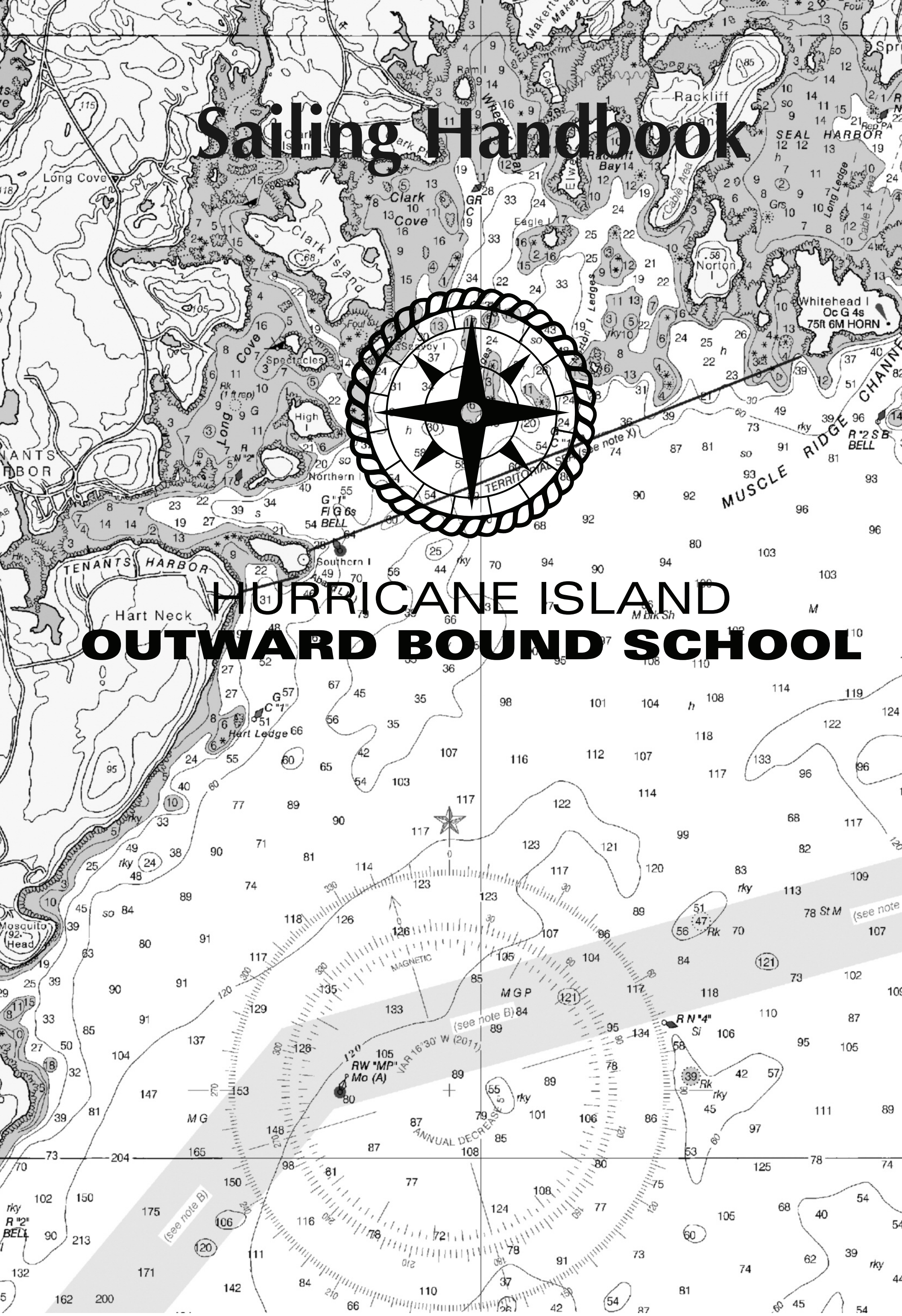
Sailing Handbook



HURRICANE ISLAND
OUTWARD BOUND SCHOOL

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WATCH LIST

Course Director: ____________________

Instructors: ____________________

Group Members:

Name Address E-Mail

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

6. ____________________

7. ____________________

8. ____________________

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12. ____________________

INTRODUCTION

Congratulations on choosing to do an Outward Bound sailing course! Outward Bound has been teaching sailing courses since 1964, and we are confident this will be one of the best experiences of your life.

You are about to embark on a great adventure, and learn many new skills, most of which require substantial practice to master. This handbook contains many resources to help you prepare for and complete your course. The information contained in this handbook is designed to supplement the instruction of your Outward Bound staff; it is not an exhaustive manual.

How to Use This Handbook

This handbook contains technical skill information about sailing. The more competent you become with the technical skills taught on your course, the better prepared you will be to take on responsibility for your expedition.

The blank spaces are for you to fill, perhaps with additional tips learned from your group members, or perhaps with thoughts that come to you about how this course fits into your life. The reading lists in each section provide you with other resources you can use to increase your knowledge of a particular topic.

Credits

This handbook was written and edited by Gretchen Ostherr and Caroline Blair-Smith. Drawings were done by Cooper Dragonette. Tim Swenson of Midcoast Creative did formatting and design work.

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SECTION 1 — ALL PROGRAM

OUTWARD BOUND HISTORY

The aim of education is to impel people into value-forming experiences, to ensure the survival of these qualities: an ***enterprising curiosity****, an* ***indefatigable spirit, tenacity in pursuit, readiness for sensible self-denial,*** *and above all,* ***compassion.***

Outward Bound was founded by Kurt Hahn, whose guiding philosophy is summarized best in his quotation above. Born to German Jewish parents in Germany, Hahn was influenced by Plato and the progressive school movement, which inspired his first school, called the Salem (German for "Peace") School in 1920.

> Salem represented an attempt to create a healthy environment in which young people could learn habits that would protect them against what Hahn saw as the deteriorating values of modern life. He identified the worst declines as those in fitness, skill and care, self discipline, initiative and enterprise, memory and imagination, and compassion...he incorporated egalitarian aims into the design of the school; while Salem naturally attracted the children of the wealthy, it also made space for, and actively sought, less privileged students. Among the unusual assumptions underlying all forms of instruction at Salem was Hahn's conviction that students should experience failure as well as success. They should learn to overcome negative inclinations within themselves and prevail against adversity. He believed moreover that students should learn to discipline their own needs and desires for the good of the community.
>
> – Thomas James: Kurt Hahn and the Aims of Education, 2000

Hahn championed the belief that moral aims should animate every aspect of education. In 1932, after Nazi storm troopers kicked to death a young communist, Hahn took a bold stand: he wrote to all Salem alumni, declared the values of Nazi Germany incompatible with the values of Salem School, and required them to choose between Salem and Hitler. Hitler imprisoned Hahn in 1933. Through the intervention of friends in Britain (including the Prime Minister), Hahn was allowed to emigrate and settle in Britain. Within the year he founded Gordonstoun, a progressive school in Scotland that advanced the philosophies of the Salem School. Gordonstoun boys were evaluated not only on their academic performance, but also on their integrity and principles. The Gordonstoun final report to parents graded boys in:

- Esprit de corps
- Sense of justice
- Ability to state facts precisely
- Ability to follow out what he believes to be the right course in the face of: discomforts, hardships, dangers, mockery, boredom, skepticism, and impulses of the moment
- Ability to plan
- Imagination
- Ability to organize: as shown in the disposition of work and in the direction of young boys
- Ability to deal with the unexpected
- Degree of mental concentration: where the task in question interests him, and where it does not
- Conscientiousness: in everyday affairs, and in tasks with which he is specially entrusted
- Manners
- Manual dexterity
- Standard reached in school subjects: German, modern languages, history, natural science and mathematics
- Practical work
- Art work
- Physical exercises: fighting spirit, endurance and reaction time

During World War II, Hahn was asked to adapt his educational philosophy to a program that became known as Outward Bound. In the early days of World War II, British merchant ships were torpedoed and sunk by German submarines. Survivors took to lifeboats and faced tremendous hardships in the stormy North Atlantic, particularly in winter. An unexpected phenomenon occurred with surprising frequency: the younger, fitter sailors often died while the older "salts" survived. Lawrence Holt, of the Blue Funnel Shipping Line, surmised that this unexpected outcome could be attributed to the life experience of the older men. He sought to develop an educational process that would "arm the cadet against the enemies within—fear, defeatism, apathy, selfishness." He turned to Kurt Hahn, who developed programs with challenging physical and mental activities that helped build confidence, encouraged compassion, and instilled tenacity and perseverance. The first Outward Bound courses began in 1941.

After the war, enthusiasm for the proven value of the Outward Bound experience led to the founding of the Outward Bound Trust in 1949. Hahn expanded the concept of experiential learning to include real and powerful experience to gain self-esteem, the discovery of innate abilities, and a sense of responsibility toward others. For its name, the program retained the nautical term used when great ships left the safety of the harbor for open sea. Ships leaving port were said to be "Outward Bound" towards unknown challenges and adventures. From this beginning, a number of Outward Bound schools were established in the United Kingdom. The movement spread to Europe, Africa, Singapore, Hong Kong, Australia, New Zealand, Canada and the United States. More than thirty schools have been founded on five continents: Europe, Africa, Australia, Asia and North America. Kurt Hahn remained active in the Outward Bound movement until his death in 1974.

The Hurricane Island Outward Bound School (HIOBS) was founded by Peter Willauer in 1964, the first sea school in the United States. Originally based on Hurricane Island in Maine's Penobscot Bay, HIOBS now runs programs in many wilderness areas on land and sea in New England, the Florida Keys and Central America.

Important Milestones in HIOBS History

1964	Peter Willauer founds HIOBS, construction of five pulling boats begins
1965	First sailing courses for boys 16½ and up
1967	First courses for adults
1969	First backpacking & canoeing courses, based out of Dartmouth College
1971	First coed courses
1974	First youth courses for 14- and 15-year-olds
1977	First winter sailing courses in Florida
1980	Land in Newry, Maine purchased for backpacking & canoeing course basecamp
1982	First Intercept courses for at-risk youth
1983	First vets courses for Vietnam Veterans
1985	L.L.Bean Mountain Center built on Newry property
1987	First college-accredited semester courses
1999	Wheeler Bay Sea Base purchased for mainland sailing course basecamp
2006	First semester courses travel to Central America
2007	First vets courses for OEF/OIF Veterans

Outward Bound continues to innovate and expand programs, yet the essence of the school remains true to its beginnings. Kurt Hahn liked to describe a student's education (or "training program," as he called it) as a roof held up by four pillars: self-reliance, physical fitness, craftsmanship and service. These four pillars make the foundation of all programs, whether students are teenagers, college students, adults, veterans or corporate executives. Our timeless mission is **to change lives through challenge and discovery.**

SKILLS CHECKLIST

The length of the course will determine how many of these skills you master. All of these skills should be mastered on any course longer than 14 days

Seamanship

- ☐ Use and understand nautical terminology
- ☐ Stow all equipment properly
- ☐ Use all pertinent equipment
- ☐ Tie a bowline, slippery hitch, figure eight, sheet bend, and square knot
- ☐ Understand NOAA weather forecast

Rowing

- ☐ Maneuver pulling boat under oars
- ☐ Know basic commands

Sailing Skills

- ☐ Maneuver pulling boat through all points of sail
- ☐ Execute man overboard (MOB), heaving to and squall drill
- ☐ Get under way and stop
- ☐ Reefing and scandalizing sails

Anchoring

- ☐ Select an anchorage, secure pulling boat with one or more anchors
- ☐ Set anchor ashore
- ☐ Organize and execute standing or anchor watch

Navigation

- ☐ Read chart: symbols, colors, scale, compass rose, soundings, contours, navigation aid characteristics
- ☐ Piloting: Dead Reckoning, taking bearings, fixing position, set and drift (Estimated Position), reading tide tables and using current to your benefit
- ☐ Observe navigational rules: right of way, fog signals, channel crossings, navigation lights

Basic Campcraft

- ☐ Pitch tarps well enough to stay dry in rainy weather
- ☐ Prepare good meals
- ☐ Observe and practice Leave No Trace principles
- ☐ Basic First Aid : prevention of injuries; care of routine wounds and blisters; know how to use contents of red and blue first aid kits.

Group and Leadership Skills

- ☐ Demonstrates good judgement and risk management while on course
- ☐ Decision-making styles fit the situation and are communicated clearly to the group.
- ☐ Demonstrates initiative and completes group tasks.
- ☐ Communicates effectively; actively listens; speaks clearly; states opinion; seeks clarification when does not understand; gives feedback when necessary
- ☐ Manages conflict promptly

ENVIRONMENTAL STEWARDSHIP & LEAVE NO TRACE®

From its inception, Outward Bound has led the way in educating people about low-impact backcountry travel and helping them appreciate our limited natural resources. Many of the early guidelines for campers, hikers and backpackers used and recommended by the U.S. Forest Service and National Park Service originated in Outward Bound instructor's manuals.

Today, all Outward Bound students are trained in Leave No Trace outdoor skills and ethics developed in a coordinated effort between federal land agencies, wilderness educators, environmental scientists and outdoor retailers and equipment manufacturers. Students are also introduced to the concept of environmental stewardship, an acceptance of personal responsibility for maintaining the health and beauty of the natural environment.

By living a simple, self-reliant, low-impact lifestyle in the wilderness, you have the opportunity to analyze firsthand the effect of human activities upon the environment and realize what aspects of your lifestyle back home may be wasteful and destructive. We hope that you are inspired to deepen your ties with nature and appreciate the value of preserving wilderness.

Principles of Leave No Trace

Plan Ahead and Prepare

Visiting islands in a responsible way requires forethought and planning on the part of each individual.

- Every island is owned by someone; you must have the owner's permission to land on each island. State islands are generally open to the public.
- Many islands have regulations or recommended guidelines that limit camping, the use of fire and other recreational activities.
- To help reduce your impact, keep your group size as small as possible.
- To reduce potential litter at the source, remove excess food packaging before you leave home.

Travel and Camp on Durable Surfaces

Island soils are shallow, easily eroded and quickly compacted. Once an inch of soil layer is lost, it can take centuries to replace. Island vegetation is intrinsic to healthy soil, holding it in place and preventing erosion.

- Travel on sand, stone, resilient grassy areas and established trails.
- Avoid scrambling over dirt banks or shrubby ledges; these are easily eroded and rarely recover. Please do not walk in wet, boggy areas and avoid trampling mosses and lichens.
- Please do not cut or clear vegetation, trees, or limbs – dead or alive – for any purpose.
- Use existing campsites; do not expand established sites or clear new sites. If the campsites are already in use, squeeze into an existing site or bivouac on smooth granite, sand or gravel.
- Limit your stay to two nights. The longer you stay, the more impact you create.
- When leaving, restore your campsite to its natural state.

Dispose of Waste Properly

Human Waste

- Exposed waste is unhealthy for humans and wildlife. Digging cat-holes to bury waste is not appropriate on islands because the soils are shallow and easily eroded.
- Solid human waste should be removed from the island. Toilet paper should also be packed out.

Trash and Garbage

- Carry out all trash and garbage (both your own and any you find) and take it to the mainland for proper disposal.
- Food scraps should be picked up and packed out. Reducing food waste helps prevent animals from becoming attracted to humans as a food source.

LEAVE WHAT YOU FIND

People come to wild islands to enjoy them in their natural state. Allow others a sense of discovery by leaving rocks, plants and other objects of interest as you find them.

- Minimize campsite alterations. Consider the idea that good campsites are found and not made. Leave the area in as good as or more natural condition than you found it.
- Avoid damaging trees and plants. To prevent damage to greenery, use free- standing tents when possible. An island visitor picking flowers, leaves, edible berries or plants may seem harmless but the cumulative effect of many visitors doing so becomes quite damaging.
- Don't dig up someone's hidden past. Ancient stone walls, cellar holes, shell heaps, and other markers of past inhabitants can provide important archeological information when excavated properly.

MINIMIZE CAMPFIRE IMPACTS

Fires on islands have a high risk of spreading due to changeable winds, interconnected root systems, organic soils, and the lack of services. Most conservation associations recommend no open fires at any time.

- Use a campstove below the high tide line for cooking.
- If you must have a fire, a permit is likely required for public islands. Fires are prohibited on most private islands.
- If you must have a fire, the following techniques will ensure that you leave no trace:
  1. Use established fire rings. If no fire rings are present, build your fire on sand or use a fire pan below the high tide line. Fires on granite leave permanent scars.
  2. Make your fires small and safe.
  3. Use only driftwood from below the high tide line.
  4. Use extreme caution! Have a bucket of water nearby at all times.
  5. All fires should be dead out and cleaned up before you leave camp.

RESPECT WILDLIFE

We are all visitors to islands, most of whose inhabitants are wild. If we think of ourselves as guests when using the islands, we can't go too far wrong.

- Leave all pets at home.
- Please avoid seabird nesting islands when birds are nesting. If your presence is causing birds to leave their nests, you are too close.
- Avoid islands with eagles entirely.
- In Maine, seals bear their young between mid-May and mid-June. Disturbance can cause seals to flee, leaving pups exposed and vulnerable. Stay far enough away from the ledges so that the seals do not flee into the water.

BE CONSIDERATE OF OTHERS

When you cruise the Maine, Florida, Chesapeake or Caribbean coasts, you are among thousands of other boaters.

- If there are other people on the island, respect their privacy. Look for a landing site some distance away, or consider another island altogether.
- Help preserve the wilderness look of the island by keeping your visual impact low.
- Pull small boats out of sight on durable surfaces and pitch tents inconspicuously in established campsites.

SECTION 2 – THE BOAT

The Hurricane Island Outward Bound School has been running pulling boat courses since 1964. We designed this boat specifically for our purposes merging the qualities of simplicity and safety in a modified U.S. Navy whaleboat design. It is perhaps the ideal classroom for teaching groups of people to live and work together, and its design allows you to sail places that bigger boats are unable to reach.

This section of your handbook contains information about the pulling boat, which will help you to make the most of this expedition.

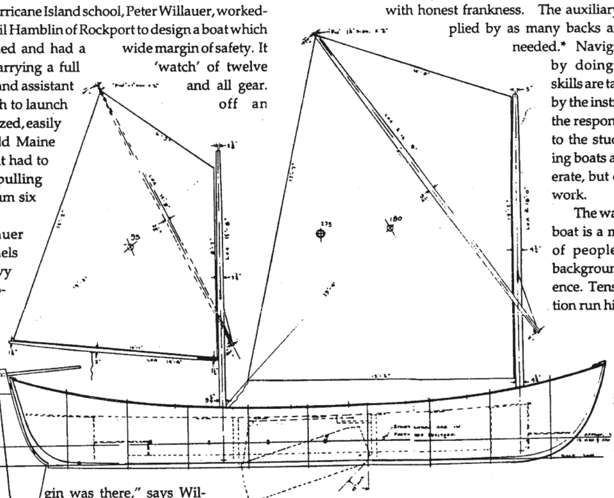
"I found the sea an interesting parallel to life in general. There is little room for indecision in a pulling boat during a storm. If you say, 'I don't know' the sea will decide for you. Life is similar, if frequently less romantic. I've often found myself saying, 'I don't know,' and letting life make decisions for me. Hopefully, my experience here has given me some new insight into the consequences of such blind sailing, and maybe even taught me something about navigation."

Hurricane Island Outward Bound Student

The Pulling Boat:
A Classic Outward Bound Metaphor

In summer of 1965, the Hurricane Island Outward Bound School began its courses with 170 students, using the sea and cliffs of the rugged Maine coast as tools for learning. The heart of the program is the pulling boat, a modest vessel with a rich history and the capability of teaching individuals a lot about seamanship, but much more about themselves.

The founder of the Hurricane Island school, Peter Willauer, worked with naval architect Cyril Hamblin of Rockport to design a boat which could be rowed or sailed and had a wide margin of safety. It had to be capable of carrying a full 'watch' of twelve students, an instructor and assistant and all gear. It had to be light enough to launch off an island beach and if capsized, easily righted. Full of the cold Maine water and passengers, it had to float freeboard. The pulling boat requires a minimum six people to operate her.



Hamblin and Willauer studied whaleboat models of the 1800's, the U.S. Navy Whaleboat and the 26-foot Monomoy surfboat used by the U.S. Coast Guard. "I was trying to get something that was sea kindly and also kindly to an inexperienced crew, with a gigantic margin of safety - even though the people in it would not be aware the margin was there," says Willauer. "Cy (Hamblin) came up with a design that gave us what we needed. When we had our second set of boats built in 1969, we made sixty small changes, but it was still the same boat." The result is the 30-foot open wooden pulling boat still used today.

To "go below" on a pulling boat merely means to put on foul weather gear. To flick on the self-bailing equipment means to prime a hand pump and to cook dinner means making sandwiches underway or priming the stove when finally anchored in a cove for the night. At night, the oars laid bow to stern are the bed. There is no place to hide when either sick or depressed and moments of weakness are shared with honest frankness. The auxiliary power is supplied by as many backs and arms as are needed.* Navigation is learned by doing. The nautical skills are taught one by one by the instructors and then the responsibilities are left to the students. The pulling boats are simple to operate, but only with teamwork.

The watch on a pulling boat is a mini community of people with diverse backgrounds and experience. Tension and frustration run high at times, due to the conflicts that arise when twelve people are together in close quarters, under stressful conditions. Out of those challenges comes learning, about oneself and one another. Successes are shared by the group, stemming from simple pleasures, such as a well-executed tack or accurate navigation. Even the rhythmic strokes of six people at the oars are enlightening.

The Pulling Boat *cont. from pg. 1*

The Pulling Boat *cont. from pg. 1*

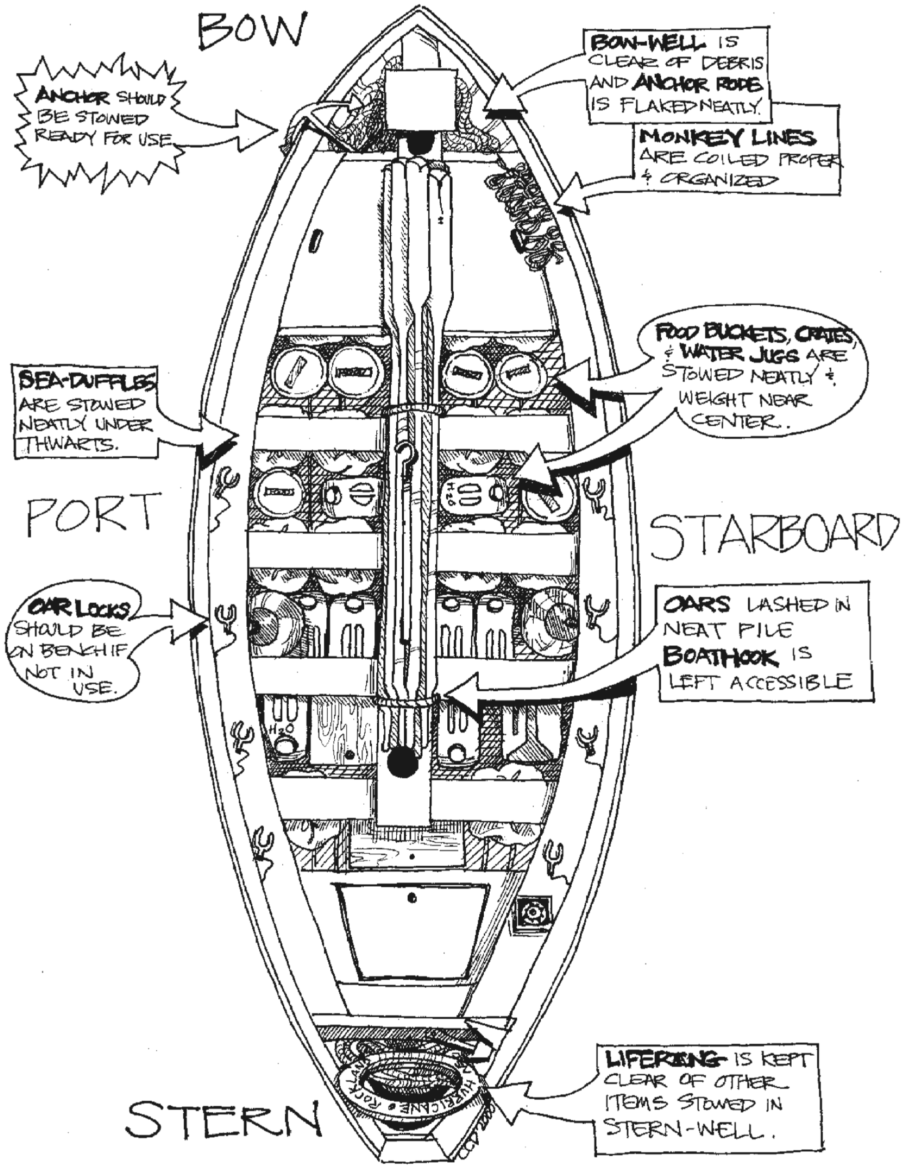
The Hurricane Island Outward Bound School uses nature and the elements to push its students beyond their self-imposed limits. Its use of the sea mirrors that of the first Outward Bound School in Aberdovey, Wales established in 1941 to instill a sense of confidence in young British sailors. The challenges they faced through the seas gave them experiences to draw from in times of stress. Outward Bound taught those young seamen that overcoming challenging situations in all walks of life demands more positive attitude and teamwork than physical ability. Those lessons still apply today, more than ever.

Students have the opportunity to experience the sea aboard a pulling boat through Outward Bound programs in Maine, Boston, New York City, Baltimore, and Florida. Whether you have been a sailor all of your life or you have never tied a bowline knot, the Outward Bound pulling boat has much to teach you. And you'll also learn how to sail. ❑

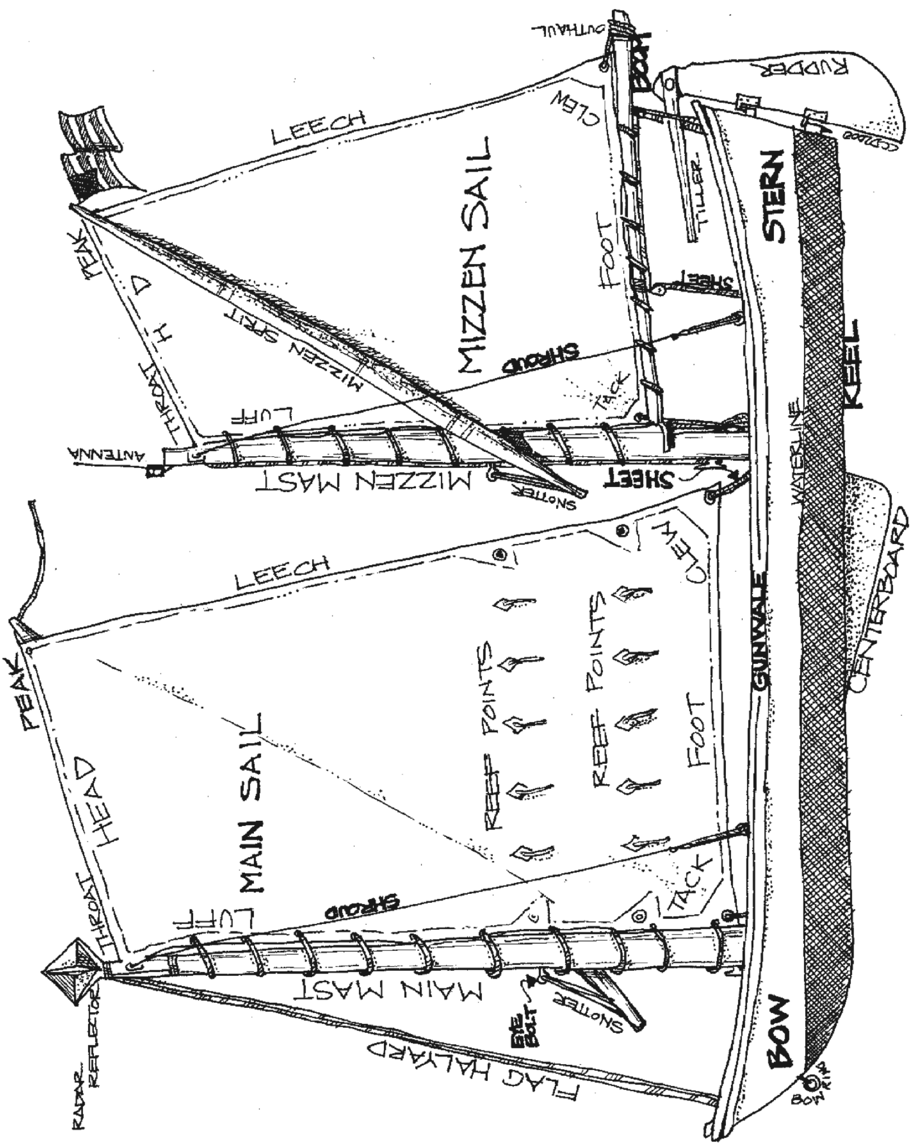
* *Perry Gates, "East of Schoodic"*

From: *The Compass Newsletter for Expeditioners*, published by Outward Bound, fall 1991.

PULLING BOAT STOWAGE PLAN



Parts of a Pulling Boat



SECTION 3 – UNDERWAY

SAIL THEORY

SAIL POWER

TRANSMITTING ENERGY. Sails are the engine of a sailboat. Wind is their fuel. Sails extract energy from the wind and rechannel it to provide propulsion to the hull. The energy is transmitted to the hull through the spars and rigging. The velocity of the wind determines the amount of energy available to the sails and hence the potential speed of the hull. Since it is up to the sailor to make this energy exchange operate efficiently, it is helpful to understand the process.

WIND DEFLECTION. Because it is fluid, wind finds its way around all obstacles. So, contrary to the popular notion, sails cannot actually "catch" wind. Sails simply redirect wind. It is by airflow deflection that sails provide propulsion to the hull. Ideally, wind should slide smoothly across sails from luff to leech (except when running).

AIRFOILS CREATE LIFT. A sail is a form of airfoil. It works by the same principle as other airfoils, such as airplane wings and Frisbees. An airfoil generates a force called *lift* as air passes around it. Airplanes and Frisbees use lift simply to remain airborne, while sailboats use lift as a means of propulsion.

To generate lift an airfoil needs a curved surface. Its leading edge splits the oncoming wind into separate streams (see *Fig.* 5). The airstream which flows around the curved surface covers extra distance as it bends around the curve. To keep up with the straighter airstream along the opposing side, it speeds up.

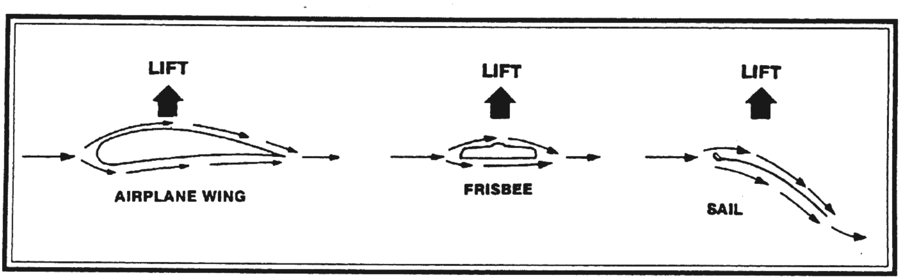


Figure 5.
Lift is generated on the outside of a curved surface.

This phenomenon is comparable to two athletes running around a curve on a track in separate lanes (see *Fig.* 6). The runner in the outside lane covers more distance and must run faster in order to stay even. Similarly, the stream of air on the outside

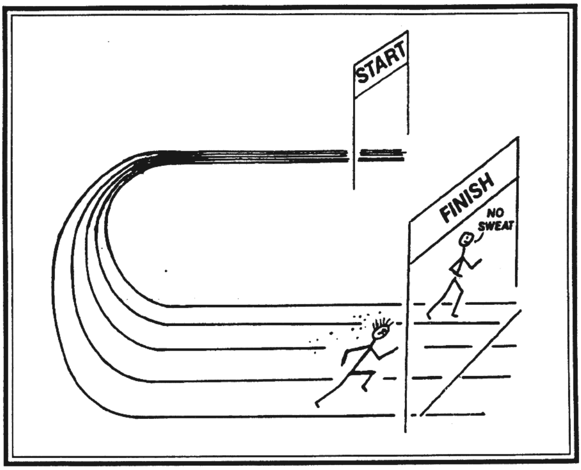


Figure 6.
The outside runner has further to go and must run faster to keep up.

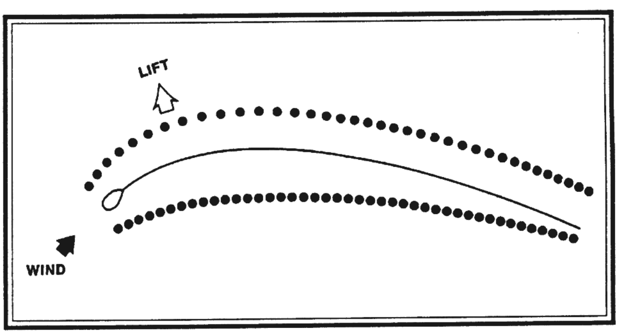
of an airfoil's curved surface temporarily accelerates in order to stay even.

The difference in airflow speed between the two sides creates an air pressure difference, higher on one side, lower on the other. This relative pressure difference provides lift.

BERNOULLI'S PRINCIPLE. The phenomenon of lift is further explained by *Bernoulli's Principle.* It states that whenever airflow speed increases, the air pressure decreases. To visualize how this works, imagine a length of chain lying on the ground with its links closely bunched. By suddenly yanking on (accelerating) one end of the chain, the separation between each link would widen until the chain reached its fully extended length.

Any fluid, including air, behaves similarly when it accelerates. Its molecules are separated, and a microscopic space opens up between them. This forms a tiny vacuum — a void which wants to be filled (see *Fig.* 7). The combined effect of the millions of tiny vacuums along the entire surface of the airfoil creates a substantial overall reduction in air pressure — a suction — which draws the airfoil toward it.

Figure 7.
Accelerated flow on leeward side of sail separates air molecules, reducing pressure and pulling the sail ahead.



The pressure reduction (lift) is continually renewed by fresh wind, so it steadily draws the airfoil toward it. The greater the acceleration, the wider the spacing between molecules, the lower the pressure, and the greater the lifting force.

TEST IT YOURSELF. It is understandable to be skeptical of all this invisible magic, so test it yourself the next time you go sailing. Put the boat on a beat so the sails are close-hauled. Then position yourself in the cockpit directly beneath the boom. Reach up as high as you can on both sides of the mainsail. Feel the difference in wind velocity on your hands. You will find the airflow convincingly stronger on its leeward side.

LATERAL RESISTANCE. Unfortunately, the lift a sail creates does not always draw the hull straight ahead. Sometimes it tries to pull the hull somewhat off to leeward (see *Fig.* 9). When beating and close reaching, for example, the drive force has a strong lateral component. If not for the

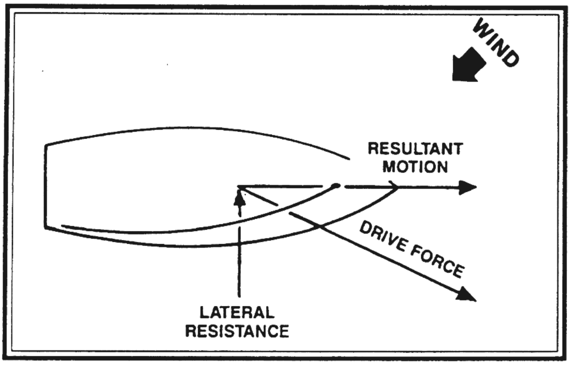


Figure 9.
Drive force pulls the hull both ahead and off to leeward. The lateral resistance of the fins prevents the hull from sideslipping to leeward.

boat's fins, and the lateral resistance they provide, the hull would follow the sails' lead and skid off to leeward — sideslipping.

Like knife blades, the fins slice easily through water on their cutting edge; but they resist being drawn through water sideways. The fins provide sufficient impediment to the lateral force, that the hull simply follows the path of less resistance, which is straight ahead.

POINTS OF SAIL

Your boat's point of sail refers to the angle between your heading and the direction from which the wind is coming. For safe and efficient sailing, you must always be aware of that angle, because it affects how you control your rudder, sails and centerboard.

Head to Wind

When your boat's heading is straight into the wind, the sails luff and you lose all headway. Because there is no pressure on the sails, this is the ideal angle for setting or furling. Because the boat stops, this is the ideal angle for dropping or weighing the anchor, or picking up an object or person lost overboard. Be aware that even an experienced crew needs some space (to leeward) and time to get a boat moving again, so make sure you have lots of room before you go head to wind.

Helmsman: Amidships
Sails: free to luff
Centerboard: down

Close Hauled

At this point of sail, the forward movement of the boat is entirely dependent on the helmsman. S/he must keep the boat moving forward while sailing as close to the wind as possible. When your boat's heading is just far enough off the wind to begin to sail, you are sailing close hauled. In a pulling boat, this is an angle of 60° off the wind, but may change slightly depending on wind strength and the size and shape of the waves. The sails are hauled in as close to the boat as they can be. To resist the sideways force of the wind on the boat, the centerboard must be down.

Helmsman: constantly adjusting course to be as close to the wind as possible without luffing
Sails: all the way in
Centerboard: down

Close Reach

At this point of sail, the helmsman can steer a compass course, and the crew must keep the sails trimmed properly. This term refers to any heading between close hauled and 90° off the wind (see beam reach).

Helmsman: keeping a course
Sails: continually trimmed to be as far out as they can be without luffing
Centerboard: down

Beam Reach

At this point of sail, the helmsman can steer a compass course, and the crew must keep the sails trimmed properly. When your boats heading is 90° off the wind, you are sailing on a beam reach. This is the fastest point of sail.

Helmsman: keeping a course
Sails: continually trimmed to be as far out as they can be without luffing
Centerboard: at least halfway down

Broad Reach

At this point of sail, the helmsman can steer a compass course, and the crew must keep the sails trimmed properly. This term refers to any heading between 90° and 180° off the wind (see beam reach and running). The centerboard may be half to all of the way up, depending on the breadth of the reach.

Helmsman: keeping a course
Sails: continually trimmed to be as far out as they can be without luffing or putting too much pressure on the shrouds
Centerboard: halfway down to all the way up

Running

At this point of sail, the helmsman must pay careful attention to the course steered so as to avoid an accidental gybe, and the crew must pay careful attention to the trim of the sails. When your boat's heading is exactly opposite the direction from which the wind is coming (180° off the wind) you are running. The sails may be on the same side, but they will probably fly best on opposite sides (wing and wing). Sailing this way there is no sideways force on the boat, so the centerboard should be up. Because a small course change in either direction will result in a gybe, it is critical that the centerboard be all the way up. In a gybe, tremendous sideways force is exerted high up on the boat, so the boat must be able to slide sideways and absorb some of that force. To gybe with the centerboard down is to risk capsizing.

Helmsman: keeping a course, constantly watching out for the gybe
Sails: continually trimmed to be as far out as they can be without putting too much pressure on the shrouds
Centerboard: all the way up

TACKING & GYBING

TACKING

Crew positions: one student on the helm, one on the bow, one on the mizzen, two on each main sheet (a sheeter and a cleater), and one on the chart. Everyone else stands by, ready to lend a hand.

Method:

Step 1 –

Helm: The helm calls, "ready about" and the sheeters and cleaters prepare themselves and reply, "ready."

Main Sail: On "ready about" the main cleater on the lazy sheet takes slack out of the sheet, and prepares to sheet in. The cleater on the working side takes off just as many turns as still allows him/her to prevent slippage.

Step 2 –

Helm: When the boat is making good close hauled, the helm puts to tiller to the leeward rail, saying, "hard alee."

Main Sail: On "hard alee" the working cleater takes off all turns on the cleat as soon as s/he observes a luff, to help bring the bow into the wind. The lazy side sheeter and cleater take all slack out of the sheet, but apply no additional pressure – backing the main will slow the boat and lose steerage way.

As the bow falls off and the sail crosses the boat, the cleater finishes making fast. Good sail handling technique renders the sheeters' services unnecessary in all but the stiffest breeze. They are useful while the cleaters are learning their task, however.

Mizzen Sail: It is not necessary to do anything to the mizzen sail when tacking. Although occasionally if the boat stalls mid-way through the tack, the mizzen can be used to help the boat complete the tack.

GYBING

Caution: It is safest to steer ten degrees upwind of dead down wind, to avoid accidental gybing. Ensure that the centerboard is up – gybing causes considerable sideways momentum on the boat and it must be allowed to slip sideways to dissipate the energy gradually. With the centerboard down, all that force is translated into heeling momentum, which can swamp or capsize the boat.

Crew positions: one student on the helm, one on the bow, one on the mizzen, two on each main sheet (a sheeter and a cleater), and one on the chart. Everyone else stands by, ready to lend a hand.

Method:

Step 1 –

Helm: The helm prepares the crew by calling, "stand by to gybe."

Mizzen Sail: The mizzen is brought in over the quarter to limit its arc of swing, but not so far as to add so much weather helm that the boat cannot fall off.

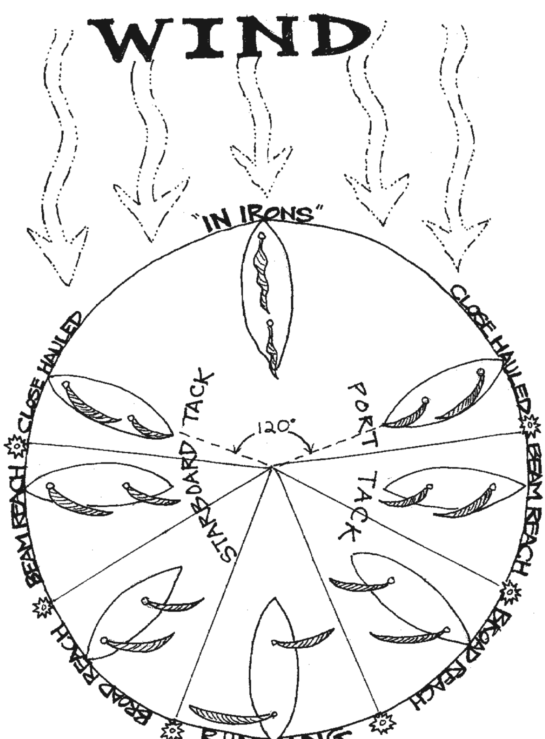
Main Sail: The main is muscled in to approximately the same trim, both the working and lazy side sheeters take out all slack and reply, "ready!"

Step 2 –

Helm: The helm says "gybe ho", turns the boat stern through the wind, and steadies on the new course by fighting the tendency of the boat to head up after a gybe.

Mizzen Sail: The mizzen sheeter controls the swing, and then immediately eases to the correct trim to reduce the load on the helm.

Main Sail: When the boat settles on the new course, the working side sheeter trims the sail, and the lazy side sheeter releases all tension.



ROWING COMMANDS

Select and Toss Oars	Choose an oar from the king plank, call, "Oar coming up" and lift it to the vertical. In strong wind, feather the blade.
Come to Oars	Ship the oarlock and lower the oar into it, keeping the blade clear of the water.
Give Way	In time with the other rowers, lean forward, drop the oar in the water and pull on it.
Hold Water	Place the oar into the water perpendicular to the boat and resist any force on it.
Back Water	In time with the other rowers, lean back, drop the oar in the water and push on it.
Come to Oars	Return to the ready position, blade clear of the water.
Cross Oars	Slide the butt of your oar into or past the oarlock on the other side of the boat. Do not leave them this way if underway because even a slight angle of heel will catch the blade.
Bench Oars	Slide the butt of your oar under the king plank and feather the blade. Make sure it doesn't get dislodged, because it will slide overboard. This works underway in light breezes, but high angles of heel will catch the blade.
Toss and Stow Oars	Lift the oar back to vertical. One at a time starting with the forward rowers, call, "Oar coming down" and lower it to the king plank, blade forward.

SECTION 4 — NAVIGATION

ELEMENTS OF NAVIGATION

Navigation is a huge and varied topic which many sailors spend years learning and perfecting. This section is designed to give you some basic background information to supplement what your instructors teach you, and give you some practice opportunities, should you wish to work on your own techniques.

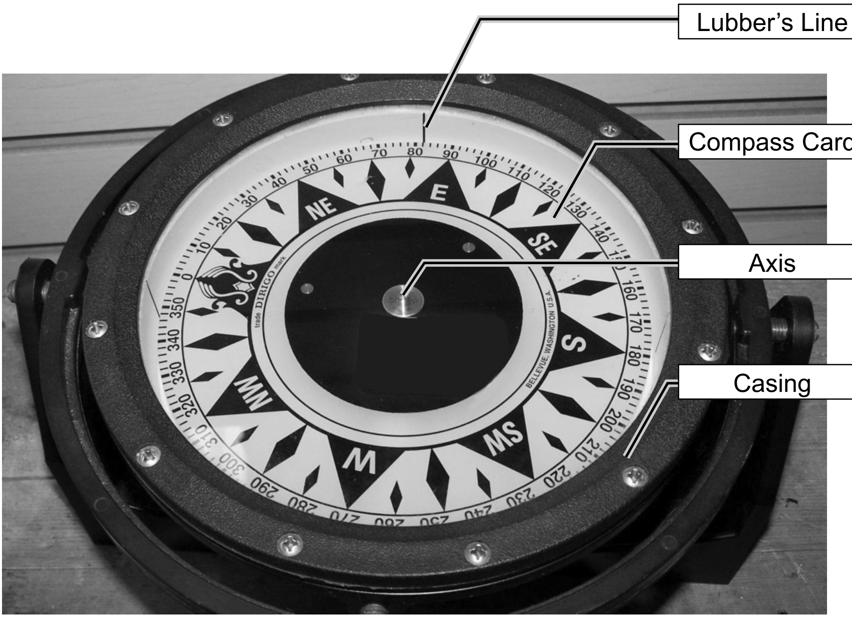
The goal of navigation is to know where you are and where you are going, so that you can avoid dangers (such as rocks and shoals), and so that you can successfully reach your destination.

NAVIGATION TOOLS

The key tools you will use to navigate on your Outward Bound course are listed below. In addition, GPS and Radar are available to many navigators to help them practice their trade. However, before you can successfully use GPS or Radar you need to have a firm grasp on the basics of traditional navigation techniques. You will learn those basics on your Outward Bound course, since we don't regularly use GPS and Radar.

- Compass – for taking bearings to known objects, and helping you steer a course
- Chart
- Parallel Rules or Plotter – for measuring and plotting chart bearings
- Dividers – for measuring distances on the chart
- Wristwatch
- Tide chart
- Your own observations of the world around you
- Pencil or grease pencil

THE COMPASS



One of the mariner's essential navigational tools is the compass. The box compasses used on HIOBS boats are magnetic compasses that work by housing a *compass card* in an oil filled *casing*. The compass card is a round disk marked with a compass rose, and the 360 degrees of a circle. The compass rose indicates the cardinal and ordinal directions.

The Cardinal Directions:

North	000°
East	090°
South	180°
West	270°

The Ordinal (or Intercardinal) Directions:

Northeast	045°
Southeast	135°
Southwest	225°
Northwest	315°

The light oil within the casing allows the card to rotate freely and steadily on an *axis* so that however the casing, the box, and the boat in which the box sits is positioned, the north on the compass card always points toward magnetic north. On the inside of the casing are markings called *lubber's lines*. If you set your box compass so that the lubber's line points directly forward on your boat, then when you turn your boat, the card remains oriented toward magnetic north, and your direction of travel is indicated by the lubber's line. This direction of travel is also referred to as a heading.

Like all magnetic compasses, your box compass indicates magnetic north, not true north. True north is the direction from where you are to the earth's north pole. Magnetic north lines up with the north pole of the earth's magnetic field, which shifts over the years and is a little different from the poles that mark the axis of the earth's spin. The difference is called variation. On the Maine coast, the variation is 17-18° west. In the Florida Keys, the variation is closer to 3° west. On the west coast of the United States, the variation is to the east.

To use a magnetic compass properly, it is important to know the variation of where you are, and also to keep the area around your compass clear of objects that have a magnetic field of their own. Flashlights and steel tools sitting near the compass will throw off the compass readings considerably!

The compass card within the box compass is the companion to the compass rose on the chart, indicated by two concentric circles divided into 360 degrees and graduated into ten degree intervals. On the chart, the outer circle indicates directions relative to true north and the inner circle indicates directions relative to magnetic north. The variation is written in the middle. When navigating using a magnetic compass, always refer to the inner circle of the compass rose on the chart.

TIME, SPEED AND DISTANCE

Time, speed and distance are related by the formula:

Distance = Speed x Time

Sounds simple enough, right? It is, as long as you keep in mind "distance" refers to nautical miles, "speed" refers to knots (nautical miles per hour), and "time" refers to hours.

As an example, let's say we were sailing along at 4 knots. How long will it take us to travel 10 nautical miles? As long as you know any two of the variables, you can solve for the third. In this case we know our speed is 4 knots and we know we want to cover the distance of 10nm. We plug these into the formula...

10nm = 4 knots x Time

$$\frac{10}{4} = \text{Time}$$

2.5 = Time or 2 $\frac{1}{2}$ hrs

What if you wanted to know how far the boat would travel in 40 *minutes* at the same speed? Obviously, we need a bit more information before we can solve this problem. We need to be able to convert some of our given information to usable information we can plug into our same formula of Distance = Speed x Time.

As a bit of background information, everyone knows that there are 60 minutes in 1 hour and 60 seconds in 1 minute. It is also necessary to be able to convert minutes into tenths of hours and vice versa. (For example, 15 minutes / 60 = .25 hours; .75 hours x 60 = 45 minutes) There is nothing complicated about this, but if you're not careful it can easily lead to mistakes. The following table will help:

Minutes	Tenths of Hours
6 min.	.1 hr.
12 min.	.2 hr.
15 min.	.25 hr.
18 min.	.3 hr.
24 min.	.4 hr.
30 min.	.5 hr.
36 min.	.6 hr.
42 min.	.7 hr.
45 min.	.75
48 min.	.8 hr.
54 min.	.9 hr.

The “6 Minute Rule” states that your speed in knots divided by 10 equals the distance traveled in nautical miles in 6 minutes. (For example, if you were sailing along at 3.5 knots, you will travel .35nm in 6 minutes.)

There are practice problems in the Appendix.

*Adapted and used by permission from the Ocean Classroom Foundation

DETERMINING YOUR SPEED

Knowing your speed is critical for navigating. If you get into the habit of writing the time on the chart every time you pass a buoy, lighthouse or any easily known location, you can calculate your speed. As you know:

Speed x Time = Distance and therefore: *Speed = Distance / Time*

If you passed two buoys two nautical miles apart in thirty minutes, you can conclude your speed to be four knots. The trouble with deducing your speed this way is that you only know your speed for a given section of your voyage after you have completed that section. If your speed is changing frequently because of the weather or course changes, this won’t be very helpful. If the fog closes in and you want to know how long before you should start listening for those breaking swells on those rocks on the chart, you will definitely want to be able to determine your speed at any time. In fact, good navigation requires that speed checks be done at least every thirty minutes and more often if your course (and point of sail) are changing rapidly.

THE METHODS

There's more than one way to discover how fast a pulling boat is moving, but they all have one thing in common: they all measure how many seconds it takes to go one boatlength (thirty feet).

The Compost Technique

Have someone stand by with a stopwatch. Take a small piece of compost and have the bow watch toss it ahead of the boat and off to the side about three feet. As the bow passes it, the bow watch yells, "MARK!" and the timer starts the watch. As the rudderpost passes it, the helmsman yells, "MARK!" and the timer stops the watch. The watch now reads the number of seconds it took the boat to go one boatlength (thirty feet).

Advantages: no equipment needed (just compost); can be done anywhere
Disadvantages : not "Leave No Trace"; gives speed through the water (affected by current), not speed over the ground.

The Chip Log Technique

You need a floating, non-hydrodynamic object on thirty feet of cord. The old-time sailors used a pie-slice shaped piece of wood (hence "chip log"), but a rubber ducky or full water bottle works well. Have someone stand by with the stopwatch. Flake the thirty feet of cord on the deck. When the chip log (or whatever) is dropped in the water, call, "MARK!" and the stopwatch starts. When all the line has run out and comes taut, call "MARK!" and the stopwatch stops. The watch now reads the number of seconds it took the boat to go one boat length (thirty feet).

Advantages: Leave No Trace; can be done anywhere
Disadvantages: Requires a little equipment, and care that the line runs out freely; gives speed through the water (affected by current), not speed over the ground.

The Lobster Buoy Technique

As you maneuver through the buoys, look for one that will be right alongside your course. Proceed as with the Compost Technique, taking care not to change your course to bring a buoy closer.

Advantages: Leave No Trace; gives speed over the ground (not affected by current).

Disadvantages: Can only be done where there are lobster buoys; any significant distance off the boat's course makes readings from the bow and stern unreliable

This is easy. All you have to do is divide 18 by the number of seconds on the stopwatch. For example, your speed check gives you **one boat length in six seconds.** Now do the math:

- 18 / time on stopwatch = speed
- 6 = time on stopwatch
- 18 / 6 = 3
- 3 knots = speed
- Check your math!

Now you know that your speed is three knots! Here is a handy table:

Seconds	Knots
18	1
12	1.5
9	2
6	3
4.5	4
3	6

(IMPORTANT! This equation is based on a 30 foot boat. If your boat were a different size, you would have a different equation.)

DEAD RECKONING

Dead reckoning (DR) is a corruption of "deduced reckoning." The sailor deduces his/her position by knowing the distance the boat has traveled in some known direction for some known length of time. We calculate distance from our speed and the time. We measure speed by speed checks, time by our wristwatches and direction by the compass.

Once again, the useful equation:

Distance = Speed x Time

DRAWING A DR TRACK:

The Method:

Draw your plot line lightly and no longer than necessary. Follow these rules for labeling your DR plot:

- Draw your course line on the chart with the course labeled above the line with a "C" in front of the three numbers of heading.
- The speed is labeled below the line with an S in front of it.
- The distance between the two points of your course is written with a D in front of it, and is written below your DR track.
- A known position at the beginning of the DR track is called a fix and is shown as a dot with a circle around it. This is labeled with the exact time of the fix written horizontally next to the circle.
- A DR position, calculated by D=ST is written as a dot along the DR track with a semicircle around it and the time written at an angle to the course line.
- Whenever a change in course or speed is made, plot a DR position and then label the new speed and course after it.
- DR positions should be plotted each hour on the hour even if there are no changes in course. DR positions should also be plotted whenever you get a LOP, as well. Plot your DR position more often if necessary.
- Whenever you fix your position, by passing close to a buoy, plot your DR position at that time (how far off you are, could give you valuable information about current). Then plot your fix and start a new DR track from there.

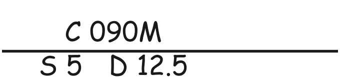
LABELING THE FIX POSITION AND SYMBOLS

○ **"Fix"** (An accurate position determined without reference to any previous position. Established by visual or celestial observations.)

△ **"Fix"** (Position determined by electronic means. Also used when more than one method is used to obtain the fix. For example, visual and radar.)

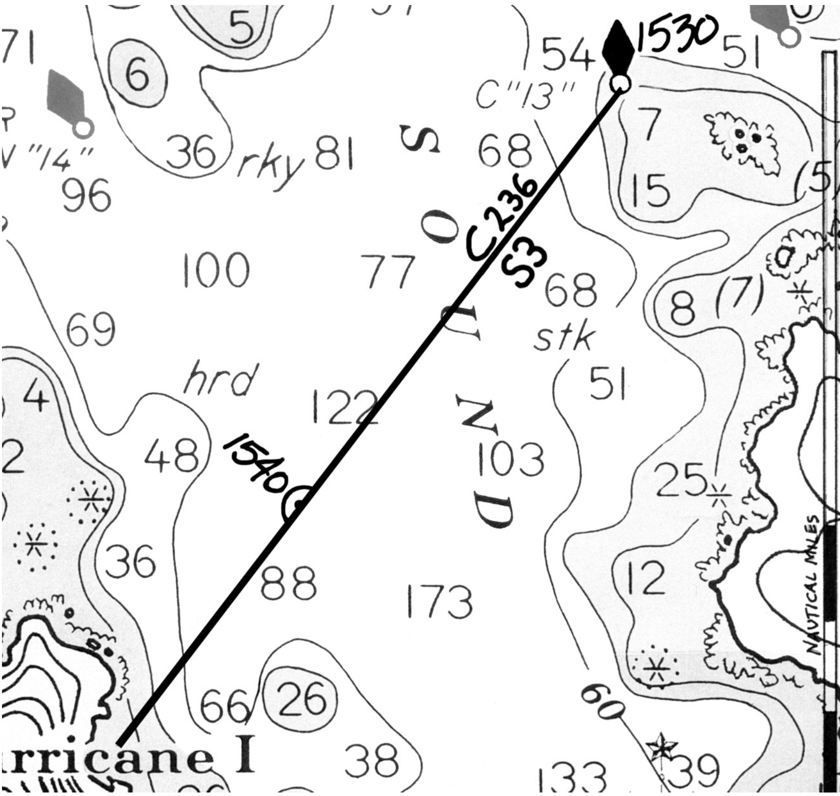
◠ **"DR"** (Dead Reckoning position. Advanced from a previous known position or fix. Course and speed are reckoned without allowance for wind or current.)

□ **"EP"** (Estimated position. The most probable position of a vessel, determined from data of questionable accuracy, such as applying estimated current and wind corrections to a DR position.)



The course is labeled above the line as a 3-digit number followed by a "T", "M" or "C" as appropriate (for True, Magnetic, or Compass). The speed and distance between points is labeled below the line. The time of a fix, EP, or DR position is written diagonally next to the appropriate symbol.

Here is a sample DR plot:



At 1530 we passed Can "13" north of Greens I. That is a fix (a definite position) so we wrote the time on the chart horizontally. Our course into the float on Hurricane Island is 236, and a speed check gave us three knots. We drew a projected course track, wrote the course above and the speed below. At 1540, we decided to plot a DR position, so we calculated how far we would travel in ten minutes at three knots. We measured out the answer (0.5nm) with the dividers, laid them along our projected course track, and marked the DR plot with a half-circle and the time diagonally (to remind us that it was only a DR plot)

Limitations of a DR plot

Creating a DR plot is the simplest way to navigate-so simple that it ignores wind, tide, any lapses in the helmsman's steering and the need to dodge lobster buoys. Keep a DR diligently; it might be all you have if the fog closes in, but never pass up a chance to get a real fix. Remember that your DR is only as good as your last fix and that its accuracy deteriorates with time from that last fix. You should try to obtain a fix every half-hour.

There are practice problems in the Appendix.

METHODS FOR DETERMINING POSITION

There are several methods for determining position. In order of MOST to LEAST accurate, they are as follows:

1. Fix
2. Running Fix
3. Estimated position using 1 LOP
4. DR position

A good DR track is critical to all of these methods.

TRIANGULATION

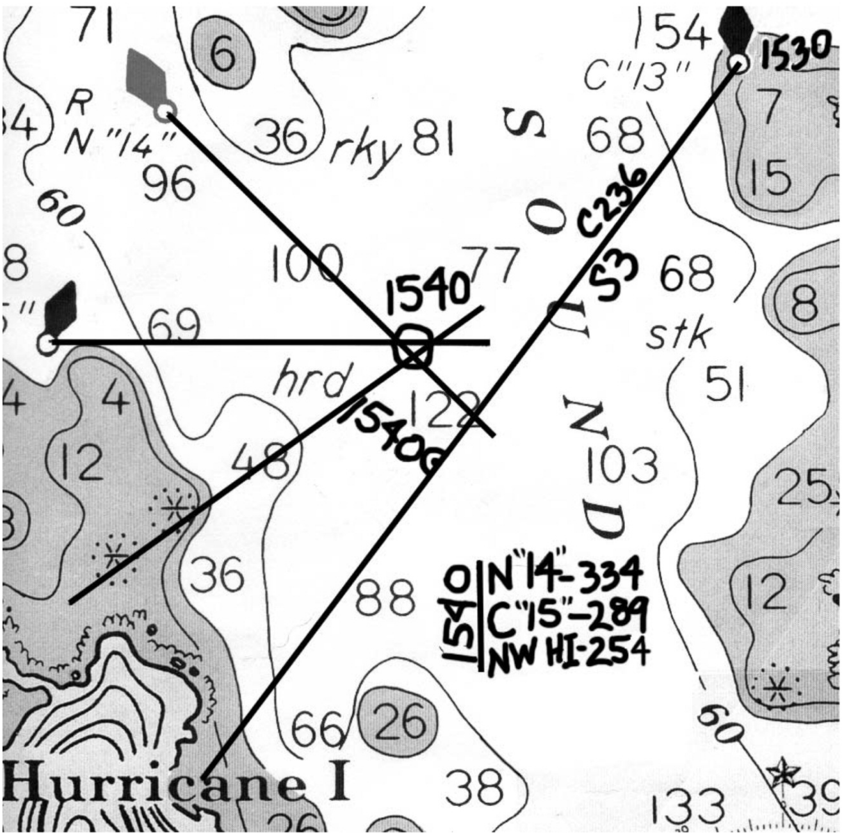
Triangulation is establishing your position by intersecting three lines of position (LOPs) taken at the same time on three different known objects. You may have already figured out that two intersecting LOPs would be logically sufficient: your position is where they cross. Two bearings will cross somewhere, even if you make a mistake in one or both. Three bearings will make a triangle (since total point accuracy is very difficult) and the size of that triangle gives you immediate feedback on the quality of your work. Consider a two LOP intersection to be an estimated position (see later section).

The Method:

- Choose three visible objects that you can positively identify, and that are neither close to each other, nor completely opposite each other from where you are looking. Buoys, lighthouses, mountaintops, and tangents (edges) of islands work well.
- On a space on the chart you won't need to refer to, make a table listing those points.

- Take the bearings as quickly as you can, and immediately write down the time over the table.
- Draw out the LOPs on the chart, erase markings except for the neighborhood of the intersection and mark your fix with the time of the bearings.
- Assume your boat is located in the part of the triangle that puts you closest to danger. Then adjust your course as needed.

Here is a sample triangulation. (The DR plot from the last example is shown again for reference):



The visibility was excellent as we crossed Hurricane Sound. Since there were three objects that we could identify, we chose to triangulate. We chose the items and made a table on a section of the chart we didn't expect to need. First we wrote N "14", then C "15", then indicated the northwest point on Hurricane Island as NW HI. With the compass we took all three bearings just as quickly in succession as we could, getting 334 for the nun, 289 for the can, and 254 for the point. Just as quickly, we wrote the time near the table: 1540. Now we take a breath, for haste is no longer needed. Carefully, we draw in the bearings, and mark a full circle where they intersect. Then we copy the time horizontally, showing that we have a fix we can feel confident in. We also notice that it is slightly north of our DR plot.

... What do you think happened?

There are practice problems in the Appendix.

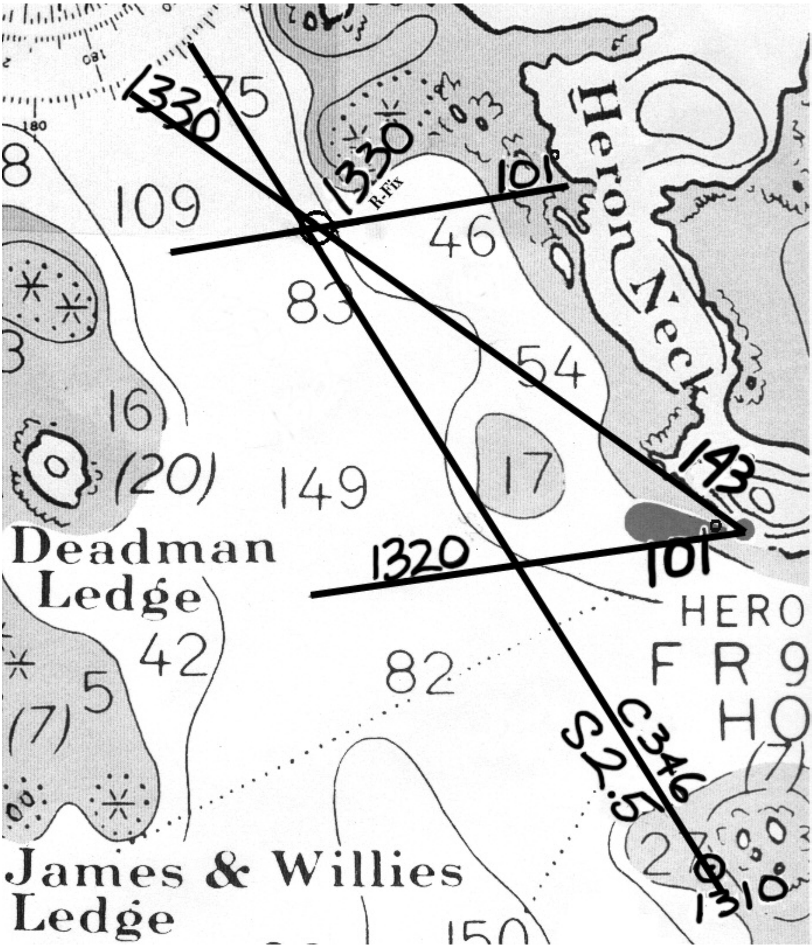
RUNNING FIX

This method combines your DR plot with two LOPs off the same object taken at different times. You advance the earlier LOP based on the distance you have traveled between the time of the 2 LOPs. ***Note: You should not advance a LOP if more than 30 minutes has passed.*** The accuracy of a running fix depends on the accuracy of the course and speed used in the DR projection during the time between the two bearings.

The Method:

- Take the first bearing, draw and label LOP with time taken written at the end of the LOP,
- Plot a DR position for the time that the LOP was taken
- Check boat speed
- Take a second bearing after the bearing has changed by ***at least*** 30°s, but no more than 30 minutes later, draw and label the LOP
- Plot a DR position for the time that the second LOP was taken
- Determine the distance traveled between the 2 LOPs by measuring between the DR positions or simply doing D=ST
- Advance the first LOP forward based on the distanced and direction traveled between the 2 LOPs
- Wherever the 2 LOPs cross is your running fix
- Draw a circle around the running fix and label it “R-FIX” with the time of the second LOP

Here is a sample Running Fix



On a windless and foggy afternoon, we heard and then saw breakers. As the sound of Heron Neck's horn was almost due north, we concluded that we were passing just west of the ledges. We marked our position on the chart with the time: 1310. We plotted a course that would take us safely up Hurricane Sound: 346. After laying our projected course track for a DR plot, we decided to get a little more information. The fog has hidden most of our landmarks, so we couldn't triangulate. Far above the surface of the cold water, the fog thinned to haze, and we could soon make out Heron Neck Light. With only one visible mark, we decide to take a running fix. Our first bearing on the light is 101, which we wrote on the line near the light. Opposite the light we wrote the time, 1320, being sure to use 24-hour notation so that times and bearings could never be confused. At 1330, our second bearing on the light was 143, which we wrote like the first. Then we estimate how far we traveled in the ten minutes between the bearings. At 2.5 knots, the distance is .33 NM. Now we advanced the first bearing .33 NM along our course track and redrew it. Our new position is where the advanced first bearing and the second bearing intersect.

There is a practice Running Fix problem in the Appendix

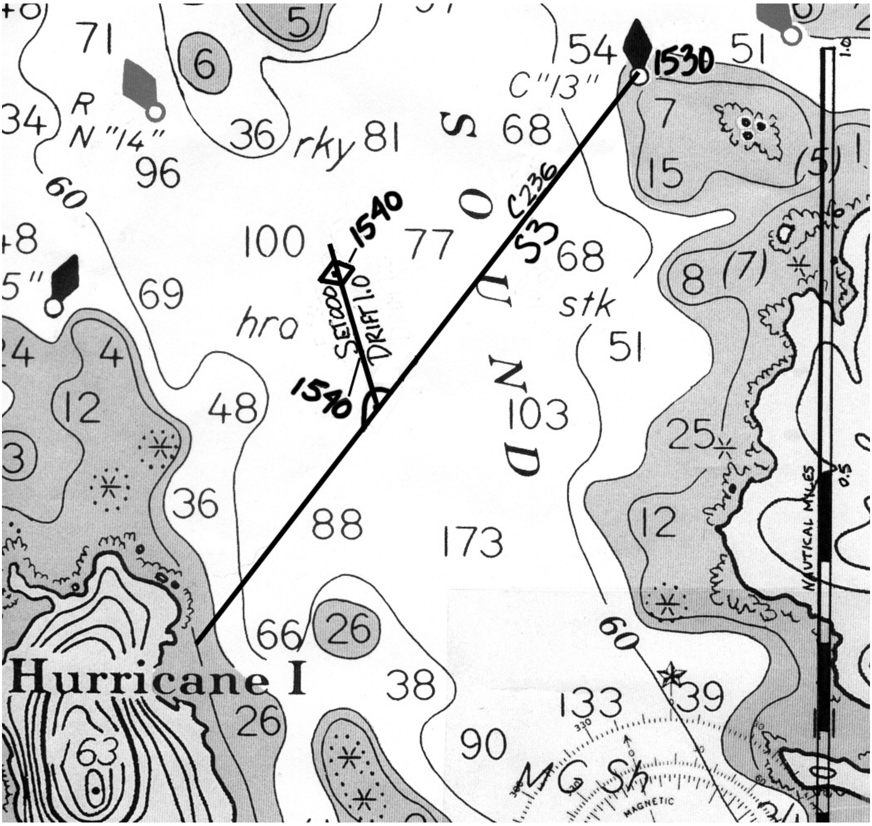
ESTIMATED POSITION

Sometimes you can't get a good fix, but you can do better than just a DR. Using your DR track and a single LOP you can estimate your position.

The Method:

- Get a LOP. Once you've plotted it, you know you are somewhere on this line
- To determine the most likely point on the LOP for your location, plot your DR position at the time the LOP was taken.
- The most probable EP of the ship is considered that point on the LOP closest to the DR position.
- Determine this point by drawing a line that intersects the DR position and the LOP at a right angle to the LOP.
- Then draw a square around the point and label it with the time.
- If you take several soundings at the time that you take get your LOP, this can serve to help you determine the accuracy of your EP (if the depths being measured at a location vary markedly from those shown on the chart, then you are NOT at the position indicated).
- Since an EP is not a well determined position, it is not customary to run a new DR track from it. However, a light line representing the course and speed should be drawn to make sure no obstacles would be encountered.
- To estimate your position using Current Set and Drift (see below), add the hourly set and drift to each DR position.

Sample EP Set and Drift Problem:

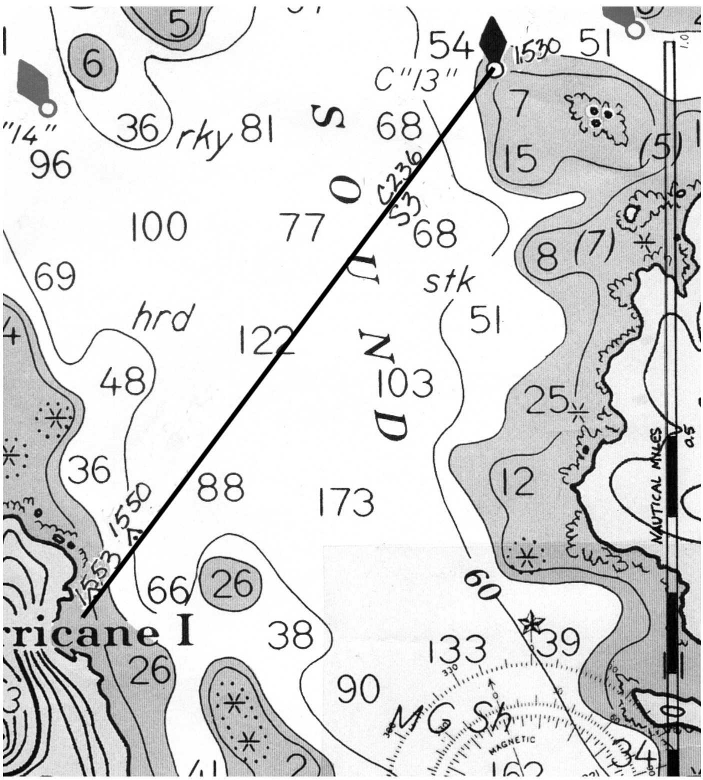


As we round the north end of Green's Island, we notice a flooding current sweeping north up Hurricane Sound. Therefore, we expect that the current will affect our progress along our DR plot. The fog is closing in, so we do not expect to be able to get bearings off landmarks. Shortly after leaving the can, we estimate the current's drift at one knot and it's set at roughly due north: 000. After drawing in our DR at 1540, we add the effect of such a current and draw in our estimated position with a square symbol, and the time diagonally.

NAVIGATING WITH SOUNDINGS

This simply combines your DR plot with a sounding. It is most reliable along straight shorelines that shoal steadily without isolated dangers: something of a rarity in Maine. Don't forget to find out the state of the tide before you plot your estimated position!

Sample Sounding Problem



As we head into Valley Cove on Hurricane Island, we begin soundings. Our tide tables show us that the tide is about halfway through the flood, and the total range today will be ten feet. By 1550 the average sounding is thirty feet, so we estimate that we are crossing the 30-foot isobath on the chart. By 1552 our soundings average twelve feet, so we estimate that we are crossing the twelve-foot isobath.

Can you see any disadvantages of this technique?

CURRENT SAILING

Set = is the direction toward which the current flows. (Note that this is different from winds, which are named for the direction from which they come.)

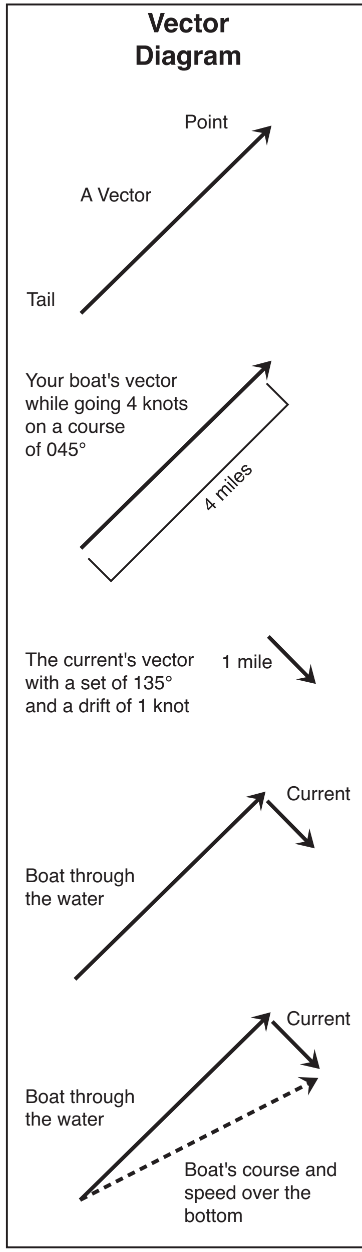
Drift = is the speed of the current in knots.

Current sailing is the art of selecting a course through the water to take into account the effect that the current has on the boat's track. This is especially important in a pulling boat, since we don't travel very fast the current can have a large impact on our course track, especially when we are crossing large bodies of water.

FIGURING OUT CURRENT SET AND DRIFT

Figuring out the speed and direction of the current is something of an art. The most reliable method is to deduce it from the difference between your DR position and a fix for a given time. Like deducing your speed from two fixes, this method is after the fact. Most sailors estimate current direction (set) and speed (drift) by looking over the side at a fixed object, especially a lobster pot buoy, or by using a tide and current table. The current makes a "wake" as it runs past an object fixed to the bottom, giving the illusion that the lobster pot is chugging along on its own. Its apparent speed is the current's drift; its apparent direction is the exact opposite of the current's set. Your instructors can help you practice taking this reading. After that, do it at every opportunity, because only with experience will you develop accuracy.

There are also Current Tables published annually by NOAA which can give you current information for thousands of locations.



Some generalizations will help you know what to look for. The tides in Maine generally flood north and east, and ebb south and west. Your instructors' store of local knowledge will provide some important exceptions to this rule. The speed of the current follows a general rule, too: The Rule of Twelfths.

The Rule of Twelfths

Given that there are about six hours between the extremes (high and low), and that there is a slack (stationary) tide at the extremes, then it makes sense that the maximum drift would fall in the middle of the cycle, where the most water is moving.

Hour in the cycle	Amount of water moving
1	1/12 of the total
2	2/12 of the total
3	3/12 of the total
4	3/12 of the total
5	2/12 of the total
6	1/12 of the total
Total	12/12 of the total

DEFINITION OF CURRENT SAILING TERMS

Course (C) and *Speed (S)* are terms used in DR plots to describe the boats motion through the water without regard to current.

Track (TR), is the direction of the boats intended track through the water with current accounted for.

Speed of Advance (SOA), is the intended rate of travel along the intended track line.

Since the intended direction and speed won't always be the actual direction and speed, two more terms are needed.

Course Made Good (CMG), is the direction of the actual path of the boat over the earth.

Speed Made Good (SMG), the net speed based on distance and time of the passage.

There are two basic current situations:

1. When the current direction is going the same or opposite direction of the boat's motion. In this case figuring out how the current will affect the

boat's track is easy: either add or subtract the *drift* to the boat's speed through the water.

2. When the current direction is at an angle to the boat's motion. In this case, figuring out how the current will affect the boat's course is most easily determined by doing a current diagram.

CURRENT (OR VECTOR) DIAGRAMS:

A **vector** is a line giving information about speed and direction. So, every time you go sailing your boat's progress can be shown as a vector – its speed and course.

A **current diagram** is basically a vector triangle, which shows:

- The boat's direction and speed through the water as one side of the triangle
- The current's direction and speed as another side of the triangle
- The third side of the triangle is the combination of the first two, so it will show you how the current affected the boat's direction and speed through the water (what the boat actually did).

So if you have the information for any two sides of the triangle, you can figure out what the third side should be.

Current triangles can be used in several different scenarios, here are the two most common:

1. Figuring out *after the fact* what the set and drift of an unknown current is.
2. Figuring out, *before sailing*, how to compensate for a known current in order to reach your destination.

How to draw a current triangle:

Scenario 1: **After the fact**, figuring out what the set and drift of an unknown current is:

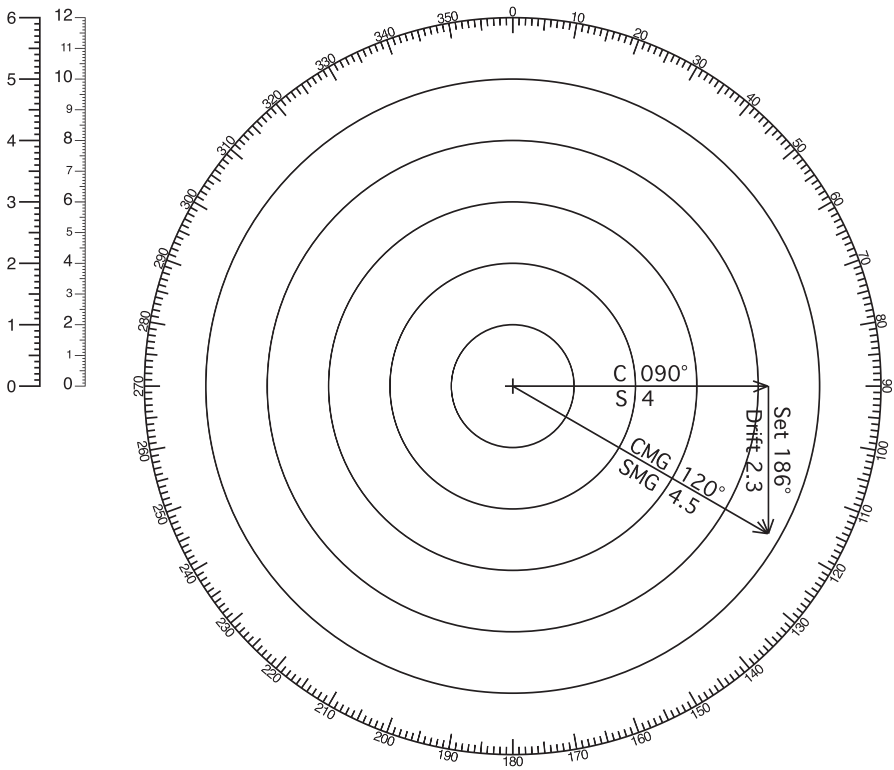
In this situation, you know the course you have steered and your speed through the water, and after getting a fix, you can figure out your CMG and SMG. From this information you can figure out the current's set and drift. You can plot this right on your chart or on a plotting sheet **(see plotting sheet on page 41 for diagram)**.

1. One vector will be your DR track, representing the course steered and speed through the water. (in the example, C = 90, S = 4). Use the compass rose to draw the line at 90°, and use the scale on the chart to represent speed, so that each knot equals 1 NM . **Note:** you can use any unit for

measuring speed, so long as you are consistent throughout the current triangle. Put the arrow on the line so that it is pointing in the direction of 90°.

2. After you have been sailing for an hour (this is the easiest unit of time to work in when doing current triangles, although, you could use another unit so long as you are consistent throughout), you get a fix which shows you that your course and speed made good were actually CMG 120° and SMG 4.5. Draw a vector representing the boat's actual course made good. This vector should start at the same point as the first vector, but it will end at a different location, due to the current set and drift.
3. Now calculate the current set and drift by connecting the first two vectors with a third that goes from the DR position to the fixed position. The direction of this line is the current's direction, and the length of this line represents the speed of the current.

PLOTTING SHEET



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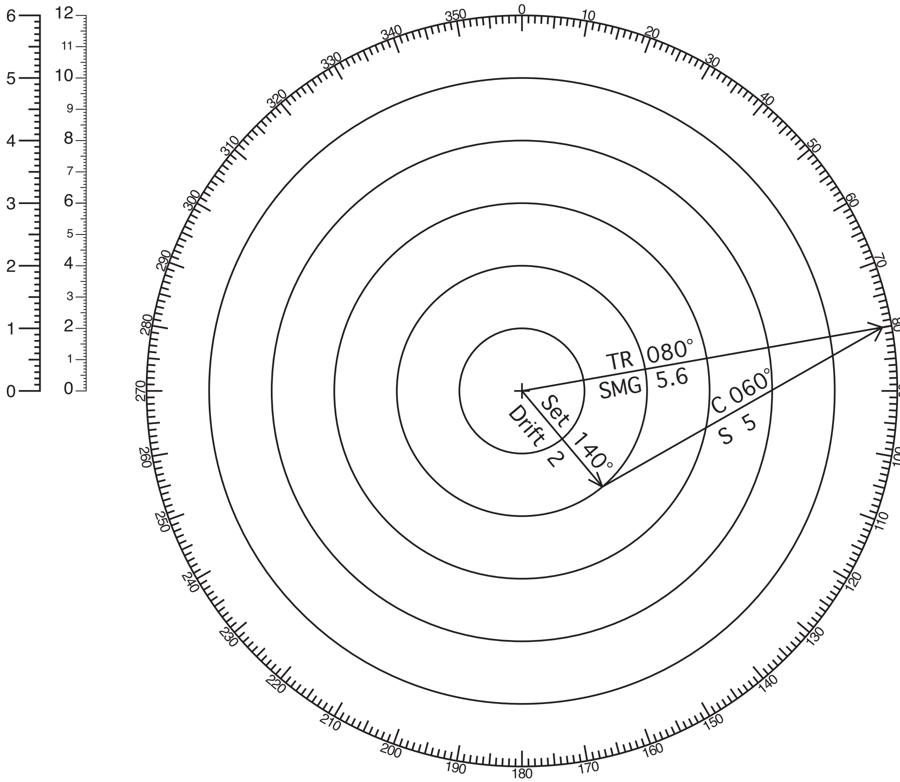

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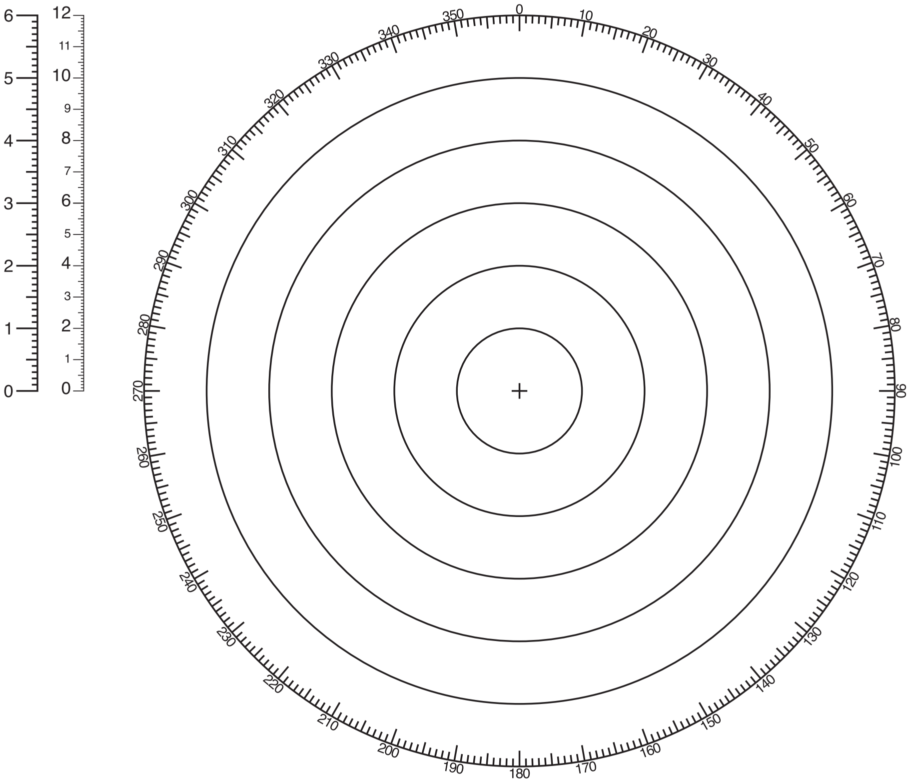
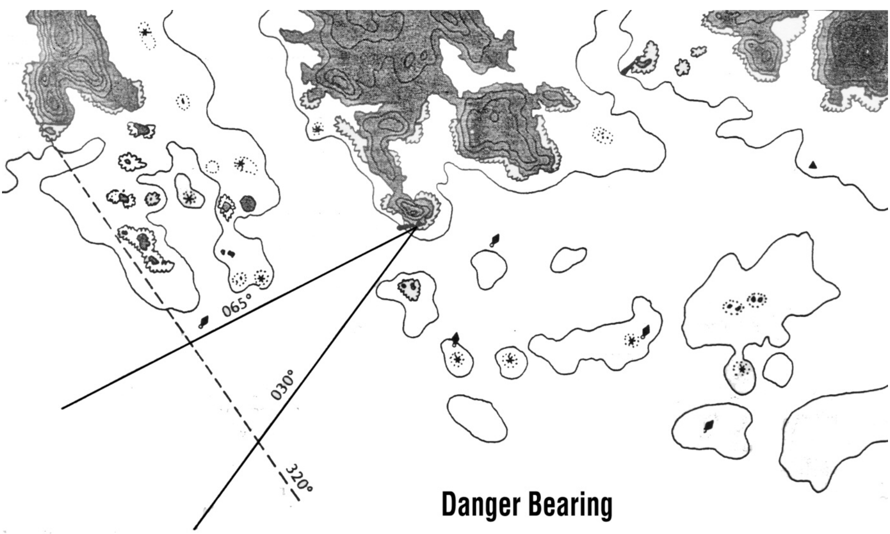


DANGER BEARING

Danger bearings allow a navigator to approach an area of unmarked hazards with confidence, by giving the navigator a quick check on the boats' position relative to the danger.

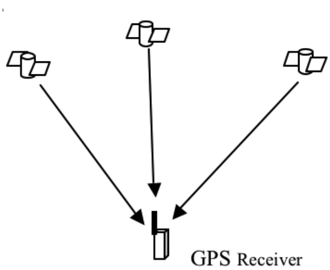
In the diagram, there are 2 danger bearings drawn to the lighthouse. The navigator knows that as long as the bearing to the lighthouse stays within these two bearings, then the boat is in no immediate danger of hitting the rocks on either side. Of course, the navigator needs to continue to fix the boat's position and maintain an accurate DR track, but this can supply a quick and effective way of knowing that the boat is safe.

Similarly, the dashed line indicates a danger bearing to keep the boat clear of the offlying ledges just off the coast. So if the boat were going to sail up the coast, as long as the bearing to the side of the peninsula does not become LESS than 320°, then the navigator knows the boat is safe from these ledges.



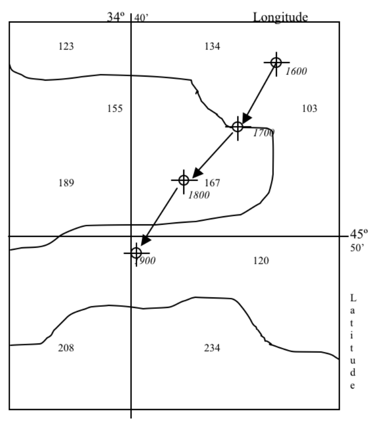
Danger Bearing

GPS (GLOBAL POSITIONING SYSTEM)



The GPS is a receiver that reads the signals from a collection of satellites. The internal software in the GPS receiver converts the signals into a distance from the satellite, then triangulates in 3 dimensions. This can place your position within 10 feet with good satellite visibility.

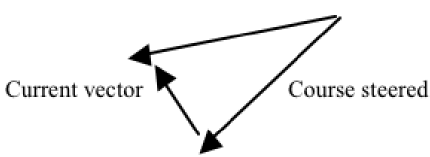
Plotting a Course with GPS



The GPS displays location in latitude and longitude, which can then be transferred to the chart. The receiver also will tell you how fast you are moving and in which direction over the sea bed you are traveling. This information will tell you what the current is doing to the boat. If you are heading 230 degrees, but the GPS reads your actual course over the ground (course made good) as 260 degrees, then you now know that there is a current pushing you northwest. You can then work out the course to steer to make good a course of 230 degrees.

Course over ground

Most GPS receivers will give you TRUE bearings, and the ship steers with a magnetic compass, so you need to take into account magnetic variation for your location. Some more sophisticated units can calculate magnetic bearings.



To account for the current you would have to steer 200 degrees.

WAYPOINTS

Waypoints allow the navigator to break up a long passage to convenient "legs." Usually the waypoints are located where there needs to be a course change. The GPS can calculate the course to steer and the expected time of arrival (ETA) based on the present speed.

The GPS is a convenient tool, but aboard ships of all sizes, primary navigation is still done with chart and pencil. A plot is always maintained and speed and direction recorded.

TIDES

An ocean **tide** refers to the cyclic rise and fall of seawater. Tides are caused by slight variations in **gravitational** attraction between the **Earth** and the **moon** and the **sun** in geometric relationship with locations on the Earth's surface. Tides are periodic primarily because of the cyclical influence of the **Earth's rotation**.

The moon is the primary factor controlling the temporal rhythm and height of tides. The moon produces two tidal bulges somewhere on the Earth through the effects of gravitational attraction. The height of these tidal bulges is controlled by the moon's gravitational force and the Earth's gravity pulling the water back toward the Earth. At the location on the Earth closest to the moon, seawater is drawn toward the moon because of the greater strength of gravitational attraction. On the opposite side of the Earth, another tidal bulge is produced away from the moon. However, this bulge is due to the fact that at this point on the Earth the force of the moon's gravity is at its weakest. Considering this information, any given point on the Earth's surface should experience two tidal crests and two tidal troughs during each tidal period.

The timing of tidal events is related to the Earth's rotation and the revolution of the moon around the Earth. If the moon was stationary in space, the tidal cycle would be 24 hours long. However, the moon is in motion revolving around the Earth. One revolution takes about 27 days and adds about 50 minutes to the tidal cycle. As a result, the **tidal period** is 24 hours and 50 minutes in length.

The second factor controlling tides on the Earth's surface is the sun's gravity. The height of the average solar tide is about 50% the average lunar tide. At certain times during the moon's revolution around the Earth, the direction of its gravitational attraction is aligned with the sun's. During these times the two tide producing bodies act together to create the highest and lowest tides of the year. These **spring tides** occur every 14-15 days during full and new moons.

When the gravitational pull of the moon and sun are at right angles to each other, the daily tidal variations on the Earth are at their least. These events are called **neap tides** and they occur during the first and last quarter of the moon.

TYPES OF TIDES

The geometric relationship of moon and sun to locations on the Earth's surface results in creation of three different types of tides. In parts of the northern Gulf of Mexico and Southeast Asia, tides have one high and one low water per tidal day.These tides are called **diurnal tides**.

Semi-diurnal tides have two high and two low waters per tidal day. They are common on the Atlantic coasts of the United States and Europe.

Many parts of the world experience mixed tides where successive high-water and low-water stands differ appreciably. In these tides, we have a higher high water and lower high water as well as higher low water and lower low water. The tides around the west coast of Canada and the United States are of this type.

NAVIGATION RULES OF THE ROAD

Always

Operate your vessel with good seamanship

- If all else fails, the rules may be broken to avoid imminent danger
- Always maintain a proper lookout by sight, hearing and other available means
- Proceed at safe speed at all times

Risk of Collision

- Risk of Collision exists if another vessel's bearing in relation to your vessel does not change or changes very little and distance decreases.

To Avoid Collision

- Do not cross ahead. Make early and obvious course changes. Slow, stop or reverse if necessary.

In Restricted Visibility

- Proceed at safe speed
- There is no give way vessel and no stand on vessel
- Use fog signals
- If you hear a fog signal ahead, slow to minimum speed or stop. Then proceed cautiously until you have determined that no risk of collision exists

Right of Way

DEFINITIONS

- Stand on vessel – maintains course and speed.
- Give way vessel – must keep well clear.

Two Vessels Meeting

- Meeting head on – both boats alter course to starboard and pass port to port
- Crossing – Port vessel (the vessel which has the other on her own starboard side) gives way to starboard vessel
- Overtaking – overtaking vessel gives way to vessel overtaken
- When in doubt between crossing and meeting head on, assume meeting head on.
- When in doubt between crossing and overtaking, assume overtaking
- Sailing on opposite tacks – port tack vessel gives way to starboard tack vessel
- Sailing on the same tack – windward vessel gives way to leeward vessel
- In channels – vessels crossing a traffic pattern give way to vessels in traffic pattern

Give way to vessels above you on this list:

- Not under command
- A vessel restricted in her ability to maneuver
- A vessel constrained by her draft
- A vessel engaged in fishing
- A sailing vessel
- Hand-powered (rowing or paddling)
- Power driven

Fog Signals

Short blast = about one second.
Prolonged blast = 4-6 seconds.
Power (driven by machinery) making way – One prolonged blast every two minutes
Power not making way – Two prolonged blasts every two minutes
Anchored – Five second bell every minute
Sailing, fishing, not under command, towing, rowing or paddling, etc. – One prolonged and two short blasts every two minutes

Sound Signals

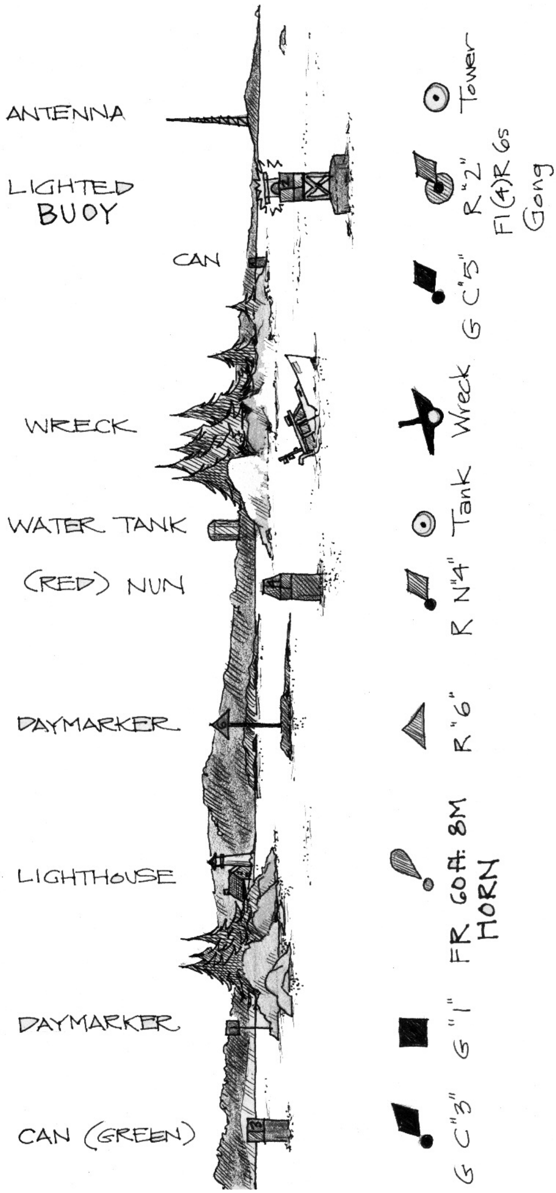
For use when vessels are in sight of each other. When a signal is heard and understood, the answering vessel uses the same signal in agreement.

"I intend to leave you to port" – One short blast
"I intend to leave you to starboard" – Two short blasts
"I intend to overtake you on my port side" – One short blast
"I intend to overtake you on my starboard side" – Two short blasts
"I am leaving my berth or approaching an obscured bend" – One long blast
"Danger! Your intentions are not clear" – Five short blasts

Convoy Sound Signals

For use when traveling with another pulling boat.
Close Convoy – Three long blasts
Rendezvous – One short, one long, 2 short blasts

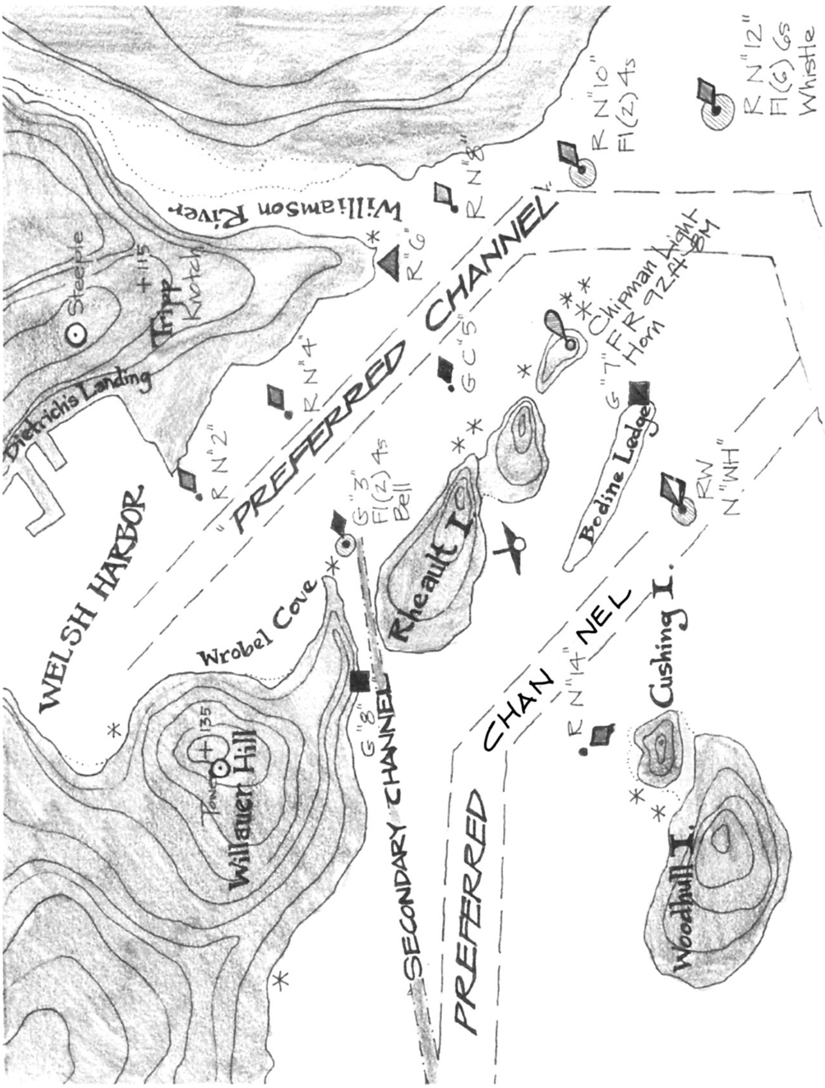
CHART SYMBOLS & AIDS TO NAVIGATION



The symbols on a chart tell the navigators what kind of object or buoy to look for to help estimate their position.

CHOOSING A CHANNEL

The color of a buoy can help the navigators choose the safest course for your boat. They just have to remember this simple rule: Keep red on your right when you're returning to harbor. Of course the opposite is true if you are leaving harbor.



SECTION 5 – LEADERSHIP

WHAT IS LEADERSHIP?

DEFINING LEADERSHIP

Leadership is exercised through chosen behavior, not intent, inherent talent, or knowledge-it is what we do that makes us effective, not who we are or what we think

- people feel well-led when their own strengths are emphasized, not the leader's-e.g. coaches and teachers who become friends, parents who show respect to their children
- leadership is most effective when any authority within the relationship is deemphasized
- leaders have been effective because they've helped to identify opportunities,
  not because they've given directions
- the follower's behavior is as important to the success of the relationship as the leader's
- anyone can be a leader if they are willing to focus on their followers, their task and the process

Leadership Brainstorm – Journal Topic

Think of someone who has played an important leadership role in your life. Choose a moment that stands out, and describe the leader's observable behavior: What did she do? What did he say? How did he say it? How was she speaking and standing? What expression was on his face? How did it feel to be led that way?

THE PRACTICES OF EXEMPLARY LEADERSHIP

The following uses the precepts of Kouzes and Posner's Team Leadership Practices Inventory.[i] Their definition of leadership is "The art of mobilizing others to want to struggle for shared aspirations." Note that if you delete "want to" from that definition, you are left with a style that depends on power and authority, which no one really has in peer leadership situations. Even when power and authority are present, effective leaders don't rely on them much. Try to keep the following characteristics in mind on days when you are captain, and see how you can apply them to your leadership.

Challenging the Process

Searching for opportunities: seeking challenges, finding novel ways to solve problems, utilizing a wide range of resources within the group

- Experimenting and taking risks: willing to take initiative and make mistakes

Inspiring a Shared Vision

Envisioning the future: creating an ideal vision of what a group or the day can become

- Enlisting support: communicating the vision with conviction and passion and getting people excited about the possibilities

Enabling Others to Act

Fostering collaboration: involving the group in a spirit of trust and respect by offering choices and sharing decisions

- Strengthening others: showing confidence by supporting the decisions of others and making each individual important and powerful

Modeling the Way

Setting an example: demonstrating commitment to the group's values or charter-showing ability as a follower

- Setting achievable, incremental milestones: making sure (through reflection and discussion) that everyone understands each step towards the goal

Encouraging the Heart

Recognizing contributions: showing appreciation for individuals' involvement and appreciating the extraordinary

- Celebrating accomplishments: making sure that team members share in the rewards of their efforts

EXEMPLARY LEADERSHIP – JOURNAL TOPICS

"If you want to be a more effective leader, then develop your values and align your behaviors with them."[ii]

When you see someone exhibit good leadership, see if anything she did fits into one or more of these practices.

- Why was it effective?
- Would you do it the same way?
- How can it be done differently and still be effective?

- How might a different situation have made a different set of actions more effective?

Of the other people in your group, consider who are the most and least effective leaders. What are the primary observable differences between them? Why are these characteristics important to you?

Which of these practices do you do well-maybe without even having to think about it?

Which of these practices would you like to incorporate more into your style? How can you make sure that you do?

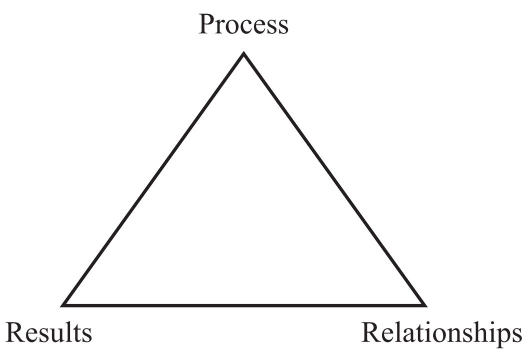
DIMENSIONS OF SUCCESS

The premise of this model is that everyone's leadership style is informed by their definition of success.

Results-oriented people will emphasize the concrete, measurable outcomes at the end of the day: miles covered, peaks bagged, etc.

Process-oriented people will emphasize the method carried throughout the day: logical and efficient navigation, information-sharing, decision-making, etc.

Relationships-oriented people will emphasize the human factors: communication, facilitation, emotional safety, etc.



Groups whose members have a balance of these areas of focus will feel successful most of the time. Groups that have an imbalance will leave some people entirely satisfied while others are consistently frustrated. Such a group will need some people to adopt the missing functions. Importantly, the best leaders are not those whose indifferent preferences land them in the middle of the triangle. More often, they are open-minded people with strong preferences who know how to balance the skills and preferences of the group as a whole.

Leaders should understand their own preference and how it affects their choices in leadership style.

A **relationships-oriented leader** will be inclined to adopt a supportive, facilitating role. Her implicit assumption is that as long as everyone is focused on communicating well, treating each other well and feeling emotionally safe, everyone will feel successful by the end of the day. This leader needs to consciously emphasize technical skills and goal-setting in her approach.

A **process-oriented leader** will be inclined to adopt a coaching, teaching role. His implicit assumption is that as long as everyone is gaining skills hand-over-fist and conducting the day with great craftsmanship, each day will feel more successful than the last. This leader needs to consciously emphasize facilitation and long-term goal-setting in his approach.

A **results-oriented leader** may find it difficult to step back at all, and when she does she will be inclined to adopt a delegating role. Her implicit assumption is that things are going great as long as everything is happening approximately as she would have made it happen if she were still directing. This leader needs to emphasize the larger outcomes of learning through experimentation in her approach.

* Adapted from *Facilitative Leadership: Tapping the Power of Participation.* Interaction Associates, LLC 1988, 1991.

DIMENSIONS OF SUCCESS – JOURNAL TOPICS

- Consider a moment of the day (or the course) that was challenging for your group.
- In what ways was this moment successful or unsuccessful for you? Why?
- If you had complete control over the situation and everyone in the group, how would the challenge have been met differently?

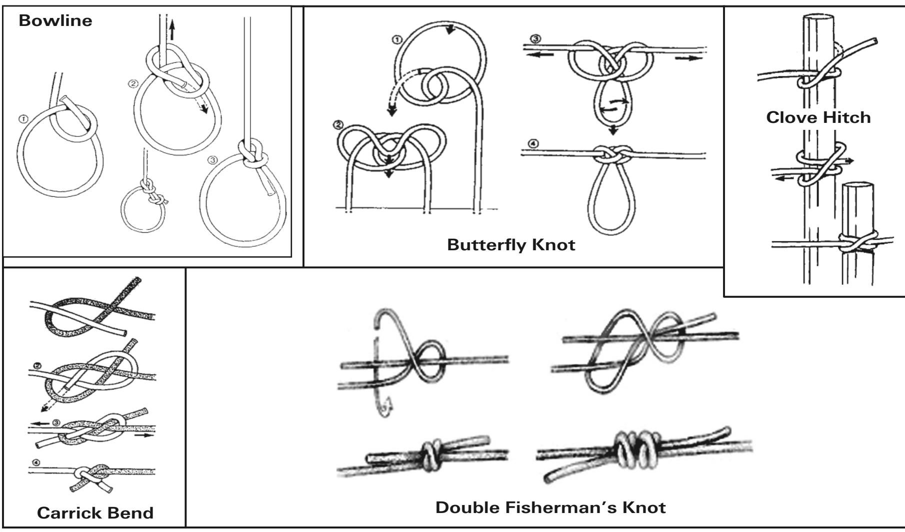
When groups find themselves challenged, it is helpful to take a few minutes to review the following questions:

- Does everyone understand the group's goal right now? If not, the group needs to reach agreement before going on.
- Does everyone agree to the same strategy for meeting that goal? Reach agreement before going on.
- Are there any missing functions in the group? How can the missing functions be filled?
- Can you think about any struggles you have had at home, work or school where having a quick discussion like this might have helped? How can you make that happen?

SECTION 6 — RELATED TOPICS

KNOTS

Knots are essential to your safety in the mountains and on the sea. You will need to learn the knots shown in the diagrams below. For further reference, please see: *The Complete Book of Knots*, by Geoffrey Budworth



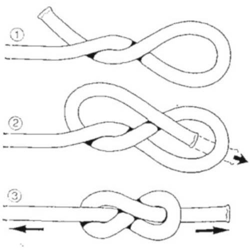


Figure 8

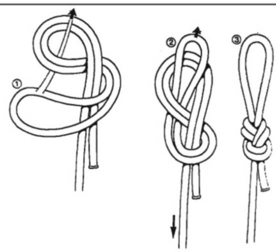
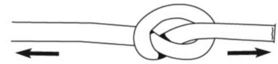
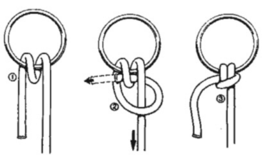


Figure 8 on a Bight

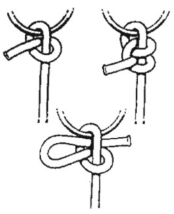


Overhand Knot

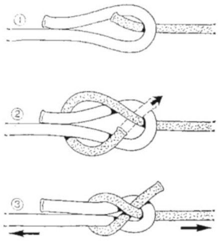
Trucker's Hitch



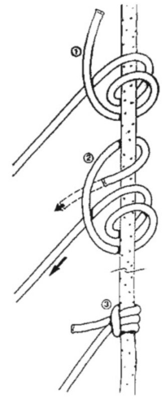
Fisherman's Bend



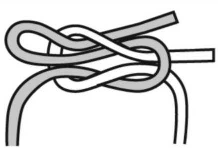
Half Hitch



Sheet Bend



Rolling Hitch



Reef Knot (Slipped)

WEATHER

Weather is a huge topic on which many tomes have been written. Rather than try to summarize this subject, we have assembled some basic information on common weather trends, weather rules of thumb, and understanding weather forecasts. For more detailed information, read the weather book in the boat's library, or talk to your instructors.

TYPICAL WIND PATTERNS IN OUTWARD BOUND CRUISING AREAS

The coast of Maine in summer:

On the coast of Maine during the summer months, the wind typically blows from the southwest in the afternoon in fair weather, because of the sea breeze that develops as land heats up. If the wind varies from this, it means that a weather system is coming through, or has come through that will affect your wind and weather.

Florida Keys and the Gulf of Mexico in winter:

The Florida Keys and Gulf of Mexico are affected by the Easterly transatlantic Trade Winds throughout the winter. This means that the wind will typically be blowing from the east, although it varies from northeast to southeast. If the wind varies from the easterly quadrant, it means that another weather system is coming through, or has come through that will affect your wind and weather.

Sea Breeze

Land heats up faster than water. A sea breeze is created as warm air over the land rises and is replaced by the cooler air moving from over the ocean. On sunny days, it will pick up by early afternoon and is heralded by formation of cumulus clouds over the shoreline.

Land Breeze

As the air over land cools more quickly than air over water, in the evening, it becomes heavier and flows out over the ocean in a light but constant breeze. The dissipation of cumulus clouds over the shoreline at sunset forecasts a night land breeze.

WEATHER RULES OF THUMB*

Weather can be expected to get worse when: *Cirrus* clouds thicken and lower; There is a Halo around the sun or moon; *Altocumulus* or *Altostratus* clouds appear to the west; Clouds at different heights are moving in different directions; *Cumulus* clouds build in height; *Cumulus* clouds do not decrease in size when daily heating stops; Lightning or rainbows are to the west; Winds are backing (counter-clockwise); Winds are from an easterly direction (especially on the East Coast); Temperature increases during the evening; Temperature is abnormally warm or cold; Atmospheric pressure falls steadily; a *Cold Front* or a *Warm Front* is approaching.

Weather can be expected to improve when: Cloud bases increase in height; Lightning or rainbows are to the east; Winds are veering (clockwise); Winds are light and from the west; Atmospheric pressure rises; a *Cold Front* has passed.

Weather can be expected to remain fair when: There are scattered *Cumulus* clouds in the afternoon; the number of clouds is decreasing; red sunset in clear sky, Winds are light and from the west; pressure is steady or rising.

Buys Ballots Law*

Air moves from areas of high pressure to areas of low pressure. Once the air begins to move, however, the Coriolis force gets involved and deflects the air to the right in the Northern Hemisphere. The result is circular winds around areas of high and low pressure. As you may remember, winds blow clockwise and outward around the center of a high-pressure system (in the Northern Hemisphere) and counterclockwise and inward around the center of a low-pressure system (in the Northern Hemisphere).

Buys Ballots Law allows a weather observer to locate the center of a low-pressure system, which can be very useful in determining safe courses and route planning. The law states that if an observer in the northern hemisphere faces directly into the wind created by a low pressure system, the low's center will bear from 090º to 135º relative (that is to the right and slightly behind the observer). These directions are reversed in the Southern Hemisphere.

· Used by permission from Ocean Classroom Foundation.

Wind

"System wind"– wind that is a result of passing air masses-is locally predictable. If you know whether the center of an air mass is going to pass to the north or south of your location, you can forecast which way the wind is going to shift.

The rule is this:

- If a high or low passes north of you, the wind will veer (shift in a clockwise direction, i.e., SW to NW).

- If a high or low passes south of you, the wind will back (shift in a counterclockwise direction, i.e. SW to SE).

To see why this rule works, move a picture of the "classic low" past an imaginary point and see how the nearest wind arrows change direction as the storm moves.

UNDERSTANDING WEATHER FORECASTS:

Forecasts on the weather radio are often read quickly. If you can take note of several important pieces of information, the forecast will help you plan your day and pick your anchorage. Comparing several forecasts over time, can also help you predict what a low-pressure system near you is doing. The key things to note on a forecast are:

Date and Time:				
Wind Direction:				
Wind Velocity:				
Seas:				
General Weather:				
Visibility:				

ANCHORING

CONSIDERATIONS

- Is the anchorage sheltered from the current winds and seas, and do you expect it to be so throughout the night?
- Is it well out of any channels or likely traffic lanes? Fishermen get up even earlier than we do!
- What is the holding ground like? Some areas, like Valley cove on Hurricane Island or Black Island in Casco passage, are too rocky and silty to hold an anchor reliably. For a peaceful night, seek thick, gray, dense, sucking, putrid-smelling mud. It's what sailors dream about. Your chart indicates bottom characteristics in *italic sans serifs*. Check Chart 1 for translation.

- What will the tide do throughout the night? The tide will affect both your scope ratio and the current will affect what direction you hang on your anchor.
- Is there room to swing in all directions? Remember that the scope you let out on the rode is the radius of the boats circle. A deep anchorage requires more room to swing than a shallower one. Consider two anchors if space is tight.
- Are there houses on the nearest shoreline? Are you so close that people jumping into cold water at dawn will disturb them? How about other anchored or moored boats?

THE METHODS

Once you have chosen your anchorage, you must then set the anchor(s) in whatever way will give you the most confidence. Here are some basic outlines.

Single anchor

This is the simplest technique and allows the anchor to turn and reset itself as the wind and tide change, but has the disadvantage of having the greatest swing area.

1. Sound the area thoroughly: more than one crew has been surprised in the night by a two foot rock next to a ten foot sounding.
2. Prepare the anchor (this can be done while still sounding) by hanging it outboard of the gunwale on one fluke. Lift the chain and lay it on the gunwale so that it can be picked up and dropped with the anchor causing no damage to the boat.
3. Head up into the wind (or lacking wind, the tide) and stop.
4. Lower the anchor to the bottom, making sure the trip line (if available) is untangled and the toggle floating.
5. Move the boat backward, feeding out anchor rode. The total rode let out should be equal to five to seven times the depth of the water at high tide.
6. Cleat it, being sure to keep fingers from being pinched as the rode comes tight.
7. Gently feel the anchor rode as the boat comes tight on it: the more backward momentum, the more likely the set. You are feeling for the rode to come tight, stretch steadily, and rebound gently. Any jerking or bouncing of the line, or a failure to come tight, tells you that the anchor is dragging on the bottom.

Two anchors opposed

With this method, you reduce the boats swing area to its own radius by cleating both anchors to the bow. This allows the boat to still swing with the wind and tide, but if it spins too many times, you will have some untangling to do in the morning. Once the rodes are twisted, it's hard to reset an anchor if it drags. If you cleat one anchor at the bow and the other to the stern, you eliminate the swing entirely. This could be an advantage in an exceptionally tight spot, and is the best technique when setting one anchor ashore. Be aware that in a crosswind and beam sea it can be very uncomfortable for the boat not to swing!

1. Sound the area thoroughly.
2. Head up into the wind or the tide and stop.
3. Set the main (bigger) anchor as for a single anchor.
4. Let out the remaining rode and drop the second (smaller) anchor. (This is an excellent time to double-check that the bitter end is fast to the mast!)
5. As you pull back up on the main anchor rode, set the second anchor.
6. Cleat them off with just enough slack to allow for a rising tide, if necessary.

This technique works well with two boats in convoy. Both boats set main anchors and raft up in the middle. It is best to prevent the rodes from twisting during the night: the anchor watch must be prepared to take up slack to keep this from happening because twisted rodes interfere with both boats' ability to maneuver.

Two anchors to windward

This is a heavy weather technique that involves some risk. The anchors need to be set far enough apart that they do not foul each other, but not so far apart that the tension on one anchor actually increases the tension on the other. Unless the wind's direction stays constant, the boat will hang on one at a time anyway, but the second is already set as a spare if necessary. Arguably, the second anchor being preset gives you fewer options and a longer reaction time if they both should begin to drag. As with all two-anchor methods, twisted rodes are a significant risk.

1. Sound thoroughly.
2. Set the main anchor.
3. Row to a spot off to the side, but not further to windward or leeward of the main anchor, and lower the second anchor.
4. Set the second anchor.

An ideal heavy weather anchor system can be achieved if two boats are in convoy. Both boats set their main anchors to windward, and one boat sets up a two anchors opposed system. Once rafted, these boats will be stationary and protected by two big anchors in the direction of the expected gale. The boats can break raft easily without moving anchors: the boat with just the main anchor down pulls in some rode and recleats.

Anchoring with a line ashore

Anchoring with line ashore: a simplified, step-by-step method for deciding where to drop the anchor.

1a. Consult tide table and determine how many feet of water will be lost between now and the next low tide. (West of Schoodic 12 feet total, 2 feet per hour works. The law of twelfths and spring and neap tide variations can be taught later after the basics of anchoring are understood.)

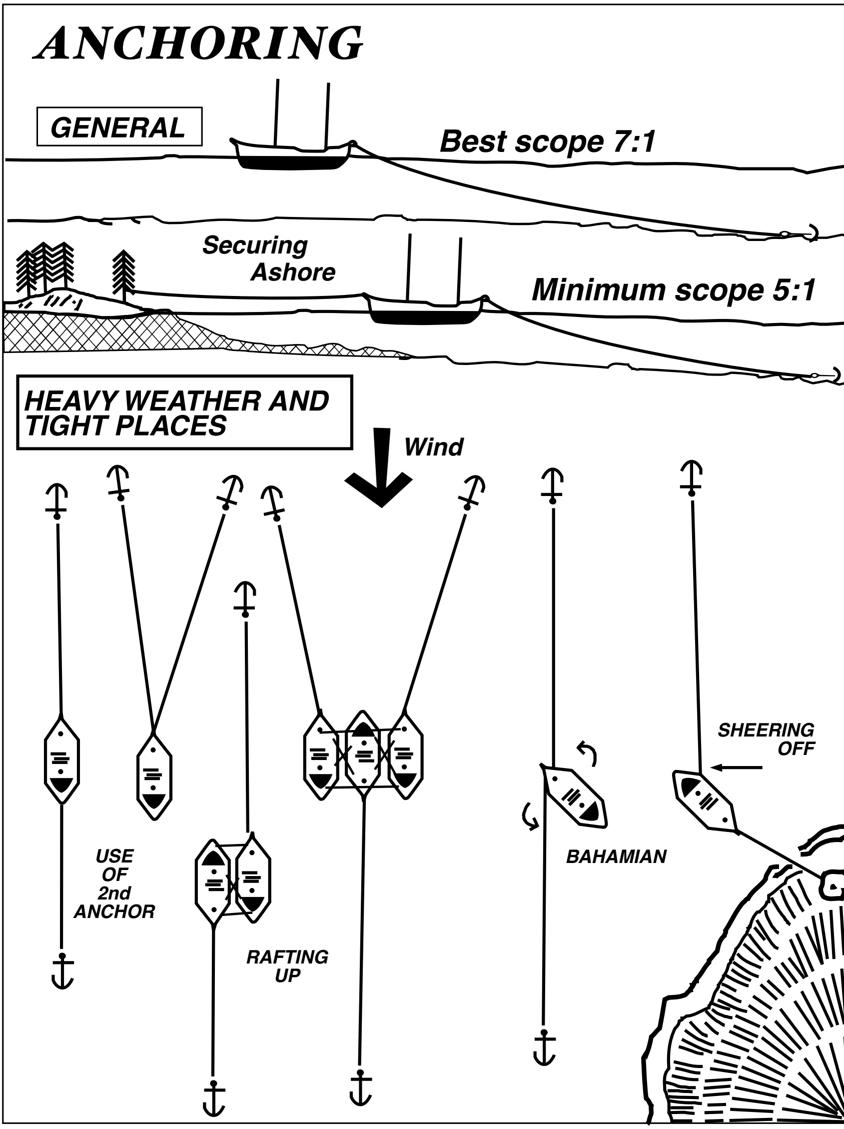
1b. Add 4 feet of water for the draft of the boat plus some to spare. This number is the least depth of water we can put the **boat** in now and not have it ground out at low tide.

2. Once in the protected cove, get out oars, take down sails, take out rudder. Have someone ready to take sounding. Have the anchor ready with someone holding it over the side.
3. Row close to shore at desired landing point. Turn boat so that bow points straight out from shore.
4. Start taking sounding, moving **very slowly** out from shore, until the depth of water needed for the boat is reached. (The number calculated in 1. above).
5. Go two boat lengths further and drop the anchor. (Why this works: if the depth of the spot found in 4. is 16 feet of water, in order to get the 5:1 scope, there should be 80 feet of rode out. Two boat lengths is 60 feet. The boat will inevitably drift **at least** the other 20 feet during the process of deciding to drop the anchor and following the command to drop anchor.)

Note that this system minimizes the likelihood both of anchoring in too little water for the low tide, and of running out of line because the anchor is too far from shore.

WEIGHING ANCHOR

1. Make sure you have a mode of power ready: rowers with oars ready or sails with sheeters and cleaters ready, or both.
2. Pull up to the position of the anchor. In heavy wind, it is helpful to have the rowers assist.
3. Make one last check that everything is ready and then lift the anchor off the bottom, pulling it smoothly up to the surface.
4. Get the boat underway while stowing the anchor: cleaning off any mud, making sure the rode is flaked in the bow well, and the trip line coiled neatly. Here's another chance to check that the bitter end is tied off!


ANCHORING
GENERAL
Best scope 7:1
Securing
Ashore
Minimum scope 5:1
HEAVY WEATHER AND
TIGHT PLACES
Wind
USE
OF
2nd
ANCHOR
RAFTING
UP
BAHAMIAN
SHEERING
OFF

THE INTER-TIDAL ENVIRONMENT

LIFE BETWEEN A HARD PLACE AND A ROCK

Low tide may expose marine plants and animals to air, sometimes for hours at a time. There are many environmental conditions that shape the life in the inter-tidal zone, such as:

Overheating and Drying Out

On a hot summer day, exposed inter-tidal creatures may be affected by the sun.

Pounding Water

When storm-driven waves hit the shore with sledgehammer blows, residents of the open coast must hang on for dear life.

Changes in Salinity

Marine animals trapped in tide pools can suffer a reduction in salinity, or salt content, when fresh water intrudes into the inter-tidal zone during heavy rains. Salinity can also increase to dangerous levels when water in tide pools evaporates under the hot sun.

Predation

Exposure at low tide makes marine animals vulnerable to predators such as seabirds and land mammals.

Adaptation

Most important, plants and animals, through natural selection, have developed adaptations that allow them to live in this difficult neighborhood.

THE INTERTIDAL CONDOMINIUM

The top floor is the **Splash, or Spray Zone**. Only the splash from waves at high tide moistens these rocks. Not many creatures can live here successfully.

Just below is the **High Tide Zone**, slightly more hospitable because it gets submerged during high water. A few small barnacles, some limpets and a handful of algae species can make a living here. But it's still a hard life, thanks to pounding waves and long periods of exposure to air.

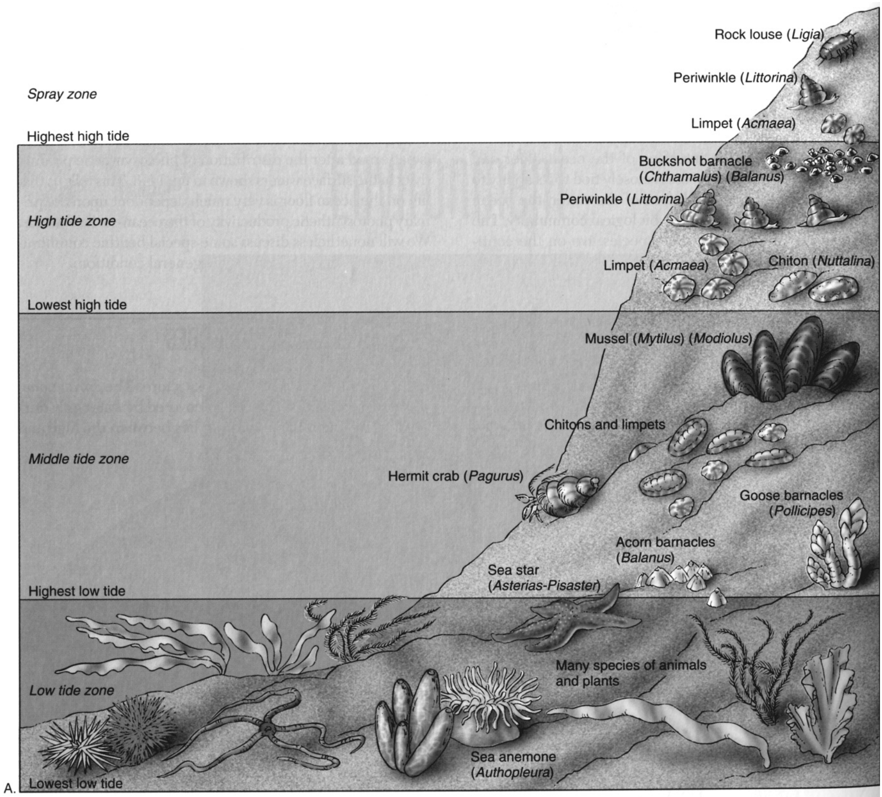
The next level down in this condominium is the **Mid Tide Zone**. It has many more residents than the floors above, because it stays wetter longer. Although this zone gets exposed by most low tides, it's covered by most high tides. We notice more seaweed, a variety of shellfish, and even some sea anemones.

Finally, is the **Low Tide Zone**, the condominium's ground floor, which is packed with residents. That's because this zone stays moist. Even during the lowest tide, there are cracks and crannies, channels and tide pools where water remains. Here, plants and animals can comfortably await the returning tide.

Shores exposed to the open sea get hammered by storm-driven waves, especially in winter. The residents need some means of hanging on. Protected coasts, like those of bays and harbors, are likely homes for more vulnerable marine creatures.

So all these factors will determine who can survive there and who cannot:

- what a particular piece of shoreline is made of,
- whether it's protected or exposed,
- how it's shaped, and
- which floor it occupies in the intertidal zone.



Credit: *Introduction to Oceanography* by Harold Thurman, Prentice Hall.

WHO LIVES IN THE INTER-TIDAL ZONE?

ALGAE

Members of the **green algae** are delicate and sheet-like. A good example is sea lettuce. Species of green algae often create thick shimmering carpets in shallow, calm areas, but they have short lives.

Species of **red algae** refuse to be confined to one color. Besides deep red, they may come in pink, purple, brown or even green! Some species feel smooth and slippery others feel rough. They may have stout, thick blades, or tiny branches as fine as lace. Red algae thrive successfully in the intertidal zone, down to depths over 100 feet.

The **brown algae** are actually brown! They include the yellowish-brown rockweeds that often smother the shore in the mid to low tide zones, and the giant kelps which form huge subtidal forests standing up to 100 feet tall.

PHYTOPLANKTON

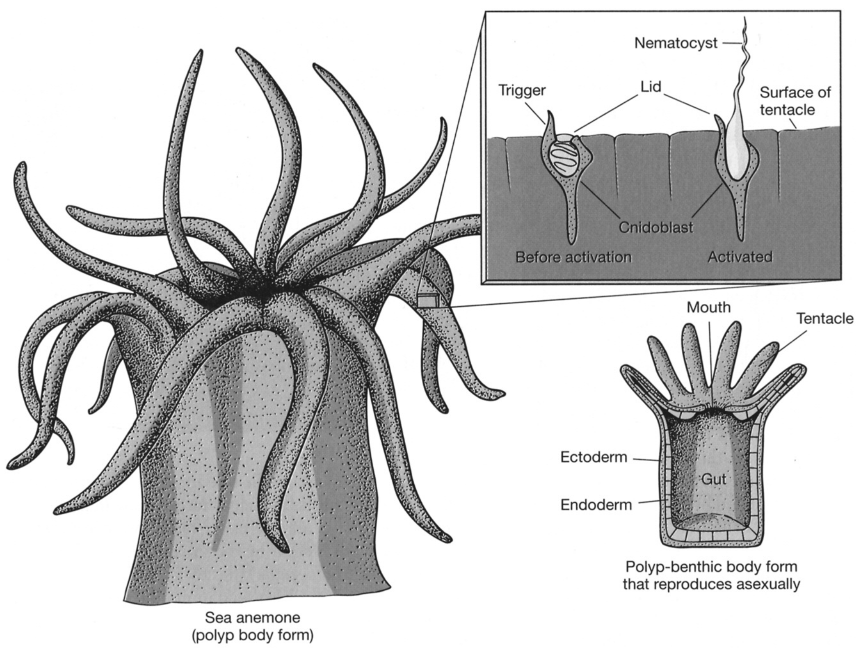
These tiny forms of algae float on and near the ocean's surface, basking in sunlight that they need for photosynthesis. These tiny plants, like the diatoms, are sometimes called the "meadows of the sea." They're grazed upon by microscopic marine animals called zooplankton which are in turn eaten by larger forms of sea life. Kelp, surf grass and encrusting seaweeds, are grazed upon by intertidal animals and also create a cool moist place for crabs and other free-moving animals to find shelter during low tide.

CNIDARIANS

One example of a Cnidarians is a sea anemone. Anemones are basically cup-shaped, with stinging tentacles arranged in a circle around a central mouth. So the anemones, flower look-alikes, are predatory animals; they paralyze their prey using special stinging cells.

If you lightly touch the tentacles; they pull on your finger, like sandpaper. Microscopic darts are being fired into your finger.

Burrowing anemones live half buried in the sand or gravel. Members of other species are out in the open, with stalks anchored firmly on the hard bottom. They can change their location by creeping slowly with the base of the stalk, known as the pedal disk.



Credit: *Introduction to Oceanography* by Harold Thurman, Prentice Hall.

CRUSTACEANS

The Crustaceans are animals with jointed legs. Crabs, lobsters and shrimp are all crustaceans, but it's the crabs that we find easily here on the rocky shore.

The crab has an exoskeleton, and it can't stretch as the animal grows bigger. Crustaceans have to shed their armour now and then and grow a new set. This is called molting.

This is not the case with the **Hermit crab**, where the lower half of the hermit's body is tucked inside the shell, wrapped neatly around the spirals.

A **true crab** is one that doesn't live in a snail shell. It has a flat, oval-shaped body called a carapace, and five pairs of legs, four mainly for walking, and one pair ending in pincers.

MOLLUSKS

A **mollusk** is a soft-bodied animal with a shell on the outside (sometimes on the inside!), and strong muscles that hold the shell closed, or clamp the animal firmly against the rocks. Clams, mussels, snails, sea slugs, squid and even the smart octopus, are all molluscs.

We find plenty of mussels; they like wave action because waves and surge bring them food. Thick, short threads stretching between the shells and the rock are called byssal threads.

Barnacles are also mollusks found up high, clustered on dry rocks. Barnacles attach to a hard surface when they're young, and stay there for life. They can close their shell plates tightly when they're exposed to air, pounding waves, and temperature changes during low tide.

Most barnacle species usually live in large crowded colonies, sometimes attaching to other animals like mussels.

Marine snails

We also find lots of marine snails living in a single shell. Some are cone-shaped; these are the limpets. But most shells are shaped like spirals.

Snails eat by scraping algae off the rocks with a very rough tongue called a radula.

A nudibranch is just a snail with no shell to hide in. Nudibranch means 'naked gill.' It's very poisonous, and the bright colors are really a warning to its enemies.

The **octopus** has a color and pattern for every mood. These costume changes are also handy for camouflage against different backgrounds. The octopus and squid are both molluscs, but the squid carries its shell inside its body, and the octopus has lost it altogether, just like the nudibranch has.

ECHINODERMS

Echinoderms have brittle plates covered with a soft layer of skin. The plates can be large – like the skeleton of a sea urchin – or hardly visible at all in an animal like the sea cucumber.

Most of the sea stars we see are called ochre stars. They have five thick arms (rays). On the underside are tiny legs, called tube feet. Each one has a little suction cup at the end. This is how the star fastens itself to the rocks and also how it creeps around.

If you count the rays on a sunflower star, they come in multiples of five, unless the star has lost an arm or two to some enemy. In that case, it will soon grow new ones.

It feeds on animals such as molluscs by using its tube feet to pry the shells apart. Eventually the star will inject its stomach right between the shells and digest the mussel's soft parts.

Urchins like open coasts with lots of wave action, but they tend to camouflage themselves by pulling seaweeds, pebbles and bits of shell over their spines. Urchins chisel the rock away with its short spines, and also with its teeth.

The five tiny white teeth arranged in a circle (sometimes called Aristotle's lantern), are also handy for scraping away at algae, its favorite food.

DISCUSSION

1. What marine life have you noticed here?
2. What adaptations for life in the intertidal zone can you identify at this location?
3. Why should we be interested in the ecology of a sea shore?

OCEAN POLLUTION

POLLUTED RUNOFF

Polluted runoff is all of the contaminated water that flows off of the land - farms, yards, roads, and developed areas - within the watershed.

For U.S. coastal waters, polluted runoff has become the number 1 water pollution problem. Many beaches, such as those in Southern California, have coastal waters unsafe for human contact after EVERY runoff-generating rain. To solve the problem of polluted runoff, we need to change many of our individual and societal lifestyle habits.

Big contributors to polluted runoff: agriculture, construction sites, vehicles, sprawling development and parking lots.

Sources of polluted runoff:

- Agriculture's heavy use of chemical pesticides and fertilizers.
- Poop from our main meat source animals – chickens, cattle and pigs.
- Oil, antifreeze, tire particles and other toxins from our nation's 100+ million cars and trucks.
- Air pollution that settles in the coastal watershed and washes into the storm drain system.
- Excess sediment from construction projects.
- Poor urban planning and a propensity for runoff-producing urban "sprawl."
- Few natural green areas are preserved to allow rainwater to soak into the ground.
- Residential and commercial properties that channel all rainwater into the concrete storm drain system instead of allowing the water to soak naturally into the ground.

WHAT CAN YOU DO?

- Plant - don't pave.
- Fix your car leaks, or better yet, don't own a car. Use mass transit and your bicycle instead. More oil ends up in the ocean from runoff than from tanker spills.
- Use non-toxic household products.
- Avoid fertilizer and pesticide use on your own lawn
- Clean up after your dog
- Say NO to Styrofoam
- Never wash your driveway or other pavement (or impermeable surfaces) with a water hose. Sweep it up instead and if you need to use water, use a bucket and use water sparingly.
- Reduce your water use, especially during heavy rain events when local sewage treatment plants get overloaded. Postpone your washing machine loads when it's raining.
- Exercise your civic and political rights to make sure that local development does not result in more polluted runoff in your watershed.

Participate Politically

Exercise your political rights to help protect your coastal environment! Be registered and vote. Voice your opinions to your political representatives. Be a part of our democratic system. Read Surfrider's latest Federal and State legislative update.

Register and VOTE!

Your vote counts. Ask your post office or any voting adult about registering.

Have a Low-Impact Lifestyle

The American lifestyle is anything but environment-friendly. Our preferred means of transport, our diet, and our shopping habits have huge negative environmental impacts, especially for our coasts and oceans.

Here are a few tips to lessen your negative impact on our coasts and oceans:

- Conserve water wherever you are.
- Reduce your electricity & other energy usage.
- Eat wisely; don't eat too much meat.
- Minimize use of motor-powered things like cars and jetskis.
- Purchase few material objects.
- Practice environmentally friendly lawn care.

DISCUSSION

1. What kind of pollution have you seen at the beach?
2. What things can you do as an individual to reduce coastal pollution?

From: The Surfrider Foundation

NUTRITION

"I think", said Christopher Robin, "that we ought to eat all our provisions now, so we won't have so much to carry." – A. A. Milne

- **Nutrients** include carbohydrates, proteins, fats, vitamins, and minerals. They are found in a variety of foods and serve different functions in our bodies.
- **Carbohydrates** provide the most efficient source of energy to the body. When you are hydrated, carbos are easy to break down and they go to work quickly. Our most common sources of carbohydrates are the sugars and starches found in grains, pastas, crackers, dried potatoes, cereals, and cocoas. Simple carbos (sugar) break down quickly, like kindling in a fire; complex carbos (starches) break down slowly, like a big log in a fire. Sugars give us quick bursts of energy; starches provide energy for hours.
- **Proteins** are used to build muscle tissue, hormones, enzymes, and antibodies. They can serve as an energy source once carbohydrate

sources are exhausted. Our protein comes from dairy products, grains, legumes, fish, nuts, seeds, and occasional meats.

- **Fat** provides the body with additional calories for energy and gives us the feeling of being full. It is the most calorically dense food type. We get our fat from nuts, cheese, oils, peanut butter, fried trail foods, margarine, and butter.
- **Vitamins and minerals** serve a variety of functions in our bodies. Some help release energy from food while others maintain bodily functions. For example, vitamin A helps with night vision, while sodium provides electrolyte balance. We get vitamins and minerals from occasional fresh fruits and vegetables and by eating a wide range of food types each day.
- **Water** is an integral part of healthy nutrition. Drink enough so that your urine is clear and copious all day long.
- **Changing caloric needs** are a result of different climates and activities, as well as body weight and metabolism. Cold weather demands calories for the body to burn for heat production, as does strenuous exercise. In general, the average summer wilderness experience (backpacking, kayaking, etc.) requires that the average teen consume between 2500 and 3500 calories per day. A more strenuous activity, such as snow camping or mountaineering, requires between 3000 and 3700 calories. The most strenuous activities, such as extreme mountaineering, call for 3700-4500 calories per day.
- **The Outward Bound** diet is largely plant-based for several reasons:
  - Plant food requires less energy, water, and natural resources to produce than meat. It is a more ecologically friendly diet.
  - The average American diet is too high in fat and calories, and especially high in saturated fat, which is routinely found in animal products.
  - Fresh meat has a short shelf life and is impractical in the field.
  - Canned meat is heavy and the can must be carried out. Meat also attracts animals more than other food.

Resources:

Good Food for Camp and Trail, Miller, Dorcas C.

GLOSSARY

There are many more sailing terms than these. See *Sailing as a Second Language* by Fred Edwards, which is in the boat's library.

Abaft: Behind. (The wheel is abaft the main mast.)
Abeam: To the side - perpendicular to the keel
Adrift: Broken loose from its mooring, cleat, etc
Aground: When the ship's keel is touching the bottom
Ahead: In front of the ship
Aft: Towards the stern
Amidships: The middle of the ship
Astern: Behind the ship
Auxiliary: A sailing vessel that has an engine is said to have "auxiliary" power
Beam: Width of a vessel at the widest point
Beam reach: Sailing with the wind from the side, perpendicular to the keel
Beam sea: Seas running from the side, perpendicular to the keel
Bearing: A compass reading or line that describes the direction of an object relative to the boats position
Beat: To work to windward by tacking
Before the wind: To sail with the wind from astern
Below: Beneath the decks (one never goes "downstairs.")
Bend: To tie two lines together
Bend on: To secure a sail to a boom or spar
Bilge: Lowest, inside part of the hull where water collects
Bitter end: The extreme end of a line
Boat: Small open vessel (see "ship")
Boom: Large spar to which the foot of the sail is secured
Bow: Forward end of a ship or boat
Bulkhead: Any partition or wall aboard a ship
Cast off: To let go. Depart.
Chafe: Wearing of the sail cloth or part of the rigging due to rubbing and friction
Chafe gear: Canvas or old cordage used as protective gear to minimize chafe
Chart: A map-like reference that shows details on water (a map shows details on land)
Cleat: A horned metal or wooden piece to which lines are secured
Clew: Lower, outboard or aft corner of a sail
Close hauled: Sailing as close to the wind as possible, with the sails sheeted in tight
Close reach: Sailing with the wind forward of the beam and sails slightly eased

COG "Course Over Ground": the direction of actual travel over the sea floor
Come about: To bring the vessel from one tack to another, with the bow crossing through the wind
Compass: Navigational device housed in a binnacle, indicates direction
Compass rose: Used as a reference for true north and magnetic north on a chart
Course: The specific direction from where you are to where you want to go
Cringle: A ring sewn in a sail through which a line may be passed
Danforth: A patented anchor that utilizes design rather than weight for holding power
Dead ahead: Directly in front of a vessel Deckhouse: Cabin that projects above deck
Depthsounder: Measures the depth of the water beneath the keel. (Also called a fathometer.)
Deviation: Effects that magnetic materials aboard a vessel have on the ship's compass, calibrated at different headings
Displacement: weight of the water displaced by the hull
Ditty bag: A small canvas bag used to stow articles for sail repair or marlinespike seamanship
Dividers: Navigational tool used to measure distance
Down east: From New York to Canada, along the coast. Sailing coasters have always been bound "down east" when headed toward Maine and Nova Scotia. The most common explanation of the term is that the winds are generally more favorable for a ship headed in that direction, going down wind, and the coast runs more easterly than northerly in Maine and Canada
Downhaul: A line used to pull a sail down
DR "Dead Reckoning": a theoretical position based on time, course and speed from a known point
Draft: The depth the hull extends below the water's surface
Drift: The speed of the current in knots
Ease away: To slack a line slowly, under control
Ensign: The national flag
E.P.I.R.B.: Emergency Position Indicating Radio Beacon. This beacon can be activated manually or is automatically activated if the vessel should sink. It broadcasts over the frequencies used by commercial airlines and rescue agencies
EP: "Estimated Position" is the navigator's best guess of the boats position based on a DR plot and one

or more of the following: set and drift calculations, soundings, a single LOP or a running fix
Fake: One circle of a coil of line
Fall off: To change the direction of your boat, relative to the wind so that the bow is pointing further away from the eye of the wind. Same as to head down
Fathom: A measurement of six feet
Fix: The boats position established at a specific time with a high degree of accuracy
Following sea: Swells, or seas, that approach a vessel from the stern
Fore and aft: Parallel to the ship's keel
Forward: Toward the bow
Foul: When something is jammed or not running free
Foot: The bottom edge of a sail
Freeboard: The distance from the waterline to the deck or gunwale
Furl: To gather up and secure the sail after it has been taken in
Galley: The ship's kitchen
Ground tackle: Catch-all term for anchors, chain, etc
Gunwale: The upper edge of a small vessel's side
Gybing: To bring the wind to the other side of a ship by bringing the stern through the wind
Halyard: A line used to raise sails
Haul: To pull on a line, such as a halyard
Head: A ship's toilet and bathroom. Also, the top corner of a marconi rigged sail or the top edge of a gaff or sprit-rigged sail
Heading: The direction in which the boat is pointing
Head sea: When seas approach a vessel head on
Head up: To change the direction of your boat, relative to the wind so that the bow is closer to the eye of the wind
Heave-to: To stop a vessel's way by arranging the sails so that she will lie nearly head to wind and not have any forward movement - and be Hove-To
Heel: When the wind pressure causes a vessel to lean to one side
Helm: Steering apparatus of a ship, such as a tiller or wheel
Helmsman: The person who is steering a vessel
Hull: The body of a ship
Inboard: Toward the fore and aft center line of a ship
In company or In convoy: When two or more vessels are sailing within sight of each other, they are said to be in company. When they are traveling together they are "in-convoy"
In irons: When a vessel is stuck between tacks and the sails are luffing

Isobath: An underwater contour line that connects areas of equal depth
Irish pennant: An untidy loose end of line
Jaws: The forward end of the gaff or boom that forms a semi-circle around the mast to keep it in place
Jib: A triangular head sail
Keel: The principle longitudinal timber or backbone of a vessel
Ketch: A sailing vessel in which the main mast is tallest and foremost. The second mast, called the mizzen, is shorter and forward of the rudder post
Knot: Nautical mile per hour
Latitude: Parallel lines running horizontal on a chart
Lay: The direction of the spiral in a multi-stranded line
Lazarette: Crawl space located beneath the quarterdeck
Leech: The after edge of a sail
Lead line: A line used for sounding water depth
Lee helm: Tendency of a vessel to fall off the wind
Leeward: The direction opposite from which the wind blows (see windward)
Leeway: Drift to leeward
Line: A rope that has a function
L.O.A: Length overall
LOPs: "Lines of Position" are derived from either a range or a bearing. An LOP gives you not a point position, but a line on which you could be anywhere. Two LOPs that intersect give you a weak fix and three give you a very positive fix. By themselves, they can provide useful negative information
Longitude: Parallel lines running vertical on a chart, converging at the poles
Lubberline: A mark on the forward point of the compass, to show the helmsman how the ship is heading
Luff: When the sails flutter because the ship is sailing too close to the wind. Also, the leading edge of a sail
L.W.L.: Length at water line
Main sail: The largest after-most sail on a sailing vessel
Main sheet: Line which controls the lateral motion of the main sail
Make fast: The act of belaying or securing a line to a cleat or pin
Marline spike: Long metal spike of hardened steel to aid in splicing and seizing rope or wire
May day: International distress signal that is reserved for instances of grave and imminent danger
Nautical mile: Equal to 6076 feet, 1.15 statute miles or 1 minute of latitude
Oil skins: Foul weather gear
Oily: Referring to bad weather and seas

Outboard: Toward the side of a vessel, away from the center
Painter: A bow line on a small boat
Parallel rules: Navigational tool used to transfer parallel lines
Peak: The upper, after end of a gaff rigged sail
Pinching: This happens when the boat is pointing too close to the wind and therefore you are barely moving forward. To correct this you need to fall off a few degrees to regain boat speed
Pitch: Vessel motion about the fore and aft or longitudinal plane
Plot: Notations on the chart showing the boats course and speed
Point: Eleven and one quarter degrees on the compass
Port: The left side of a vessel, when you are facing forward
Preventer: A line or block and tackle which prevent a boom from swinging free
Quarter: The aft "corners" of a vessel, between abeam and astern
Range: A bearing that intersects two objects and the viewer's eye, for example, a nun with a lighthouse directly over it in the background. An LOP may be plotted without taking a bearing. Also used to mean the distance to an object, especially a radar target
Reach: Sailing with the wind abeam
Reef: To shorten, or reduce the size of a sail, usually done because of heavy winds
Reef points: Short pieces of line attached to the sail used for reefing
Rode: Any anchor line or chain attaching the anchor to the ship
Roll: Vessel motion side to side pivoting on a point amidships on a vertical plane
Running: Sailing with the wind astern
Running rigging: Movable rigging, such a sheets, halyards, downhauls, etc. (as opposed to unmovable standing rigging)
Scope: Length of anchor rode, from the hawse pipe to the anchor, in relation to the depth of water, expressed as a ratio
Scantilize: To lower the peak of a gaff-rigged sail or remove the sprit from a spritsail to reduce its power.
Seize: To attach something by lashing it with line or wire
Set: The direction toward which current flows
Sheet: The line that controls the lateral movement of the sail, or the act of hauling in on the sheet
Ship: A seagoing vessel of considerable size, sometimes defined by its ability to hold a boat
Shrouds: Standing rigging that supports the masts laterally
Sloop: A sailing vessel with one mast

Spar: Wooden poles which the sails are secured to, including: Masts, booms, yards, bowsprits, jibbooms or gaffs
Spring line: A line used when securing alongside that leads forward from the stern or aft from the bow
Standing rigging: Any rope, wire or chain that does not move and whose function is to support the masts and other fixed spars
Starboard: The right side of a vessel, when you are facing forward
Stem: A piece of timber which rises from the fore part of the keel to form the bow
Step: To set a mast in place
Stern: The after end of a vessel
Stern-way: To move in reverse
Strike: The process of taking a sail down
Swinging room: The radius from anchor to stern of a ship
Tack: To bring the wind to the other side of the ship by bringing the bow through the wind. Also, the lower forward corner of a sail
Tackle: A line run through blocks to gain mechanical advantage (pronounced "Tay-kle")
Throat: Forward end of the gaff, and the related corner of the sail
Thwart: The seat in a skiff or dory
Topsides: Part of the hull that is above the waterline
Trick: The period of time or act of being at the helm ("a trick at the wheel")
Unbend: To untie
Underweigh: (or underway) A term used to describe a moving vessel
Variation: The angle between the magnetic north pole and the geographic (true) north pole
Weather helm: The tendency for a vessel to head into the wind
Weigh anchor: To raise the anchor from the bottom and secure it on board
Whipping: A method of sewing sail twine on the end of a line to prevent it from unraveling
Windward: The direction from which the wind is coming
Weather side: The windward side of a vessel
Yaw: Vessel motion side to side, pivoting about a point amidships on a horizontal plane
Yawl: Rigged like a ketch except that the mizzen is placed aft of the rudderpost.

RECOMMENDED READING

* Indicates books that are more relevant to the course

Boater's Bowditch: The Small Craft American Practical Navigator
by Richard K. Hubbard

Chapman Piloting
by Elbert S. Maloney

The Complete Book of Knot's
by Geoffrey Budworth

The Craft of Sail
by Jan Adkins

Endurance
by Alfred Lansing

First you have to row a little boat
by Richard Bode

Folklore and the Sea
by Horace Beck

Longitude
by David Sobel

The Marlinespike Sailor
by Hervey Garrett Smith

Navigation Rules- International-Inland
US Department of Transportation USCG

Ocean Almanac
by Robert Hendrickson

Oceanography and Seamanship
by William G. Van Dorn

Outward Bound USA
by Josh Miner and Joe Boldt

The Oxford Book of Sea Stories
by Tony Tanner

The Stars
by H.A. Rey

Two Years Before The Mast
by Richard Henry Dana Jr.

Weather for the Mariner
by William J. Kotsch

Service Project

Location: ____

Organizing Agency (i.e., US Forest Service, Department of Conservation, local nursing home, local land trust, etc.):

____

Number of Hours: ______________

Project Description:

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EXPEDITION PLAN

Day	Course Activity	Campsite
1.		
2.		
3.		
4.		
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9.		
10.		
11.		
12.		
13.		
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21.		
22.		
23.		
24.		
25.		
26.		

TIME, SPEED AND DISTANCE PRACTICE PROBLEMS

How many minutes are in the following...

1. 2.5 hours

2. 16 hours

3. 0.8 hours

4. 0.02 hours

5. 1 hour

6. 24 hours

7. 0.13 hours

8. 9.77 hours

[Answers: 1.) 150 2.) 960 3.) 48 4.) 1.2 5.) 60 6.) 1440 7.) 7.8 8.) 586.2]

How many hours are in the following...

1. 33 minutes

2. 9 minutes

3. 60 minutes

4. 90 minutes

5. 19. 65 minutes

6. 22,000 seconds

7. 60 seconds

8. 180 minutes

[Answers: 1.) 0.55 2.) 0.1 3.) 1 4.) 1.5 5.) 0.33 6.) 6.1 7.) 0.02 8.) 3]

PRACTICE DR PROBLEMS

1. You are sailing along at 3 knots and the bow watch spots breaking water "dead ahead" at approximately 1NM away. If you did nothing and continued sailing along at the same speed, how long would it take to run into the rocks?

2. The captain asks you how long it will take to travel 6.5NM at your present speed of 3.2 knots?

3. You are on bow watch and you notice a large freighter anchored off the port bow. You estimate the distance of the freighter to be .5 miles away. How long will it take to reach the freighter if you are traveling at a speed of 2.5 knots?

4. Your watch wants to reach Matinicus by 1800. The current time is 1100. How fast will you need to sail or row to make it the 15 NM you need to cover?

5. You are pulling into a tight channel with steep rocks on both sides. How far will the boat travel in 6 minutes at a speed of 3 knots?

6. You are crossing Florida Bay and you see a squall line coming. You look on the charts and the closest anchorage is 1.5 NM away. How long will it take you to get there if you are traveling at a speed of 3.5 NM?

7. It is a foggy day and you overhear a security transmission on Ch. 16 warning mariners that a container ship is heading up Penobscot Bay toward the 'PB' buoy and it will be there in 15 minutes. Your boat is also on a course for the 'PB' buoy. You are 1 NM away from the buoy and traveling at a speed of 2.5 NM. Are you in danger of being hit by the container ship?

8. Your next mark, a bell, is 2.3 NM away. It is pea soup fog and you are traveling at a speed of 4 NM. How long before the bow watch should start looking and listening for it?

PRACTICE TRIANGULATION PROBLEMS

Practice triangulating as often as possible. This is an indispensable skill for any navigator worth their salt. It will also help you get better at identifying the landmarks and buoys around you. At the very least, when you are the navigator you should try to get a fix every hour or half hour depending on conditions.

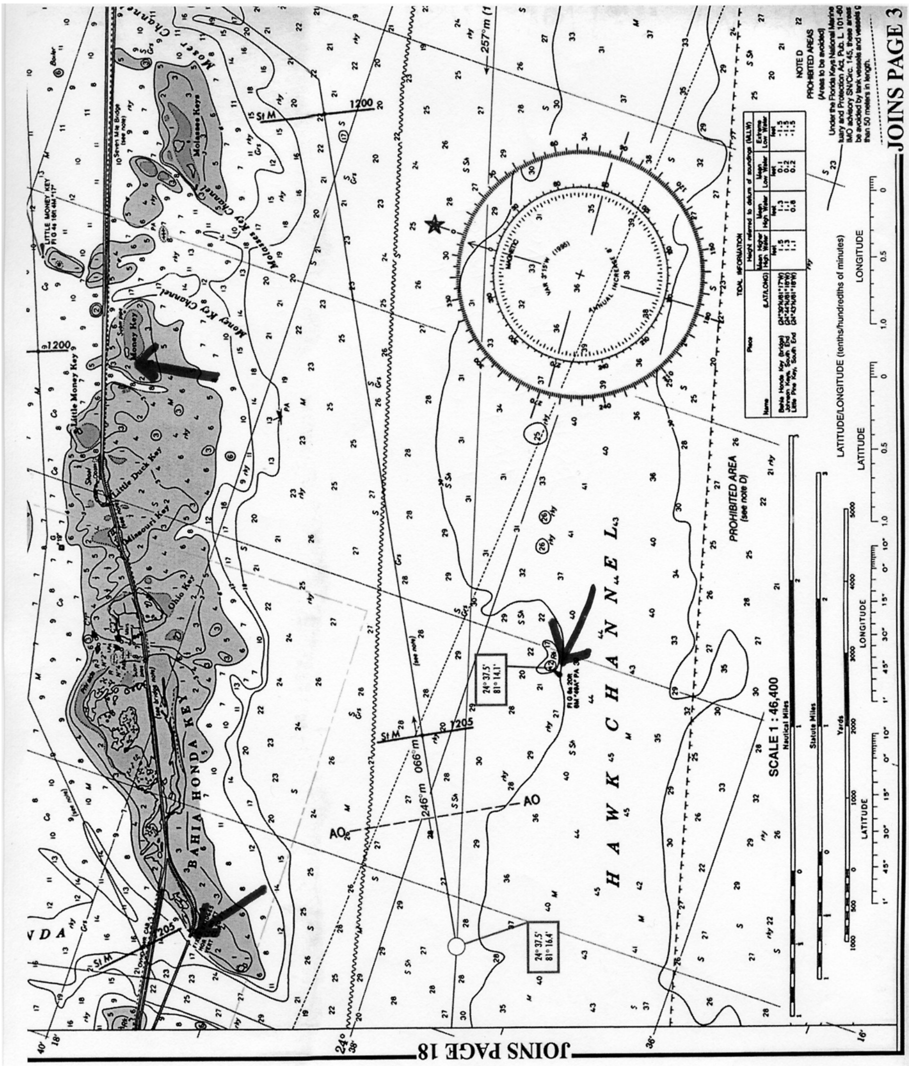
Scenario

1. You are sailing along in Hawk Channel, and your DR track is the lubber's line track on the chart at 246°M. You pass abeam of the eastern edge of Molasses Key at 1200, your speed is 4 knots. At 1300 you triangulate to get a fix. You use the following 3 points/bearings:
    1. FlG '49A' bears 155°M
    2. Western edge of the break in old Bahia Honda bridge bears 303°M
    3. Western edge of Money Key bears 028°M

Using the *Triangulation Practice Chart* on the next page, plot your DR track and positions at 1200 and 1300. Then plot the triangulation based on the bearings above.

- How far off is your fixed position from your DR position at 1300?
- In what direction?

Triangulation Practice Chart



PRACTICE RUNNING FIX PROBLEMS

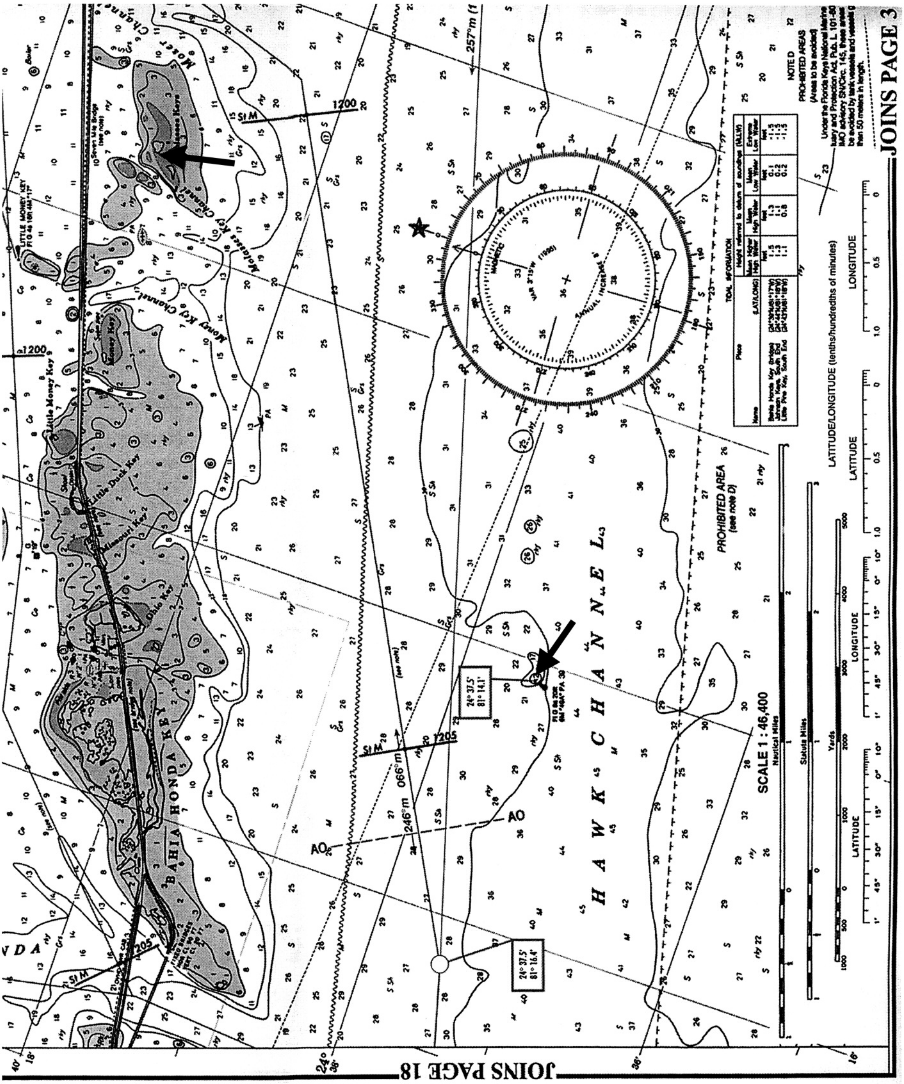
As with triangulation, this can be practiced anytime you are underway. Try plotting a running fix and taking bearings for a triangulation at the same time. Plot both the triangulation and the running fix, this will give you good information about how accurate your running fix is.

Scenario

You are sailing along in Hawk Channel, and your DR track is the lubber's line track on the chart at 246°M. You pass abeam of the eastern edge of Molasses Key at 1200, your speed is 4 knots. At 1245 you get a LOP off of FlG '49A' of 192°M. At 1300, you take another bearing off of FlG '49A' of 140°M.

Using the *Running Fix Practice Chart* on the next page, plot and label a running fix based on the 2 LOPs. Be sure to plot and label your DR positions as well.

Running Fix Practice Chart

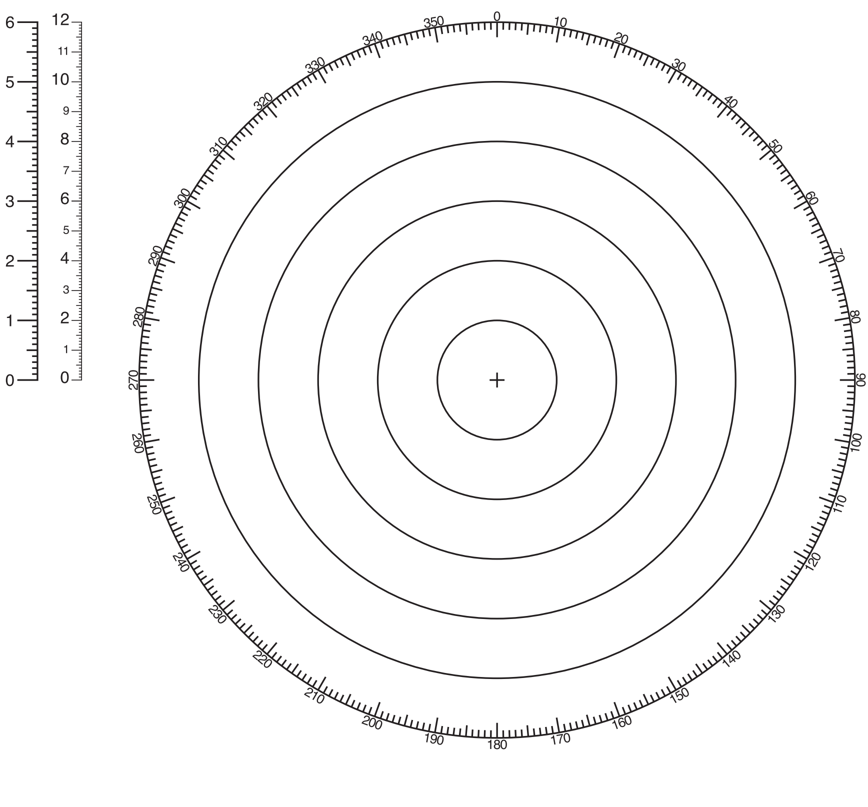


SET & DRIFT PRACTICE PROBLEMS

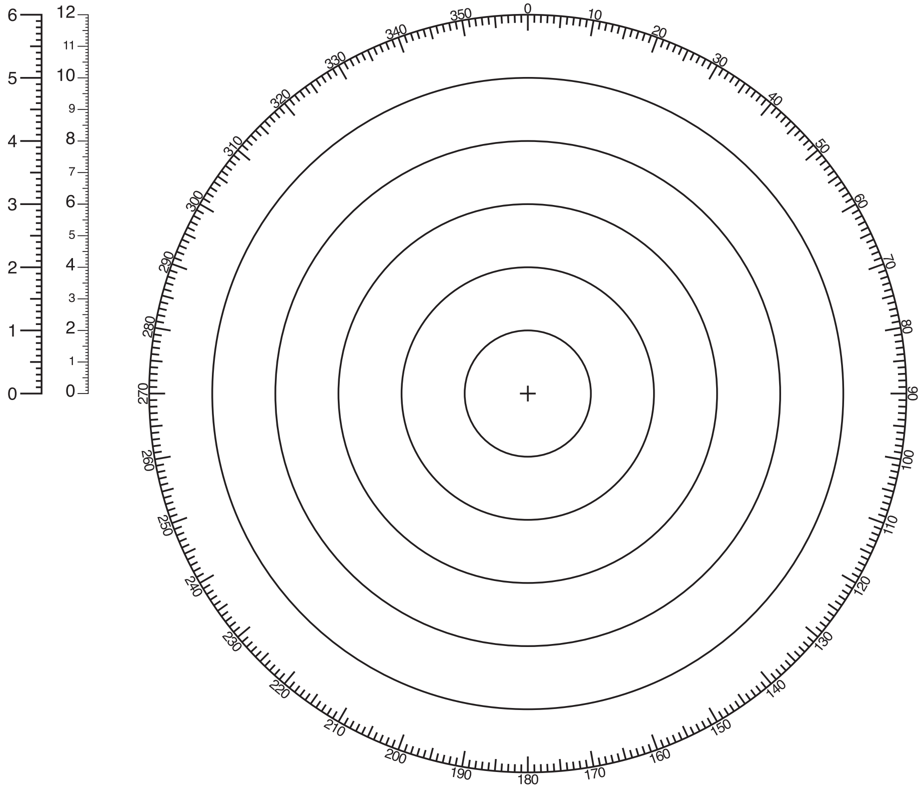
Use the plotting sheets to do these practice problems. **Use pencil** so you can erase and use the plotting sheet more than once.

1. Course to make good is 055(. The current has a set of 007° and an estimated drift of 2.6 knots, and your boat speed is 6 knots. What is the course to steer and what will be the speed made good?
2. You are underway on a course of 240° at a speed of 6 knots, the current is 150° at 3.4 knots. What is your course and speed being made good?
3. You are underway on a course of 255° and a speed of 12 knots through the water. You look on your GPS and find that your course made good is 245° and your speed made good is 13.4 knots. What is the current's set and drift? (make sure you determine the set in the correct direction, from C to COG)

PLOTTING SHEET



PLOTTING SHEET



A ship in a harbor is safe, but that is not what ships are built for.

– William Shedd

Anchor Watch: *Crew members standing watch while a vessel is moored. Capt. John Smith wrote, "lest some miscreants from ye shippes about should steal ye anchors or other gear whilst they, the crew, sleepeth."*

– The origin of nautical terms

Fair wind is fuel. To sleep while a fair wind blows is the same thing as running the engine of a boat with the lines fast to the dock or the anchor locked in the mud.

– Joe Richards

If we want to teach our children self-reliance, then we shouldn't take them to the diamond or gridiron. We should take them down to a river, a lake or a bay and let them learn to row a little boat.

– Richard Bode

Sailors, with their built-in sense of order, service and discipline, should really be running the world.

– Nicholas Monserrat

The difference between loneliness and solitude is your perception of who you are alone with and who made the choice.

– Anonymous

The journey of a thousand miles begins with one step.

– Lao-Tzu

The significant problems we face today cannot be solved by the same level of thinking that created them.

– Albert Einstein

The trick is what one emphasizes.
We either make ourselves miserable
Or we make ourselves strong.
The amount of work is the same…

– Carlos Castaneda

The ultimate measure of man is not where he stands in moments of comfort and convenience, but where he stands in times of challenge and controversy.

– Martin Luther King Jr.

Want is a thing that unfurls unbidden like fungus, opening large upon itself, stopless, filling the sky. But needs, from one day to the next, are few enough to fit in a bucket with room enough left to rattle like brittlebush in a dry wind.

– Barbara Kingsolver

*When you get into a tight place and everything goes against you,
till it seems as though you could not hang on a minute longer, never give up
then, for that is just the place and time that the tide will turn.*

– Harriet Beecher Stowe

Whenever I find myself getting grim about the mouth and stepping deliberately into the streets and knocking people's hats off, then I take it high time to get to sea.

– Herman Melville

Your position never gives you the right to command. It only imposes on you the duty of living your life that others can receive your orders without being humiliated.

– Dag Hammarskjöld

"What we get from this adventure is just shear joy. And joy is, after all, the end of life. We do not live to eat and make money. We eat and make money to be able to enjoy life. That is what life means and what life is for."

– George Leigh Mallory

HURRICANE ISLAND
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