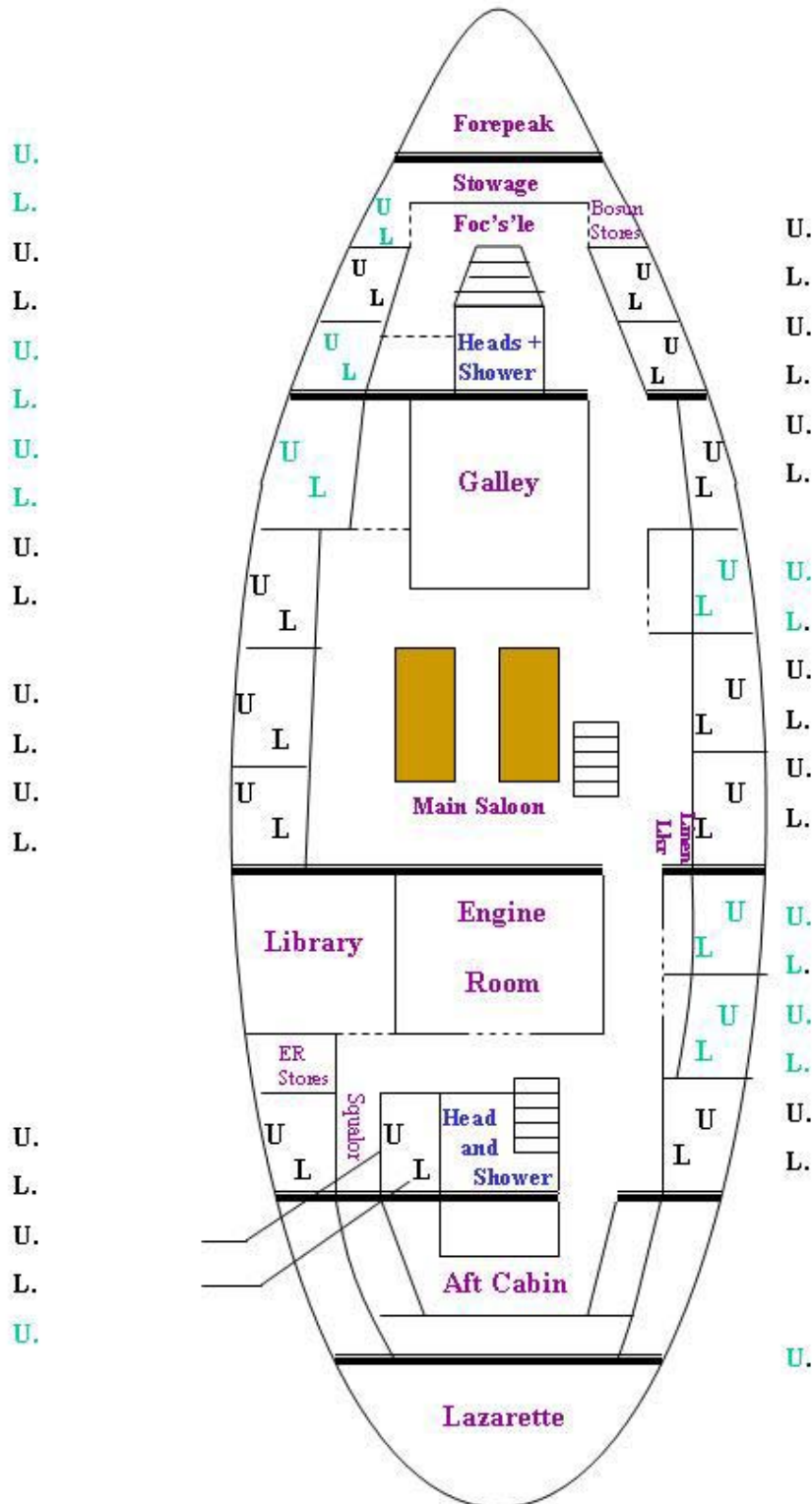
- * (6) Vessel's Crew: Captain, three Mates, Engineer, Steward
- * (4) Scientific Staff: Chief Scientist, three Assistant Scientists
- * (2) Visiting Scientists
- * (26) Students

CORWITH CRAMER Pin Rail Diagram

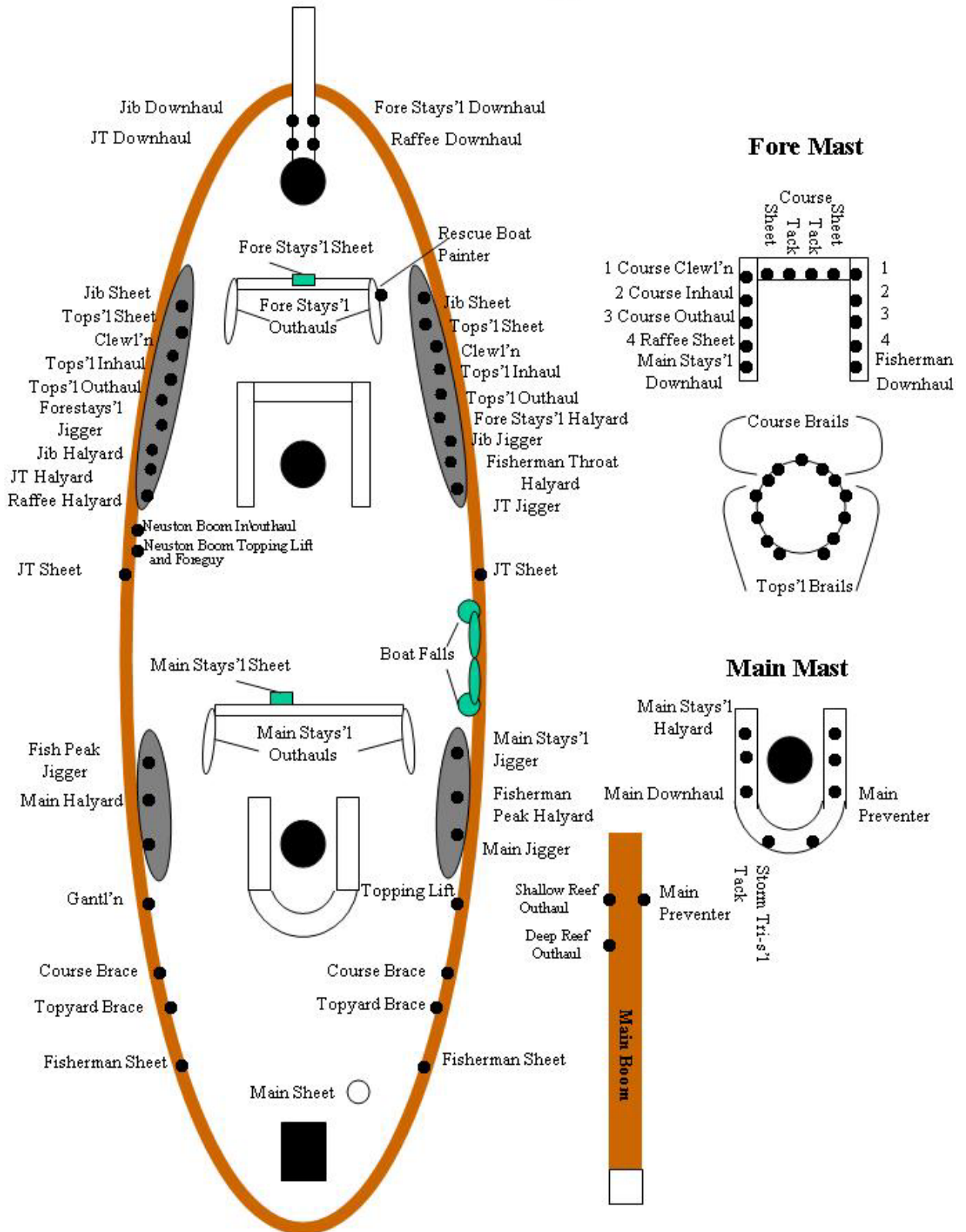


H. *Corwith Cramer* Accommodation Plan

SSV Corwith Cramer
Accommodation Plan

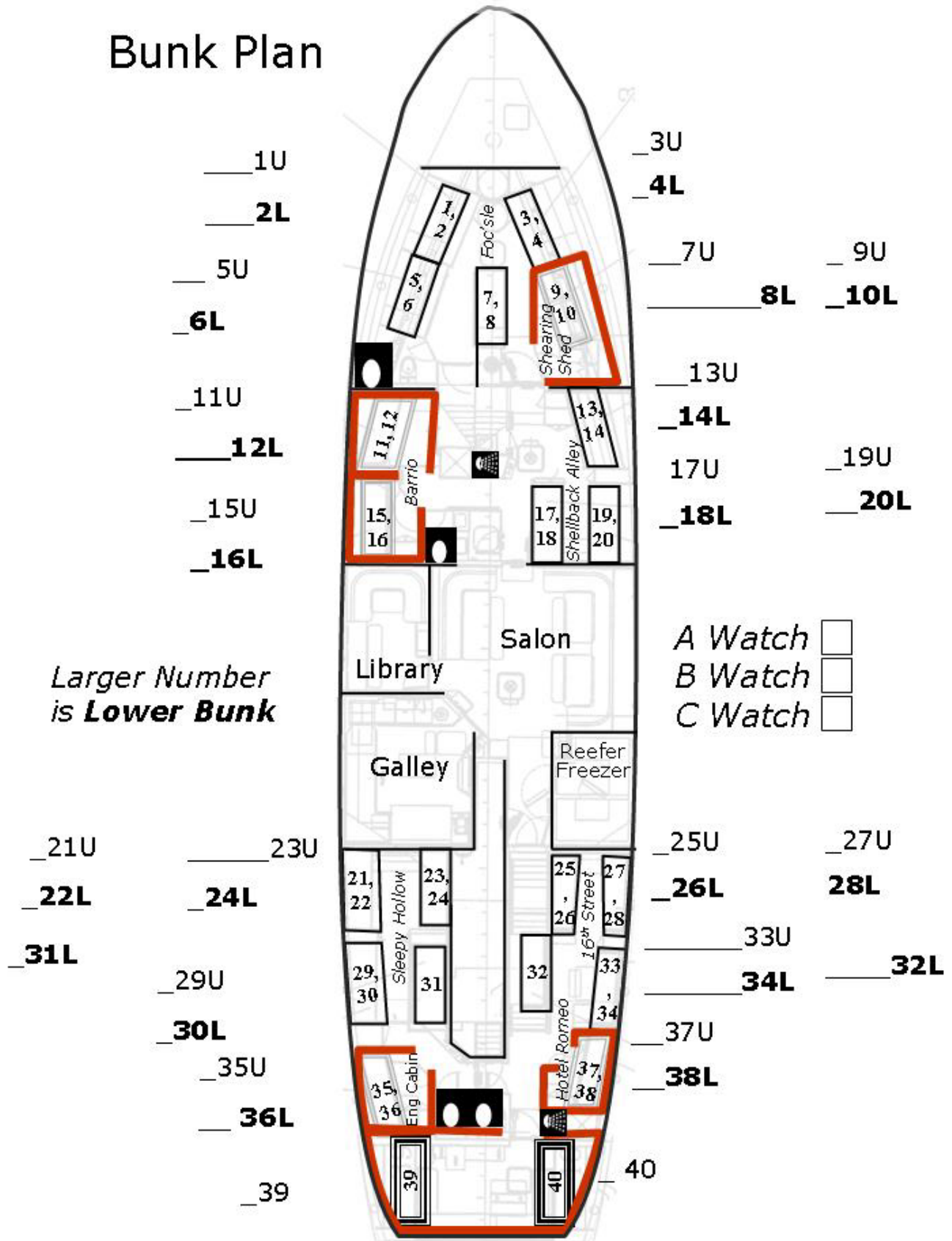


Robert C. Seamans Pin Rail Diagram



SSV Robert C. Seamans

Bunk Plan



PART FOUR -- EMERGENCY!

I. EMERGENCY ORGANIZATION

A. Emergency Station Bill

The Emergency Station Bill is prominently posted on board. It organizes everyone on board for various activities. You should memorize your assignments the first night on board. The Emergency Station Bill gives you permanent assignments for:

1. Routine Operations

The vessel is normally operated by a single watch. However, some activities, such as anchoring, docking and piloting through harbors, require all hands. On these occasions the Captain takes charge, relieves the deck watch, and orders everyone to their Station Bill assignment. General Quarters (GQ) is a Station Bill assignment for these routine operations. All persons remain at their Station Bill assignments until watches are set again.

2. Emergency Operations

The Emergency Station Bill provides for various emergency situations. Drills are held weekly, and walk-through drills are held the first day. Drills are always unannounced and may be at night. You are always to assume that it is a real emergency. The watch on deck remains at their posts until relieved by the emergency watch standers, then go to their own emergency stations. The Watch Officer in charge remains in charge until officially relieved by the Captain.

B. Emergency Signals

1. MAN OVERBOARD (MOB) -- Ringing of alarm bell in groups of three blasts. (---)

Response: Proceed to MOB stations, prepared to handle sails and maneuver vessel. Engine room on standby. Execute appropriate recovery maneuver. Boat crew in personal flotation devices (PFDs).

2. FIRE/EMERGENCY -- Continuous ringing of alarm bell.

Response: Evacuate and secure down below, then proceed to Fire/Emergency stations. Engine Room on standby, fire pump started and connected. Be prepared to handle sails and maneuver vessel.

3. ABANDON SHIP -- Verbal announcement from Captain.

-- More than six short blasts of the foghorn followed by one prolonged blast.

Response: Muster on deck, get your immersion suit, and proceed to assigned life raft. Raft commanders muster crew and collect extra supplies if time permits. Launch and embark without further instructions.

4. ALL CLEAR -- Three rings of the alarm bell.

Response: Put away all emergency equipment. Open closed hatches and watertight doors, return vessel to condition existing before drill. Immediately stow PFDs in proper location. Deck watch takes charge again.

C. Emergency Procedures

The three principal emergency situations--man overboard, fire, and abandon ship--are discussed here to provide guidelines for action to be taken. It is expected that each Watch Officer will carry out a plan of immediate action, taking into account prevailing circumstances, and will instruct his/her watch what to do. The following is typical of such a plan, and can be followed under nearly every sea condition and sail combination.

1. General Comments

- a. Emergency procedures should be started immediately by the watch on deck.
- b. In general, all hands should go to their emergency stations. If someone is there already, help him/her until the Watch Officer or the Captain reassigns you.
- c. DO NOT PANIC AND KEEP QUIET. Remember, the lives of all depend on you and your ability to hear and follow orders promptly and efficiently.

2. Man Overboard (MOB)

- a. Throw over pole floats, water lights and life rings, while shouting "MAN OVERBOARD!" Stop engine at once, and/or turn toward person in water.
- b. Assign lookouts to watch the victim until relieved by regular MOB lookouts.
- c. Ring vessel's alarm bell in groups of three short bursts. Send someone to notify the Captain. Watch Officer remains in charge until officially relieved by the Captain.
- d. Vessel Maneuvers:
 1. Under Power (several options according to circumstances)
 - i. Stop vessel immediately. Retrieve victim by heaving line, rescue boat, or other means.
 - ii. Maneuver vessel back to victim, using Williamson Turn or other method.
 2. Under Sail
 - i. Stop vessel immediately. Luff up, gybe, or heave to. Retrieve victim by above methods.
 - ii. Strike or reduce sail. Maneuver back to victim under power.
 - iii. Sail back to victim. Stop vessel when close enough to retrieve.

e. Recovery

1. Throw heaving line or ring buoy to victim. Haul back to vessel.
2. Launch manned rescue boat.
3. Send life-jacketed, tethered swimmer from either vessel or rescue boat.

NOTE: The variables of wind and sea conditions, daylight and darkness, sail combinations, and the condition of the victim preclude any fixed procedures for recovering a man overboard. Quick, orderly response, discipline, and good seamanship must be combined to deal with the special circumstances of the situation.

3. Fire

- a. Anyone discovering a fire is to shout "FIRE!" and, if practical, take immediate action to put it out. You must know where all fire extinguishers are and how to operate them.
- b. Evacuate to the deck. Person closest to alarm bell rings it. Inform the Watch Officer.
- c. Secure watertight doors in closed position.
- d. Vessel is maneuvered as deemed appropriate.
- e. Deck watch proceeds as ordered by Watch Officer until they are relieved by persons assigned in accordance with the Watch Quarter and Station Bill.

4. Abandon Ship

To abandon ship is a last resort; chances of survival are best on the vessel, even if she is damaged or crippled. If abandonment becomes necessary, there are a number of overall priorities which should be kept in mind, as well as the individual tasks assigned via the Station Bill. The vessel will be abandoned only at the direct order of the Captain or next in command.

a. Personal Flotation Devices (PFDs) and Immersion Suits

These are stowed in boxes on deck. You will be shown how to wear the PFD and the immersion suit and how to operate attached equipment on your first day on board. They are the first line of defense in terms of lifesaving.

b. Life Rafts

The vessel is equipped with inflatable life rafts. Each member of the vessel's company is assigned to one of the rafts. It is important that you learn your raft assignment and become familiar with launching and inflation techniques. In extremis, the rafts launch and inflate automatically.

c. Distress Calls

If there is time in an emergency, *Cramer* and *Seamans* can use their radiotelephones or satellite phone to call for help (even if the main electrical systems are inoperative). Each vessel carries one ship mounted EPIRB- a portable transmitter which signals ship particulars and position to orbiting satellites and three raft packed EPIRBS. Both vessel and rafts are equipped with visual distress signals--lights, mirrors, smoke signals and flares.

d. Survival Equipment

All life rafts are equipped with SOLAS approved survival gear, but the quality of life while awaiting rescue can be improved with additional supplies. Therefore, the Station Bill assigns each member of the ship's company to bring extra gear to his/her raft, if time and circumstances permit. These items range from extra drinking water to blankets to more flares, and are bundled primarily at the rafts for quick access.

APPENDIX I: SCIENTIFIC EQUIPMENT ON BOARD SSV CORWITH CRAMER AND ROBERT C. SEAMANS
Operated by SEA EDUCATION ASSOCIATION, Woods Hole, MA, USA

Winches:	Markey DESF-4 Electric Hydrographic Winch with 5000m ¼” wire rope Markey DEBT-3 Auxiliary “enhanced BT” Winch with 1/8” wire rope Hydraulic J-frame and Dynacon electronic metered wheel
Bathymetric Equipment:	Benthos 2-7 kHz CHIRP-II sub-bottom profiling system consisting of: (8 CC / 9 RCS) TR-109 Transducers, DSP 661/662 signal processor and digital recorder Oceanographic Instrument Systems Model 6000 Pinger
Physical/Chemical Oceanographic Equipment:	Water sampling Carousel SBE 32-16 with: SBE 90208 Auto Fire Module (2) Seabird SEACAT Profiler Model SBE 19plus Conductivity- Temperature- Depth units, PAR sensor, in-vivo chl and CDOM fluorometers, transmissometer, SBE43 oxygen sensor (12) 2.5-L Water Sampling Bottles Acoustic Doppler Current Profiler (RDI Ocean Surveyor 75kHz) Gyro (Xsea Octans fiber optic gyro on CC, traditional gyro on RCS) RBR towed CTD with optional Seapoint in-situ fluorometer Continuous logging from clean seawaters system of : salinity, temperature, in-vivo chl fluorescence, beam attenuation (transmissometer), CDOM fluorescence YSI handheld Salinity-Conductivity-Temperature meter Portable pH meter Orion 3-star benchtop fluorometer Ocean Optics Chem2000 digital spectrophotometer Ocean Optics reflectance and oxygen meters Secchi Disk
Biological Sampling Equipment:	VideoRay Pro-II ROV (150m rating, color and b/w cameras) Sea-Perch ROV (20m rating, color camera) Turner Designs Model 10-AU Fluorometer Fucile SSBP (solid state bathyphotometer for bioluminescence measurements) SeaGear 200, 333, 1000 µm mesh Plankton nets SeaGear 333 µm mesh Neuston nets (1m wide by 0.5m high) SeaGear 63 µm Phytoplankton nets Tucker Trawl multiple opening/closing net Small Otter Trawl net (oceanographic purposes only) with Pelagic Electronics Weak Link tension release
Geological Sampling Equipment:	Shipek Sediment Grab Rock Dredges Gravity Corer Fisher Sediment Scoop
Microscopes:	(2) Zeiss stereo dissecting scopes Zeiss Axiostar compound scope with epifluorescence Camera for digital photomicrographs
Datalogging:	Clean flowing seawater (plastic pump and lines) with SBE45 thermosalinograph and in-vivo chlorophyll fluorometer. System logs these and other parameters along with GPS position every minute during cruise.
Computer Network:	Desktop and laptop computers, printers, wireless network, automatic data backup
Other:	centrifuge, stir plate, adjustable micropipets, Milli-Q lab water, aquaria, PAR reference sensor, hydrophone, plankton splitter, Minilog TD sensor, Orion 3Star benchtop pH meter, handheld GPS

APPENDIX II. PREPARATION FOR *SEA SEMINARS*

Required Reading: Organization and Operations Manual for *SEA Seminars*.

Personal Preparation:

- ◆ Get a full night's sleep before traveling to the vessel.
- ◆ Stay well hydrated before you sail (reduces seasickness).
- ◆ If you are prone to seasickness, consult your doctor about taking a seasick remedy beginning 24 hours prior to departure.
- ◆ Over-the-counter remedies such as Dramamine or Bonine may also be effective while on board.

Packing for the Sea Component:

- ◆ Space aboard is limited. EVERYTHING you bring will live with you in your bunk (except foul weather gear).
- ◆ Pack in crushable luggage such as a duffel bag or backpack. Do not bring rollaboard or hard suitcases.
- ◆ In northern latitudes (New England, Pacific Northwest) temperatures will range from very cold to pretty warm. In the tropics, it can be anywhere from chilly to sweltering.
- ◆ The key to clothing on the ship is layering. Clothes that can be worn over or under other layers will serve you well.
- ◆ Clothes that dry quickly will make you happy. It is a boat, after all. As a rule, synthetic fibers like polar fleece and various polyesters and nylons do a better job of this than heavy cotton. Avoid denim, thick towels and heavy cotton sweatshirts; once wet, they will NEVER dry.
- ◆ The clothes you bring should be comfortable and easy to move in.
- ◆ The clothes you bring to sea will be put to hard use and are subject to the same rugged life aboard a working vessel you will be. In other words, things might get torn, stained, etc. You might think of this as an opportunity to take some of your oldest T-shirts out for one last fling (and maybe not bring them back).
- ◆ You will be provided with a mattress, pillow and pillow case. You'll need to bring 1) a twin fitted sheet, sleeping bag and pillowcase or 2) a twin sheet set, pillow case and a warm blanket. Folks sailing in the tropics generally prefer sheets and often end up sleeping on top of everything to stay a little cooler.
- ◆ If you wear prescription glasses, bring a second pair. If you wear contact lenses, bring your glasses as well.
- ◆ Bring 2x your regular prescription drugs. Make sure extra meds are in separate containers should one container become contaminated or lost.

DO NOT BRING electronic equipment (ipod, cell phone), scuba gear, food, liquor.

Optional: Marlinespike, writing material, reading material, camera, musical instruments, ziplock bags (waterproof packaging), insect repellent, thumb drive or blank CDs to copy digital pictures or personal files from the ship's computers.

You Must Bring on all Cruise Tracks:

Waterproof Foul weather gear	Jacket w/hood, pants and (in Northern latitudes) boots
Light jacket	1 windbreaker or polar fleece shell
Wrist watch	1 digital or with second hand
Towels	2 light and quick drying (leave the giant thick bath sheet at home)
Sleeping bag or sheets	1 sheet + bag or 2 sheets (+blanket)
Sunblock and chapstick	SPF 30 or greater for both
Sunglasses	1 pair – must have UV protection
Toilet kit	Toothpaste, toothbrush, etc. No hair dryers
Flashlight	One small flashlight with one set extra batteries
Water Bottle	Durable ~1 liter
Shampoo/body detergent	Do not bring bar soap, it won't foam up in salt water. Any detergent based product will work. Suave is cheap & works great.
Hat	Broad brimmed for sun protection

You Should Bring

Southern Trips

Northern Trips

	Southern Trips	Northern Trips
Underwear	Enough for entire cruise with no laundry	Enough for entire cruise with no laundry
Socks	2-3 pairs – Less if you wear sandals. More if you're a sneaker wearer.	2-3 pairs – Wool / Polypropylene – wet cotton will freeze your feet
Shoes – non-skid/rubber soled	1-2 pairs – Teva/Chaco or similar with heel strap -no flip flops. One pair of sneakers.	1-2 pairs – probably lace-ups to wear with warm socks. Teva/Chaco for warmer days if you have room.
Shorts	3 pairs – quick drying	3 pairs
T-shirts	4-5 (1-2 long sleeved)	4-5 (1-2 long sleeved)
Pants	1-2 pairs – avoid denim, it never dries. Lightweight canvas or synthetic blends.	1-2 pairs –avoid denim. Wool or synthetic blends. Cahart's are the pants of choice for the crew
Swimsuit	1	1
Sweater/ Fleece	1 Wool or Polar Fleece – no cotton	1 Wool or polar fleece – no cotton
Hat	1 – broad brimmed hat/cap	1 – one wool/fleece (warm) hat and 1 sun hat/cap
Long underwear	-----	1 pair
Gloves	-----	1 thin warm pair

Note: Each *SEA Seminar* cruise varies in length. Use the above list as a starting point, and pack to accommodate your specific needs for the length of the cruise.