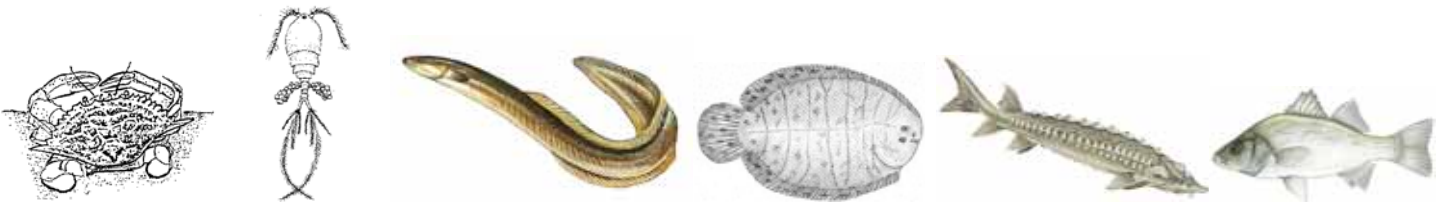


Hudson River Sloop Clearwater



Volunteer Handbook






Dear Volunteer -

In 1966 a few starry eyed volunteers starting raising money to build the Clearwater. Little did we know how the project would turn out. But I think all of us still up and about are deeply proud that the river is a lot cleaner, and that volunteers like you are still keeping the sloop sailing.

Thank you!

Pete Seeger 



WELCOME ABOARD ...

And congratulations! You are about to join the ranks of the thousands of volunteers who have helped Clearwater fulfill its mission of a cleaner and healthier Hudson River. In the 30-plus years we have been sailing the river, we have created a generation of citizens more intimately connected to the ecological, historic, and scenic wonders of the Hudson Estuary through our exciting hands-on programs. We could never reach as many people as we do without the support of volunteers like you. So, thank you for giving a week of your time to sail with us. Your dedication is sincerely appreciated.

As you might imagine, reaching the hundreds of students that benefit from Clearwater's Classroom of the Waves program every week is a full-time job. You will be an integral part of the students' introduction to the Hudson, as well as a vital part of the on-board community. This guide is designed to help prepare you for your volunteer week and introduce you to some of our education and sailing basics. We do not expect you to memorize the guide, but being exposed to the material will help with your training and transition into *Clearwater* crew. And away we go....

Living on the Sloop

While you are a member of the crew, the *Clearwater* will be your home. The bunks are close together and privacy is limited. At least ten other people will be sharing the main cabin area where you will be sleeping. Guests and passengers will also tour below decks during sails, so a clean cabin is a must. To keep clutter and chaos to a minimum, most everybody lives out of their backpacks or duffels for the week and stores their gear in their bunks during the day. Our bathrooms, or "heads", onboard consist of sturdy toilets built over five-gallon plastic buckets. Sawdust is used to absorb odor. It's Coast Guard approved, and it works! When full, the buckets are capped and stored until we can dump them and clean them at a sewage treatment plant. The *Clearwater* has no showers, although some docks have shower facilities. We have plenty of freshwater to wash up with, but please be prepared to go a week without showering. Remember, flexibility and a positive attitude are key to successfully living in such rustic conditions.

Meals are a chance for us all to come together and discuss the day or make any necessary announcements, so it is important for you to attend. Besides, most people do not want to miss meals. The food onboard is always plentiful and delicious. If you have any dietary restrictions, please let the cook know, and she or he will do their best to accommodate your needs. After all, a well-fed crew is a happy crew!

Although living in close quarters can be challenging, the lifestyle on the *Clearwater* tends to foster a close-knit camaraderie and community which often stands out as a volunteer's favorite part of the experience. Volunteers frequently return year after year, or even come back as paid crew, to share in that special onboard community. Although problems are uncommon, if they should arise, please let the educator, captain or another crew member know so we can remedy the situation. You are here to have fun, and we cannot deal with a problem if we do not know about it.

What to Bring?

Space is a limiting factor on the *Clearwater*, but we always have room for the necessities listed below and a favorite instrument, camera, or sketch pad. Pack simply. Bring clothes that you do not mind getting dirty, nothing fragile or valuable. Be prepared for cold, stormy weather in the spring and fall and hot, humid weather in the summer. The temperature always seems more extreme, whether hot or cold, on the water. If you have any questions about what to bring, please call us.

The necessities:

- sleeping bag or blanket and a pillow (we supply a mattress)
- rain gear (rain coat is a must; boots, pants, a hat if you have them)
- sneakers or rubber-soled shoes
- wind-breaker or jacket
- wool sweater/sweatshirt
- towel/washcloth
- toiletries
- shorts/bathing suit (when appropriate)
- wool hat and gloves for cold weather; sun hat and sunscreen for hot weather
- spare clothes for seven days (comfortable work clothes, things get dirty or torn easily)

A Day in the Life:Our Sailing Schedule

Every year from early April to late October, the Sloop *Clearwater* is on the estuary teaching people about the Hudson. Our sailing territory is from Albany to New York City, as well as occasional ventures into NY Harbor, East River and Long Island Sound. Volunteers typically arrive on Sunday (or sometimes Monday) and spend the first day training. The rest of the week is spent sailing with groups scheduled in advance to participate in our education programs. We usually have two three-hour sails each day and sometimes a transit from one dock to another.

We can accommodate groups of up to fifty participants and groups ranging in age from third grade through adults. Almost every sail is an education program of some sort, and the structure and content will vary to reflect the students, no matter what the age. Where the *Clearwater* docks from day to day and week to week is dependent on the needs of the groups that schedule the boat.

With variables like weather, tides, and dock availability, no day or week fits perfectly into a standard schedule. During your week aboard, festivals, dockside visits, extended or overnight programs, and maintenance could alter the routine. The schedule can change on short notice. We will try to keep you informed of any changes as quickly as possible.

The following is a schedule of a "typical" day:

6:45AM	Wake-up	12:30PM	Clean-up/chores
7:00	On deck for deck wash	1:00-4:00	Education sail
7:30	Breakfast and announcements	4:30	Secure boat/transit
8:00	Chores and prepare boat for sailing	6:00	Dinner
9:00-12:00	Education sail	7:00	Chores
12:00PM	Lunch	10:00PM	Quiet time

Ah! the sailor's life.

Safety

Every week six new volunteers come aboard the sloop, many of whom have never sailed on a traditionally rigged boat or worked with students in an outdoor setting. With that many inexperienced people, the professional crew must be extremely safety conscious. It is difficult to assess everyone's ability in a week, so please respect the crew's decisions and their need to "watch out" for you a bit. Please do not take it personally. If you feel ready to tackle more responsibility, let us know!

When you arrive, the captain, educator, and mate will begin your training with all the necessary details of staying safe on the boat. The following is a list of common sense rules/tips that will keep you safe. We will fill in the details when you arrive.

1. Move around the sloop carefully. Wet companionways and decks can be very slippery.
2. Keep arms, legs, and head out from between the boat and the dock. Your body is more important than the rub rail.
3. Keep legs and feet clear of coils and lines when underway.
4. Do not stand on the cabin top when the boat is under sail.
5. Be mindful of moving parts (lines, blocks, sails, etc.)
6. Be quiet when docking, so the captain commands may be heard.
7. Watch for the safety of passengers and guests while under sail.
8. In general, stick with whatever job you have been assigned. The safety of others depends on you. If you do not understand your job, please ask a crew member
9. Know your limits. This is not Outward Bound. We want you to have fun.

Rules and Regulations

Since *Clearwater* is a Coast Guard licensed vessel and we have so many people living in a small space, we have certain guidelines you must follow during your stay with us.

1. Illegal substances are not allowed on the sloop. Their presence endangers the boat, the crew, and the organization. The Coast Guard takes this subject *very* seriously, and so do we.
2. No smoking onboard. If you smoke, you must be on the dock or on land at least 50 ft away from the propane tanks that fuel our stove.
3. No one under the age of 21 may drink alcoholic beverages; no one under the age of 18 may smoke.
4. Drinking alcohol before getting under way or while underway is not allowed.
5. If over 21, you may have alcoholic beverages at the end of the day at the discretion of the mate or captain.
6. When drinking alcoholic beverage at dockside, we ask that they be in a mug.
7. Swimming from the sloop can only take place once the captain or mate has made an official "swim call".
8. Volunteers may go aloft with permission and supervision from a crew member. You must climb aloft twice at the dock before you can climb underway. Passengers may not climb aloft.
9. Shirts must be worn in public view and at mealtimes.
10. Shoes must be worn on the dock and when passengers are aboard.
11. No stereos, headphones, or cell phones may be used while underway.
12. Quiet time is 10:00 PM. You do not need to go to bed, but be quiet for those who do.
13. Always check in with a crew member before leaving the boat. The schedule can change on short notice and we may have places to go, and people to see.
14. Discrimination or harassment on the basis of race, color, sex, national origin, physical challenges, age, religion, or sexual orientation is not tolerated on board the sloop.
15. Remember you are Clearwater's ambassadors to our visitors under sail and dockside. Please be polite, courteous, and respectful of others.

ABOUT CLEARWATER

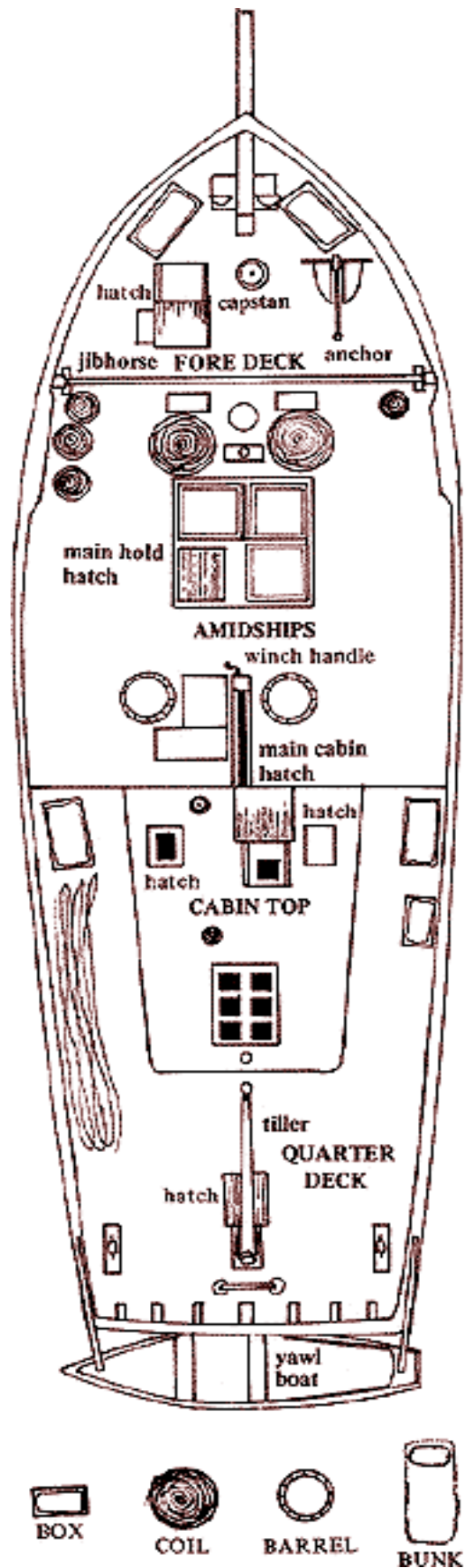
The Beginnings:

Back in 1966, Vic Schwartz lent his folk-singer friend Pete Seeger a book published in 1908 titled **Sloops of the Hudson River**, written by William Verplanck and Moses Collyer. The book triggered an idea. Pete decided to round up some folks and build a Hudson River Sloop. Sloops were once the signature vessel on the river, but steam boats and railroads had driven them to extinction. Pete hoped building a "big beautiful boat to share" would focus people's attention back towards the neglected and polluted Hudson. Soon sailors, business people, children, historians, musicians were getting involved. No one knew exactly for what the boat should be used, but they eventually settled on a mission of restoration and preservation of the river. Thus, the unbuilt sloop was named "Clearwater."

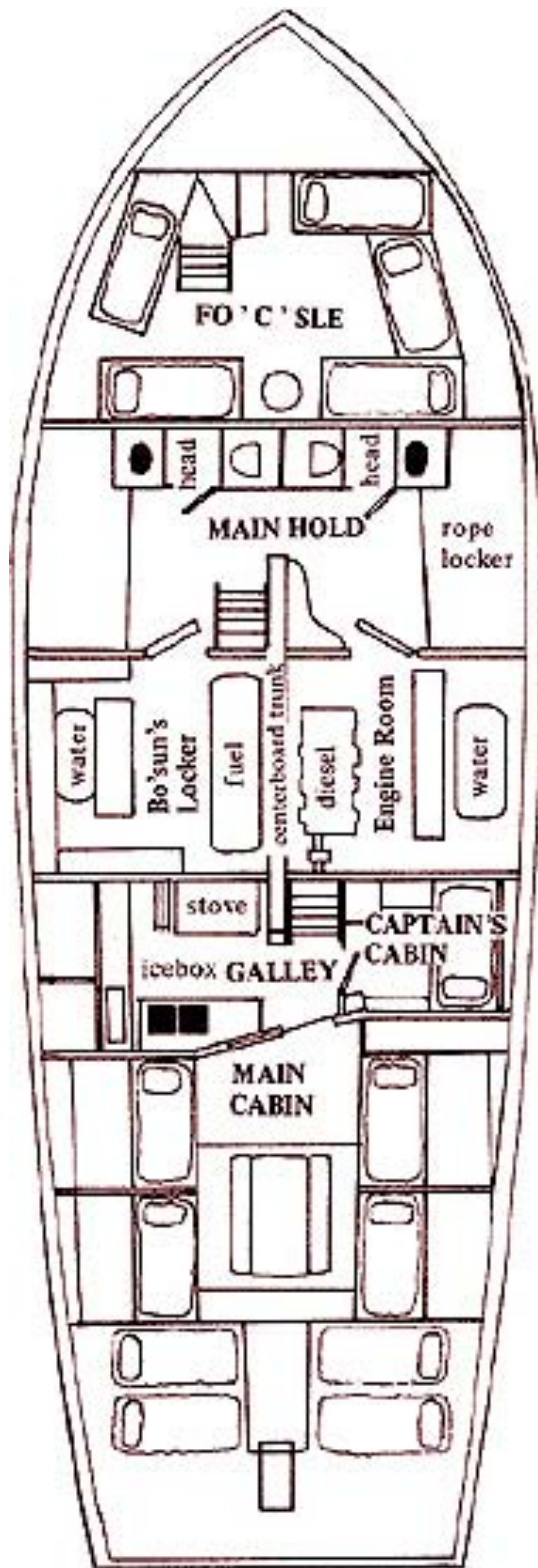
Finally, on May 17, 1969, the Sloop *Clearwater* was launched from Harvey Gamage Shipyard in South Bristol, Maine, and began her mission as the flagship of the Hudson's growing environmental movement.

From its inception, the *Clearwater* has been an important part of the environmental movement of the valley and the nation. Increased awareness and concerns led to the Clean Water Act and Coastal Zone Management Act of the 1970's. *Clearwater* was instrumental in the defeat of the Westway project that would have buried miles of river habitat under a highway. Most recently, in 2002 the EPA passed a Record of Decision to clean up PCB contamination in the upper Hudson. This contamination has persisted for decades, posing great health risks to humans and wildlife. The clean-up of these PCBs is a major victory for the *Clearwater* and all of the people that live along the Hudson.

On Deck



Below Deck



The Present:

The river is cleaner today thanks in part to the sloop raising environmental awareness throughout the Hudson Valley for the past three decades. But Hudson River Sloop Clearwater, Inc. is much more than the sloop. Clearwater is a member supported not-for-profit organization, with thousands of members who contribute annually to keep strong our mission of education, celebration and advocacy.

Up and down the river, groups of members have organized themselves into Sloop Clubs, tackling issues at the local level and educating citizens through riverfront concerts and festivals.

Our largest festival is Clearwater's *Hudson River Revival* that happens Father's Day Weekend every June, and consists of two days of music and environmental awareness. From its conception Clearwater has focused its energy on grassroots activism as a force of change. Clearwater's Environmental Action department is a tenacious advocate for Hudson River preservation, tackling issues like PCB's, power plants, and sprawl.

The Future:

The *Clearwater* will continue to be an outspoken force on Hudson Valley issues. Our programs will continue to reach thousands of citizens every year and foster new generations of river stewards. The Sloop *Clearwater* will long be on the river as a reminder of what people can accomplish when they work towards a common goal. The Hudson River has already gotten cleaner, but challenges remain to the river, the watershed, and its residents.

The Hudson River Sloop *CLEARWATER*

Launched: May 17, 1969, Harvey Gamage Shipyard, South Bristol, Maine

Designer: Cy Hamlin

Owners: All members of Hudson River Sloop Clearwater, Inc.

Sparred length: 106'

Length on deck: 76'6"

Length at water line: 67'

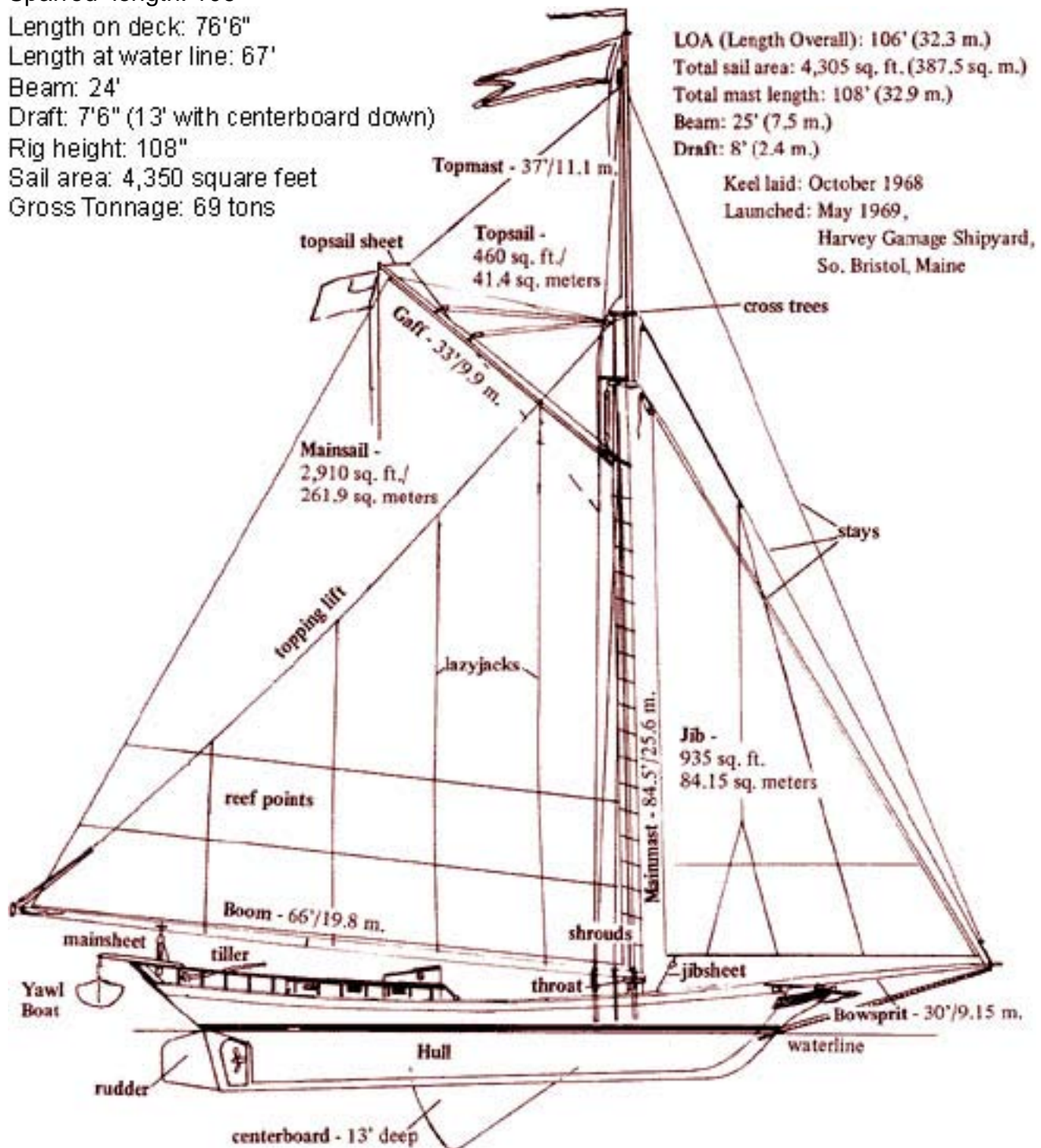
Beam: 24'

Draft: 7'6" (13' with centerboard down)

Rig height: 108"

Sail area: 4,350 square feet

Gross Tonnage: 69 tons



VOLUNTEER CREW DUTIES

As mentioned earlier, volunteers typically spend the first day aboard in orientation. After we discuss rules and safety, your training will be in three basic categories: education, sailing, and chores. The following sections are an outline of many of the duties in which you will assist the crew. Because every week is different, you may not get to see and do everything included in these duties. It is only an introduction. Again do not feel the need to memorize this booklet. The real training will occur when you step aboard to begin your adventure.

Education Basics

Clearwater volunteers are a large part of our education programs. You will assist in leading and teaching the school groups that sail with us. If you have never worked with children before, do not panic! We will show you everything you need to know. Listed below are some frequently asked questions and a few pointers that will help you embrace your new role as volunteer educator.

How old will the students be?

We sail with groups ranging from third grade to adult. Most of the school groups we serve are fourth through tenth grades, with students aged nine to sixteen years old.

How many students?

We sail with groups of no more than fifty. As a group leader or learning station teacher you will be working with groups of no more than ten. Each group that sails with us will come with a number of teachers and adult chaperones. Maintaining discipline is the responsibility of the teacher, not you.

What do we teach?

The main goal is to provide a hands-on Hudson experience that gives the students a sense of connection to and stewardship for the river that can extend to the entire natural world. Most sails are three hours long, although we occasionally have longer sails. The students spend the first half of the experience as a whole group working as a team to collect fish with our trawl net, haul up the main sail, and investigate themes such as pollution, conservation, and food webs. The second half of the trip the students are divided into smaller groups and rotate through five learning stations which may include water sampling, fish investigation, plankton sampling, navigation, habitats and history. This is their opportunity to investigate things up close; a chance to see and touch the world around them. The learning stations usually last about 10 to 15 minutes, depending on age and scheduling.

Often, adult groups request less structured sails. They may bring snacks or drinks, and really focus on enjoying the Hudson River. However, every sail is an education sail. And (almost) everybody helps raise the main sail! Adults may not be broken up into smaller groups, but the learning stations are still set up around the deck as optional activities. Your job is to engage passengers and answer their questions about the stations, the sloop, or the organization. On many days, the teaching does not stop when we reach the dock. Curious public may want to ask you questions and you may want to invite them aboard for a quick tour. Please remember that during your volunteer week you are a Clearwater spokesperson and a very important link to the public and their support of our organization.

The sloop is a unique and engaging environment for teaching. The boat program is structured, but lends itself to exploring the many spontaneous distractions (tugboats, birds, trains, gybes)

that make up daily life on the river. These distractions are what being on the river is all about. It is your job as an experiential educator to take advantage of this opportunity and expose students to new perspectives.

Volunteers will be asked to serve as group leaders and station teachers. In addition to your training, you may want to explore the resources listed in this booklet or the *Clearwater's* onboard library.

A FEW POINTERS

- Introduce yourself and get to know the students' names.
- Safety is always the first priority. Make sure your students follow the safety guidelines the captain sets forth.
- Try to make connections to things they already know, so they can relate it to their own lives.
- Do not worry if you are not a professional teacher or expert in the field. Good teaching is not so much a matter of giving information as it is getting students to think independently.
- Encourage imagination. Ask lots of questions. Sometimes you can answer their questions with questions. "What kind of fish is that?" could be answered with, "What clues do you see that might help us figure out its name and where it might live?"
- Whenever possible, have students make predictions, so that they become invested in the outcome of an activity.
- Be alert for students who may be wet from rain or suffering from cold or heat. Let the educator know.
- Be positive. We want students to enjoy their experience.
- Be mindful of using inappropriate language or making comments about a student's appearance or behavior.
- Discipline is rarely a problem. If a child is being rude or disruptive, calmly point out to the child that their behavior is making things difficult for you and the group. If that does not work alert the educator, teacher, or chaperone and they will address the problem. Do not raise your voice or argue. We do not want to reinforce the idea that rudeness is acceptable.
- Have fun. Relax with your group and enjoy the sail. Do not get anxious if you can not remember all the training.
- Do not be afraid to say "I don't know." The educator and other crew members are great resources, please ask them for help.

The following few pages contain outlines of station lesson plans that you will be asked to teach. They are designed to be a reference of suggested topics you may cover at a station. Take some time to read over the lessons, so you will have an understanding of what occurs during a sail. **You are not expected to remember all of this stuff!** The educator will explain everything in your training. It's more important to take a look through the stations and start to get a taste for what interests *you*...

THE FISH STATION

Objectives:

Students should leave this station experiencing some of the following:

- ◆ Fish anatomy as a reflection of adaptation to habitat.
- ◆ The specialization of fish senses to life in the water.
- ◆ A hands-on encounter with Hudson River life.
- ◆ An introduction to the diversity of life in the estuary.
- ◆ Use of a dichotomous key as a scientific tool in identification of Hudson River fishes.
- ◆ The importance of fish to the estuary and our lives.

The Station:

One of the most exciting moments of an education sail is opening the cod-end of our net to see what amazing life we have caught during our trawl. The Hudson is a rich, productive system and we almost always catch something. Even after years on the river, the trawl can still bring surprises. You will probably be just as anxious as the students to get to the fish tank and experience some Hudson River fish fauna up close and personal.

- Anatomy -

Fish come in a wide array of sizes and shapes. These sizes and shapes are a reflection of a fish's role in an ecosystem and its habitat. For example, the flounder-like hogchoker's flattened body and dark, mottled coloring help the fish to blend in with the river bottom as it searches the sediment for invertebrates. A fish like a shad, which cruises the open water, has a much more streamlined body built for speed and a silvery color that helps it blend into light penetrating the water. Even with such an assortment of forms, fish share some common adaptations for life in the water.

What makes a fish a fish? Or how are fish different from us? Students can quickly compile a list of differences, including fins, gills, scales, color. All of these differences are adaptations fish have for living in the water. Just the act of moving through the water can be a difficult task. If you have ever tried to run through waist deep water you understand this difficulty. One of the adaptations most fish share is a streamlined body shape to help them move efficiently through the water without expending so much energy. The many fin types that a fish can have play specific roles in swimming. The tail, or caudal, fin propels the fish through the water. The dorsal and anal fins act as stabilizers. The pectoral and pelvic fins can be used for steering or fine movements. Fins can vary greatly in size and number, but most fish have at least some of these basic fin structures. To power the muscles driving the fins, the gills are designed to get dissolved oxygen from the water into the bloodstream. Scales serve as armor to help protect the fish, but not all fish have scales. Most fish, even those with scales, secrete a mucous coat over their bodies to help protect them from infections. Fish come in a rainbow of colors, but almost all fish will be darker above and lighter below. This phenomenon is called countershading and helps fish avoid predation. The dark back when viewed from above blends in with the shadows or the bottom. The light belly when viewed from below blends in with the scattering of light. Some adaptations may not be as visible. For example, many fish have a swim bladder. The swim bladder is a gas-filled organ that the fish can regulate to maintain neutral buoyancy. In this manner, a fish can maintain its depth without expending energy from its muscles and fins.

- Senses -

Differences between fish and humans are obvious, but what about our similarities? Fish need the same things we need: food, a place to live, and a way to find a mate and reproduce. To accomplish these goals fish have the same five senses that we have. However, each of these senses is specialized for life in the water. Many fish have obvious eyes and rely heavily on their sense of sight to find food, escape predation, or locate a mate, but for fish active at night or living in the Hudson's murky depths, other senses are needed to survive. Most fish have nares, similar to our nostrils, for picking up scents in the water. Although fish do not have external ears, sound waves easily pass through their flesh to their otoliths, or internal ear stones. Fish often have very sensitive mouths or specialized structures that allow them to taste potential food and decide what is appropriate to eat. Fish clearly respond to touch stimulus and quickly swim away when handled. Many have fins specialized as touch sensors. A catfish's barbels, or whiskers, are a specialized structure that combines the sense of taste and touch to allow the catfish to survive and find food in its dark bottom habitat. Fish have another sensory organ beyond our limited senses called the lateral line. We often refer to the lateral line as a fish's "sixth sense." The lateral line can often be seen as a seam running down the side of the fish and is composed of pockets of a gelatin-like material. As turbulence hits the side of the fish, the pockets jiggle, triggering nerves that connect the line to the brain. Since so much of the fish's sensory perception is focused in the head, the lateral line helps extend its perception down the entire length of its body. The lateral line allows fish to react so quickly in schools and effectively avoid predators before visually encountering them.

- Handling Fish -

Certain species of fish are more sensitive than others and we always try and limit the amount of stress a fish encounters during its time aboard the *Clearwater*. However, many fish are hardy enough to be gently touched or handled to provide the students with a deeper connection to the Hudson's wonderful fish diversity. The educator or crew will let you know which fish can be safely handled and which fish are best viewed from the aquarium or small viewing tank. Students must always wet their hand before touching a fish so that they do not rub away the fish's mucous coat.

- Using the Key -

A great tool for helping you and the students to identify the fish we catch is *Clearwater's Key to Common Hudson River Fishes*. The key challenges the students with choices and forces them to use their powers of observation to look at a fish's structures and determine what species of fish it is. The key also has brief descriptions of the fish's natural history.

- Importance of fish -

Fish have always been an important resource linking humans to the river. Dating back to the Native Americans, humans have relied on fish from the river to feed themselves and their families. Only a few decades ago, the Hudson supported a thriving commercial fishery for species like striped bass, eel, catfish and sturgeon. Chemical pollutants, lowered water quality, and over-fishing all but decimated these fisheries. Although the river is cleaner today than it has been in years and many fish populations are at strong levels, the fish are still contaminated with toxic PCB's. Currently the only viable fishery on the river is shad, whose PCB levels are lower because of their feeding low on the food web and their using the river primarily for spawning. Far more than just a food source for humans, fish populations provide nourishment for other mammals, birds, and reptiles throughout the watershed and serve as indicators of the estuary's health and future.

THE PLANKTON & INVERTEBRATES STATION

Objectives:

Students should leave this station experiencing some of the following:

- ◆ A definition of plankton and their habitat
- ◆ The differences between the terms invertebrate and plankton.
- ◆ The role plankton play in the food web.
- ◆ An introduction to the diversity of plankton and invertebrate form and function
- ◆ In depth and hands-on exploration of a plankton or invertebrate sample using microscopes and magnifiers.

The Station:

The plankton/invertebrate station provides students with another hands-on encounter with some of the Hudson's diversity of life. Here they begin to see the intricate connections within the food web, and how important even the tiniest creepy-crawlies can be to the estuary.

- Plankton -

The term plankton is not a taxonomic classification, like genus and species. Instead, the term plankton allows scientist to group together organisms that may be evolutionarily very different, but live or behave in a similar way. So, what are plankton? Generally speaking, plankton have three unifying characteristics in common: they are alive, they spend the majority of their time in an aquatic environment, and they are not strong enough swimmers to move against the current.

People often think that all plankton must be microscopic. Many planktonic creatures are, but if we reflect on our basic definition, we see that often, large things like jellyfish may fit into the category of plankton. People also often think that plankton must be invertebrates. An invertebrate is an animal without a backbone. Most fish larvae start their life as plankton, and fish are clearly vertebrates. So, not all invertebrates are plankton, and not all plankton are invertebrates.

- Phyto vs. Zoo -

Plankton can be further broken down into two major groups: phytoplankton and zooplankton. Phytoplankton are plant plankton, including organisms such as diatoms, algae, cyanobacteria, and dinoflagellates. Although they may not resemble the plants we are familiar with on land, phytoplankton perform the same vital tasks as their relatives on land. Phytoplankton, like all plants, photosynthesize. As a by-product of photosynthesis they give off oxygen. Phytoplankton are the greatest oxygen source and probably provide more than 60% of global atmospheric oxygen. In aquatic systems, phytoplankton are the primary producers that make up the base of the food web. Zooplankton, or animal plankton, fill the next step in the food web, grazing primarily on phytoplankton. The zooplankton, such as copepods, cladocerans, and amphipods, serve as a vast food source for small and developing fish, which in turn feed larger animals higher on the food web. In this way energy is moved throughout the system. Although much of the energy in the Hudson estuary comes from detritus, the productivity of phyto- and zooplankton drastically effect the productivity of the whole river. Even the slightest changes in the plankton could ripple throughout the complex interconnections of the food web.

- Biomagnification -

Just as plankton pass energy up the food web, so too can they pass pollutants, especially persistent chemicals and heavy metals. Let us imagine that a persistent toxin has gotten into

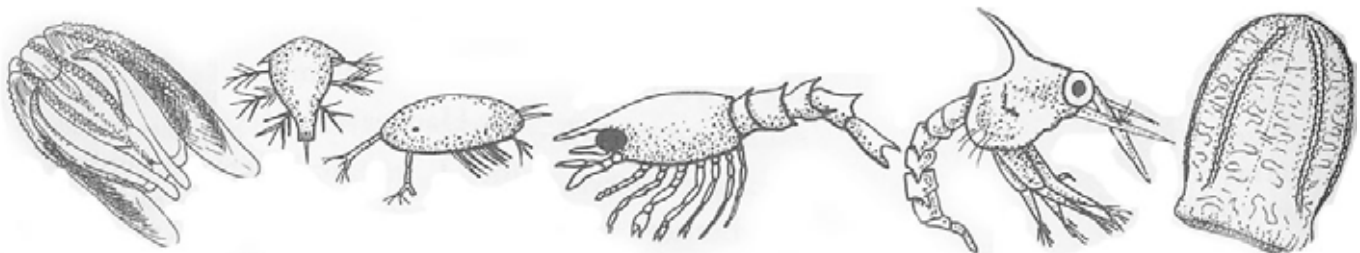
the river. The phytoplankton will receive small amounts of this toxin as they exchange materials between their cells and their environment. Zooplankton graze on the phytoplankton and concentrate the pollutants. Larger invertebrates or small fish that eat the zooplankton, thereby concentrating the pollutants in their bodies, which are in turn eaten by larger predators. Although this example is greatly simplified, it illustrates how quickly toxins can build up in the food web and how higher levels in the food web have higher concentrations of toxins, a process called biomagnification. In the Hudson, a toxic chemical, PCB's, was dumped over the course of 30 years and now contaminates the fish in the river through biomagnification. But the problem extends far beyond the river to the birds and mammals and humans that would use the river as a food source. Currently, New York State has health advisories warning against eating fish from the river to limit people's exposure to PCB's. To learn more about the PCB issue, please consult our website, www.clearwater.org, or call our Poughkeepsie office at 845 454-7673.

- Investigating Plankton -

After a brief discussion about plankton's importance, the students will be anxious to "muck around" in the plankton sample. Generally, the educator will collect a sample prior to the sail using a small, fine-meshed net called a plankton tow. If your comfort level and sailing environment allow, you may want to set the net again with your group. For the most part, students will be searching for zooplankton, since our limited technology excludes finding and viewing the microscopic phytoplankton. Students should be encouraged to pour samples from the bucket into the trays or glass dishes for better viewing. They may want to place an organism on a slide for viewing under the microscope. If someone finds an interesting specimen, make sure everyone gets a chance to see it. Have the students sketch, count, and identify the different types of plankton they see. Please remind the students that these are living creatures and need to be treated with care and respect. After all, where would we be without plankton? In big trouble!

-Larger Invertebrates-

Our fish net frequently brings up a number of larger invertebrates that do not qualify as plankton, but should still be discussed at this station. Blue crabs, grass shrimp, barnacles, and many species of insect larvae all put in appearances. However, the likelihood of seeing any of these organisms depends on where the boat is in the estuary. Some larger invertebrates are herbivores, feeding on algae or phytoplankton. Some are carnivorous, consuming zooplankton or other small invertebrates or fish. There are also a number of larger invertebrates that are detritivores and play important roles in breaking down the dead and decaying material that forms the true base of the Hudson River food web.



THE SAILING STATION

Objectives:

Students should leave this station experiencing some of the following:

- ◆ A chance to be on the tiller and learn the concepts of steering the sloop.
- ◆ An introduction to some of the traditional and modern tools used for navigation.
- ◆ Observing the river around them and drawing conclusions from those observations.
- ◆ The basic principles and symbols of nautical charts.

The Station:

As soon as you and your group reach this station, split them in half. Half will spend the first part of the station at the tiller with captain steering the boat. Half will stay with you and learn some of the basics of sailing. After several minutes, the groups will switch, so everyone gets a chance to try both. While on the tiller, the students will learn some of the principles of sailing and steering. Imagine how empowering it is to be twelve years old and swing a hundred-foot wooden sailboat through a tack! But how do sailors know where to steer the boat? That's where you come in.

Navigating on the river is different from navigating on the ocean. In past centuries, when out of sight of land on the ocean, sailors have had to rely on the position of the sun and stars to navigate. But on the river, we can see the shore and can rely heavily on landmarks. At this station, we will talk about river navigation tools. You probably won't have time to cover every concept; just focus on what you can.

The navigation tools we have onboard are used to determine water depth, wind direction, and relative position of landmarks. These are the same key factors that sailors have needed to know throughout the history of boat travel. Many of the tools that were used historically have been updated--new technology has allowed for greater accuracy and precision. However, in many cases, the old tools are still effective ways to learn information about the water and land around us. On the *Clearwater*, we use the new technology but you will also see examples of the traditional tools in use.

Make sure students don't spend the whole station looking down. Give the students a chance to observe their surroundings and help them find answers to questions that come up. Now let's look at some of the tools and concepts.

-Depth-

By attaching a weight to a line and lowering it to the bottom, sailors can determine depth of the water. This method has been in use since at least the 13th century. On the sloop we sometimes use a **lead line** to estimate water depth. We also have the electronic depth sounder that sends a signal to the bottom of the river to get a measurement.

-Wind Direction-

How can you find **wind direction**? On the Hudson, northwesterly and westerly winds prevail, which was favorable for the historic sloops traveling up and down the river. We use a **compass** to find out direction. A compass is a device that uses the magnetic field of the earth to determine which way is north. Because compasses rely on magnetism, any large pieces of metal near one may affect the compass's ability to accurately determine the directions. Modern boats ran into problems when they tried to use the traditional type of compass. Why? Older boats had wooden hulls (like the *Clearwater* does) but later boats had metal hulls- and that's certainly a large piece of metal. Compasses for metal-hulled boats are now modified to accommodate the hulls. The

compasses that we have onboard may be affected by the metal in wrist watches or bracelets. **Tell tales** (ribbons near the top of the mast) used in conjunction with a compass is the traditional way to find wind direction. The ribbons are most accurate when the boat is not moving. When the sloop is in motion, our motion creates an "apparent wind" that moves the tell tales. We still use tell tales to determine wind direction on the Clearwater, but many sailors use an anemometer instead.

-Position of the Sloop-

When we want to find our location, we can look for **landmarks** with the traditional spyglass (a telescope-like device) or binoculars (which have the advantage of providing depth perception). The **nautical chart** tells us some key landmarks that are visible from the water. If you have time, you can use the nautical chart display to teach students what the various chart symbols mean. A chart is a wealth of information about not only what we can see, but also about what lies beneath the river's surface. Obstructions below the surface of the water won't help us determine where we are, but it's pretty important to know about them in order to keep the boat safe. Have the students figure out where we are on the river. Choose a symbol on the chart and find what it corresponds to on land. Feel free to use landmarks or interesting sites to spark conversations.

Do not forget to remind the students of their most powerful navigational tool: their ability to carefully observe the world around them.



THE WATER TESTING STATION

Objectives:

Students should leave this station experiencing some of the following:

- ◆ The importance of water as a resource and its necessity to all living things.
- ◆ Properties of water.
- ◆ Water quality parameters and how to measure them using hands-on field testing.

The Station:

Water is surely one of our most important natural resources, yet it is the resource we most often take for granted. All living things need water, and humans are no exception. However, throughout our modern history we have a long tradition of using our water resources as dumping grounds or cooling ditches. No matter how far technology advances, it can not replace our basic need for clean, fresh water.

- Water(shed) World -

Water covers about 70% of our planet. Scientists estimate that the world's water supply- liquid, frozen, and gas- totals 326 million cubic miles (one cubic mile = 1.1 trillion gallons of water). If this total supply were in liquid form and poured upon the 50 United States, the land surface would be submerged to a depth of **90 miles**. In those terms, water seems like an infinite resource. But the majority of that water is salty seawater with little use for us humans. In fact, only about 3% of all the water on the earth is fresh water. And most of that fresh water is frozen in the polar ice caps and glaciers. In the end, we are left with only a small amount of easily available fresh water.

A watershed is an area of land that drains into a water body, like a stream or river. The Hudson's watershed encompasses parts of New York, Massachusetts, Connecticut, Vermont, and New Jersey. Anything that we put on the land in that watershed- like pesticides, fertilizer, or garbage- can eventually end up in the Hudson River. So, when thinking about protecting a water body, you must consider protecting the watershed.

- Properties of Water -

Water has some unique properties that make it essential to life on this planet. Water is the only substance that occurs as a solid, a liquid, and a gas under the normal temperature range of the earth. Water becomes less dense as it reaches its freezing point. Therefore, ice floats! If a lake froze from the bottom up instead of the top down it would kill most of the plant and animal life living there. Water has the ability to absorb a large amount of heat without a large change in temperature. It also retains heat longer than many other substances. This property prevents wide temperature fluctuations that might stress or kill organisms.

One end of a water molecule has a slight negative charge, and the other a slight positive. This polarized structure creates weak bonds or cohesion between the molecules, called hydrogen bonds. If you have ever felt the sting after a belly flop into a pool, you have felt the effects of these bonds creating surface tension. Often we will challenge students to see how many drops of water they can fit onto a penny to demonstrate hydrogen bonding. Many organisms found their niche living on or attached to surface tension. Water also adheres to other surfaces. The properties of adhesion and cohesion allow water to move from the roots to the leaves of a tree, sometimes traveling hundreds of feet.

- Water Quality -

Often students look at the river and mistake its murky appearance as a sure sign of pollution. If we collect some river water in a bucket, the water looks much clearer without the dark shadow of

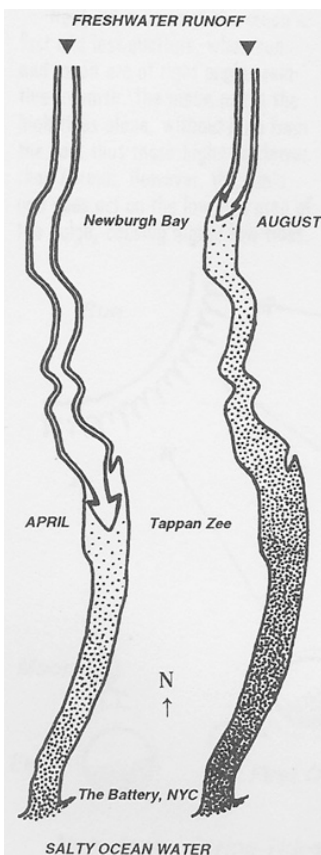
the river depths. River water in small glass vials looks clear enough to have come from a tap. Ah, but just because water is clear does not mean it is clean. To find out if the river is polluted we need to take more than a superficial look. Many things that we can't see such as chemicals and bacteria can effect the river and ultimately our health. Two properties of water quality that are easy to test onboard are dissolved oxygen and turbidity.

Almost all aquatic organisms need oxygen, O_2 , just like we do on land. How does oxygen get into the water? Phytoplankton (algae) give off a large amount of oxygen that dissolves into the water and is available for aquatic creatures. Turbulence (waves) is another major source of dissolved oxygen (DO). The level of DO can tell us a lot about what factors might be affecting the system. Sewage has a major effect on DO. As sewage enters the river, bacteria begin to flourish and break down the sewage. This process of decomposition robs the water of DO. Only a couple of decades ago, it was common to find DO levels around Manhattan below 4 parts per million (ppm), which is the minimum amount for fish survival. The years of sewage pollution created "dead zones" around New York City where only a few hardy creatures could live. DO level is also closely linked to water temperature. Colder water holds more DO. Power plants will often use river water to cool down their generators and then discharge the effluent at an unnatural temperature.

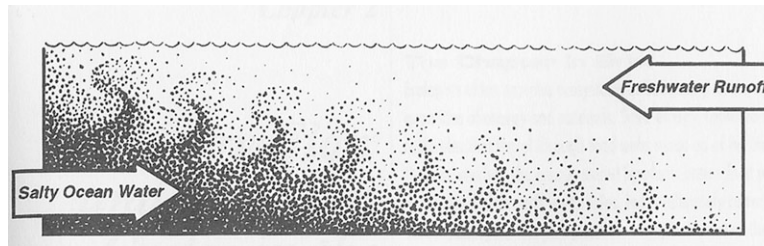
Turbidity is a measure of how the suspended material a water body is holding effects light penetration, or clarity. Suspended materials include things like soil particles, algae, plankton, and microscopic organisms. The more light that can penetrate the water column the greater the rate of photosynthesis of phytoplankton and submerged aquatic vegetation. The Hudson has a large watershed, and all the development of land within the watershed has added to the amount of sediment entering the river and consequently increasing the turbidity. Turbidity can fluctuate greatly during the course of a year, a season, or even a day. For example, a heavy rainfall or snowmelt dumps a lot of sediment into the river. Despite the fluctuations, turbidity can be an important tool for monitoring water quality because the clarity of the water is directly related to the productivity of a system.

- Estuary Essentials -

The Hudson is an estuary- a coastal body of water that is freely connected with the ocean. Because there is only a very slight change in elevation of the Hudson between Albany and New York City, the estuary extends for almost 150 north from the mouth of the Hudson River. Each day, high tides in the Atlantic Ocean push salt water northward up the river and the river flows north. During low tide, freshwater from upriver pushes south and the river flows south. The meeting and mixing of nutrients from upriver with nutrients and salts from the ocean make the Hudson an extremely productive system. Scientists consider water with less than 1 part per thousand (ppt) of salts to be fresh water (the ocean is about 30 ppt). The Hudson River is usually fresh north of the Beacon-Newburgh Bridge. However, this border between fresh and salt water, or salt front, is not a clear line and varies quite a bit. Measuring salinity allows us to understand where the salt front is, why it might be fluctuating, and what species we might expect to find. During the spring snowmelt, the onrush of fresh water from the north pushes the salt levels very far south. As things dry up in the summer, the salt front creeps northward.



On really dry years, traces of salt water have nearly reached Poughkeepsie's drinking water intakes! Salinity will also vary with depth. Salt water is denser than fresh water and as we sample deeper we should see an increase in the salt levels.



The History Timeline (in the Main Cabin)

Objectives:

Students at this station will:

- ◆ Visit the Main Cabin area on the sloop Clearwater
- ◆ View and use a giant Hudson Valley Timeline depicting the elements that define a society and the accompanying historical events
- ◆ Touch actual historical artifacts and determine their place on the timeline
- ◆ Demonstrate an understanding of the concept of "generations"
- ◆ Appraise their place and role in a historical context by identifying their current community positions compared to the past and predict their future positions

- Materials -

A giant cloth historical timeline that surrounds the entire bunk area in the main cabin with artifacts/pictures representative of different time periods and societal components attached to it at various points.

- Background -

The concept of community – or society – is one that is dependent upon structural components and surrounding cultural influence. The identified elements of society are:

- | | |
|--------------|------------------|
| ◆ Art | ◆ Energy |
| ◆ Literature | ◆ Transportation |
| ◆ Government | ◆ Ecosystem |
| ◆ Peace/War | ◆ Technology |

On the timeline we've selected the following components:

- | | |
|------------------------|----------------------------|
| ◆ The Arts | ◆ Ecosystem |
| ◆ Government & Economy | ◆ Hudson Valley Milestones |
| ◆ Science & Technology | ◆ Global Context |

- Procedure -

- 1) The students sit at the table
- 2) The educator welcomes the students to the main cabin area - explaining that this is where the Clearwater crew lives. This is the table where they eat and a place where they gather for meetings. Do they have a place like that in their own homes? In their communities?
- 3) The educator describes this station as the History Station and makes note of the timeline that surround them

- 4) The educator tells the kids that they are going to explore Hudson Valley history between about 1600 and 2000. Do they think they will encounter a lot of change or has everything remained pretty much the same?
- 5) First take a look at 2000 on the timeline. Here's where we are. Where were your grandparents? Your great grandparents or great great grandparents? Each of these "greats" is a generation. How many generations do we go back to get to 1600's?
- 6) Select an artifact from the timeline but don't take it down! Ask a kid to take down the artifact, but don't say what it is. Explain WHERE it is (this enforces a whole host of skills-reading a chart and listening to directions are just a couple)
- 7) Ask the kids to pass the artifact around and take a guess as to what it is and what event it represents. (There may be a ton of answers for an artifact! Let discussion flow naturally from this but don't let it consume the time for the entire station)
- 8) Chose another artifact/ picture and do the same

- Themes in Timeline -

- 1) The contributions of the Hudson Valley's indigenous peoples and African/European settlers were monumental. Too often overlooked, Hudson Valley African Americans were an integral part of the fabric that made up the Valley. The Iroquois Constitution – an oral record created in the 1400s – was the basis for our own constitution.
- 2) The Hudson Valley is the birthplace of America's Environmental Movement. Contributions from the Hudson's artists, leaders and scientists created the environmental ethic that we rely on to preserve and protect this lovely space we all share.

- Use of Themes with Older Students -

Tell the students that there are 2 hidden themes in the timeline. Can they figure them out? Of course, you will need, as educator, to present the particular artifacts/ pictures to them, which create the themes.



Hudson's Half Moon

EXTRAS

Frequently, the educators may alter the structure or content of the program to fit the specific needs of the group. Some stations may be omitted, added, or expanded to make sure a group gets the most out of their experience on board. What follows are the descriptions of two stations that you may encounter during your volunteer week. There may be others as well; education is full of surprises!

THE HABITAT STATION

Objectives:

Students should leave this station having experienced some of the following:

- The definition of “habitat”
- A discussion of the various habitats of the watershed
- A demonstration of the interconnectedness of habitats within the watershed using nutrient cycling as an example
- Comparing aerial photographs and nautical charts and the information that they provide for locating and investigating habitats
- The environmental factors in the river that create different habitats
- The ways in which many habitats combine to create the Hudson River ecosystem and the role that students play as organisms in that ecosystem

The Station:

We use the word “habitat” often at various stations on the boat. At this station we will really spend some time defining the term and showing the students that the river is not a single, uniform habitat but rather a complex of many different habitats, which together with the adjacent terrestrial habitats form an ecosystem. A habitat is a place where a species lives, basically just a fancy word for “home”. Each species of organism that lives in or near the river has its own habitat. The habitat must supply the needs of the organism, such as food, water, temperature, oxygen, and minerals. Ask the students to describe the habitat of some different plants and animals associated with the Hudson: an eagle, a hogchoker, a cattail, a blue crab, a student living in NYC... Some of the artifacts we have onboard show adaptations to particular habitats. Have students examine a crab exoskeleton or a water chestnut nut hull. Aerial photographs of the river are a useful tool for investigating habitats and a way to show students that multiple habitats can exist in one cross section of the Hudson. Examine the aerial photo of the river at the Esopus Lighthouse and ask the students to pick out areas that they think represent different habitats within this stretch of the river. Then, have them think about animals that might live in each of the different habitats.

- Upland -

This very broad term in fact encompasses a huge variation of land based habitats, from forest to meadow to urban parking lot. For our purposes here, it's important to remember that upland habitats are intimately connected to the river by streams and tributaries—that's what a watershed is all about. Carbon from rotting leaves, nutrients from lawn fertilizer, and pollutants from leaky oil drums can all reach the river and effect what lives there, usually by mixing in with the detritus at the bottom of the river.

- Intertidal -

This is the interface of earth, air, and water. The intertidal zone is the area between high and low tides, so the creatures here are either well adapted to constant change or mobile enough to deal with the tidal fluctuations. Some organisms, such as barnacles in saltwater and spatterdock plants in freshwater, can withstand short periods of time in both air and water.

- Marshes, swamps -

Both swamps and marshes are wetlands, which are found in the more sheltered flats and bays in the intertidal areas along the Hudson. Both are dominated by emergent vegetation (plants that have their leaves and stems above the water's surface). When trees and woody plants dominate, the habitat is called a swamp. When cattail, reeds or other non-woody plants dominate, the habitat is referred to as a marsh. A lot of the detritus, which forms the base of the Hudson River food web, comes from the dead vegetation of marshes and swamps.

- Submerged Aquatic Vegetation -

Submerged aquatic vegetation (SAV) beds are found in the shallow water near the edge of the Hudson. These areas provide important habitat for many invertebrates, including insect larvae, crustaceans, and snails. Young fish are common in the SAV beds, where they can find a ready supply of food and shelter from predators. Waterfowl also rely heavily on SAV beds.

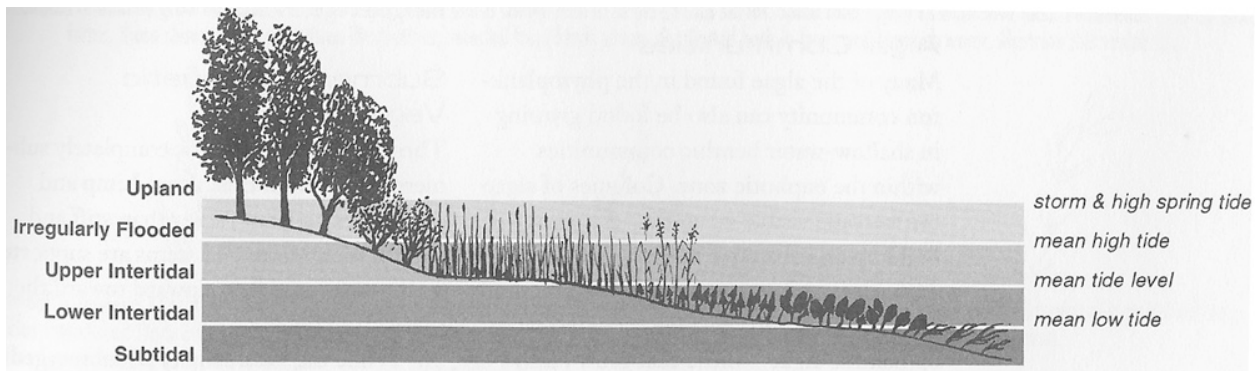
- Open water -

The open water part of the Hudson from Troy to New York City experiences the full force of currents in the Hudson. However, the depth and large volume of water moderate the extreme seasonal changes that assail the shallows. Fish frequently take refuge in this habitat whenever extreme conditions prevail. Plankton also make their home in the open water habitat.

- Benthic -

Though the murky water of the Hudson prevents light from penetrating more than 6 feet, there is still a thriving community of organisms that makes the Hudson's bottom their home. This community is dominated by detritivores, which feed on the dead and decaying organic matter that collects on the river bottom. Clams and worms are examples of such organisms, which in turn feed carnivores such as fish and crabs.

An **ecosystem** is any group of living and nonliving things interacting with each other. The nonliving things could include sunlight, rainfall, soil nutrients, climate, salinity, water depth, etc... and the living things are the plants and animals that call the river home. Varying combinations of living and nonliving factors within an ecosystem create many different habitats, as we discussed above. Choose one nonliving factor and describe how variations in it might create different habitats. For example, how could salinity determine habitat? Then, choose one living thing and describe its impact on habitats. For example, look at the dense clusters of water chestnut in the aerial photos. The thick plant cover on the surface of the water creates a habitat for some organisms.



THE PHYSICS STATION

Objectives:

Students should leave this station experiencing some of the following:

- ◆ An introduction to the physical nature of the boat and some simple machines that help get work done.
- ◆ A hand-on demonstration of mechanical advantage, leverage, and friction.
- ◆ Relating these principles to everyday life.

The Station:

Physics is the science dealing with matter, energy, motion, and force. A quick glance around the decks of the *Clearwater* reveals that it is an ideal platform for discussing and experimenting with physics. The equipment on the sloop is very heavy and requires a lot of work, and without the assistance of simple machines we could never do it all. Simple machines allow us to do the work we normally could not accomplish. The basic simple machines are the inclined plane, the wedge, the wheel and axle, the screw, the pulley, and the lever. We use them all, but the most obvious simple machines visible on the sloop are the lever and the pulley.

Moving the enormous rudder on the *Clearwater* would be tough work without the tiller acting as a **lever**. Students will notice that the closer they are to the fist on the tiller, the easier it is to push it where it needs to go. This is a wonderful example of a lever in action. The students can also experiment with levers and leverage while helping to pump our bilges with the manual bilge pump. The mainsail with its enormous boom acts as a lever that wants to swing the boat into the wind. The resistance of the rudder, centerboard, and jib balance this effect. Have the students try and think of how they use levers in their daily life. Can you think of any levers that you use? A crow bar, scissors, and a nutcracker are good examples.

The pulleys on the boat are called **block and tackle**. Raising that 3000 pound mainsail would be near impossible without the help of block and tackle. But it is not magic. Block and tackle help us do the same work using less force. The catch is that we have to haul over a greater distance, or in the case of block and tackle, more line. Using a small block and tackle system the students will have a tug o' war to determine how blocks work and how much advantage may be gained from their use. If you set up the challenge correctly even the four strongest students in your group will not be able to beat the one person who holds the line with purchase, or advantage. The throat halyard has an advantage of four times, minus a fair bit for friction. Why do we not use bigger blocks with line running between eight or ten sheaves to give an advantage of eight or ten times? Remember that nothing in physics is free. It would be easier hauling up that heavy throat, but we would have to haul up so much line. Ten times the advantage means ten times the line!

Friction is one of the most important forces on the boat. The rope we used is braided or made up of many smaller strands. Each of those strands is made up of smaller and smaller fibers. The friction between all of those strands gives the rope its strength. When we haul up the huge mainsail and tie the halyards off at a cleat, friction holds each turn in place until we lock it with a hitch. The friction between the line and the cleat keeps all that weight from crashing down. And while you are holding that halyard, waiting for them to tie it off on the cleat, that burning you feel in your hands...that is friction, too!

SAILING BASICS

For many volunteers, a week aboard the *Clearwater* is their first introduction to sailing, or at least to sailing on a large, traditionally rigged vessel. *Clearwater* is a sloop, with an enormous mainsail that weighs about a ton and a half. All the blocks and tackle are large as well, and lines must be handled slowly and with skill. As a result, some sailing duties are reserved for the professional crew who are more familiar with the boat. However, you will be an active part of much of the sailing that occurs. If you have specific tasks you would like to learn more about, please let the crew know.

Throughout the day the mate will assign you various sailing duties ranging from steering the boat to coiling lines. It is important to be available and to complete the duties the mate asks of you. With so many different parts and with so much new vocabulary, it can be difficult to see how your contribution fits into the whole of a working vessel. If you do not understand your task, please do not hesitate to ask. Listed below are some pointers that will help you with your sail training.

Pointers-

1. The mate assigns sailing duties.
2. Stick to whatever duty you have been assigned
3. If you having nothing to do, ask the crew.
4. Remain quiet during docking, and be listening for instructions from the captain and mate.
5. Always coil lines clockwise.
6. The day is not done until the mate says so.
7. All hands means all hands (which means "Crew, come here!").
8. Always be aware of safety concerns around you.
9. If you do not know, ask!

Please refer to our reference section for some knots and vocabulary you may want to have under your belt before you arrive on board. Two-six heave!

CHORES

Clearwater serves as a home to around eighteen people, as well as a classroom for up to fifty people each sail. With this many people living on and using the sloop, keeping our home clean is essential. The *Clearwater* is undeniably a work boat, but we do try to keep her looking as best we can. The crew takes pride in keeping her clean, and we hope you will, too. But cleaning is about more than just appearances. Dirt attracts water, and water attracts rot. As you can imagine, rot is a dreaded foe on a wooden boat like the sloop.

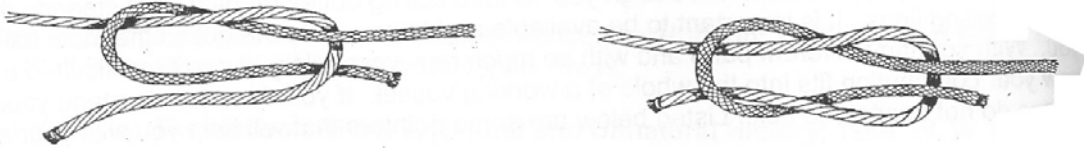
To keep things ship-shape, volunteers and crew rotate through a daily chore schedule. Most chores happen after meals, and include things like doing dishes, cleaning the heads (bathrooms), or sweeping and sponging the soles (floors). Usually once a week, the crew will do an extensive boat clean, or field day, to get all the corners and neglected spots.

Maintenance is another part of keeping the boat looking her best. Following the afternoon sail, or during designated maintenance days, the mate will assign maintenance jobs. Sometimes the jobs may seem a bit unglamorous, but even scraping, sanding, and painting all add to the overall beauty of our sloop. As the captains always say, "A clean boat is a happy boat!"

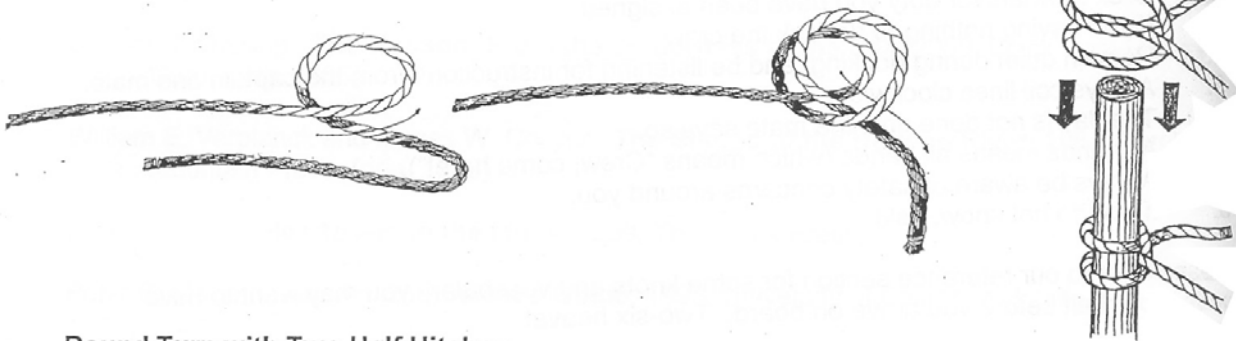
Knots to Know

As mentioned earlier, we will train you in everything you need to know once you come aboard. But if you really want to impress the crew, practice these few simple and practical knots at home with some clothesline or spare rope. It is usually best to remove the clothes from the clothesline before attempting any of the following:

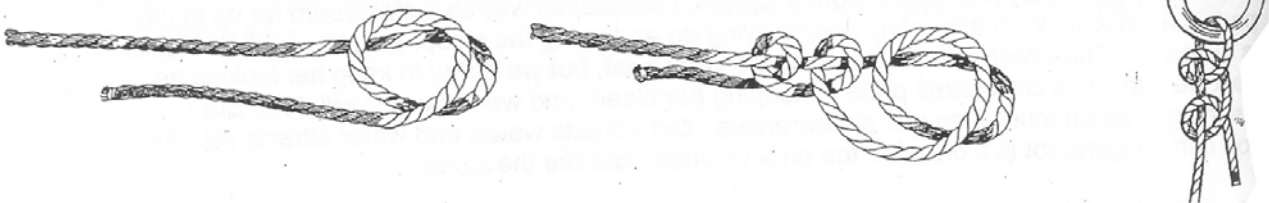
Square Knot



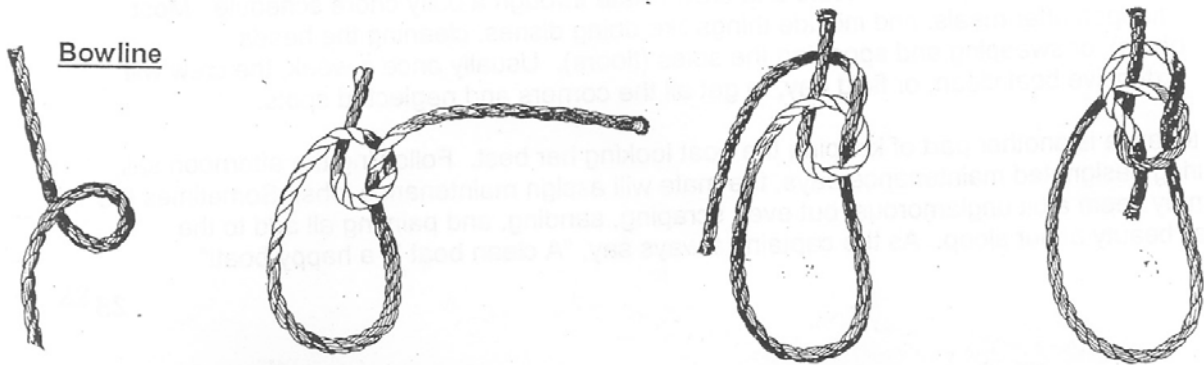
Clove Hitch



Round Turn with Two Half Hitches



Bowline



The Sailor's Dictionary

During your week on board the *Clearwater*, you will be learning the language of sailors. The following list of words will provide you with the basic vocabulary of your new language (expletives excluded, of course, to protect the young and the innocent). You will certainly get confused, since many sailing terms are either shortened or compounded words that help sailors compensate for their lack of teeth and/or proper enunciation. So, hoist up your bilges, hop on your jib horse and you will be spittin' tar from the lazy jacks in no time.

AFT - near or towards the stern of a vessel.

AMIDSHIPS - roughly the middle, or center, of the boat.

BILGE - the lower part of the interior of the hull, usually below the soles.

BOOM - the lower spar of the mainsail.

BOW - the forward end; the front.

CENTERBOARD - a retractable keel that adds to directional control.

CLEAT - a double horned-piece of metal or wood used for securing lines.

COMPANIONWAY - a stair or ladder and the space they occupy.

DOWN BELOW - sailor's talk for downstairs.

FORECASTLE (FO'CSLE) - The compartment "before the mast" where some of the crew live.

FURL - to fold or roll the sail on the boom.

GAFF - the upper spar of the mainsail.

GALLEY - the kitchen.

HALYARD - a line used to raise sails, spars, or flags.

HEAD - our lovely toilet

HULL - the main body of a vessel.

JIB - a three cornered sail carried forward of the forward most mast. *Clearwater* has one jib.

JIB HORSE - a horizontal beam on which the jib sheet blocks travel.

KEEL - the "backbone" of a ship; provides ballast and directional control.

LAZY JACKS - lines rigged from the crosstrees to the boom to catch the sail when dropped quickly

LEAD LINE - a long line with an oblong-shaped lead weight at one end for judging water depths.

MAINSAIL - the principle sail on the mainmast of a vessel. (pronounced "mainsil")

MAST - a vertical spar that supports sails and rigging.

PEAK - the after end of the gaff.

PORT - the left side of the boat when facing forward.

QUARTERDECK - the afterdeck from where the ship is coned (captained).

SHROUD - vertical cables extending from the sides to the crosstrees for supporting the mast.

SOLE - the floor.

SPAR - any rounded pole in the rigging on a sailing vessel.

STARBOARD - the right side of a vessel when facing forward.

STERN - the after end of any craft.

TACKING/GYBING - altering course in relation to the wind.

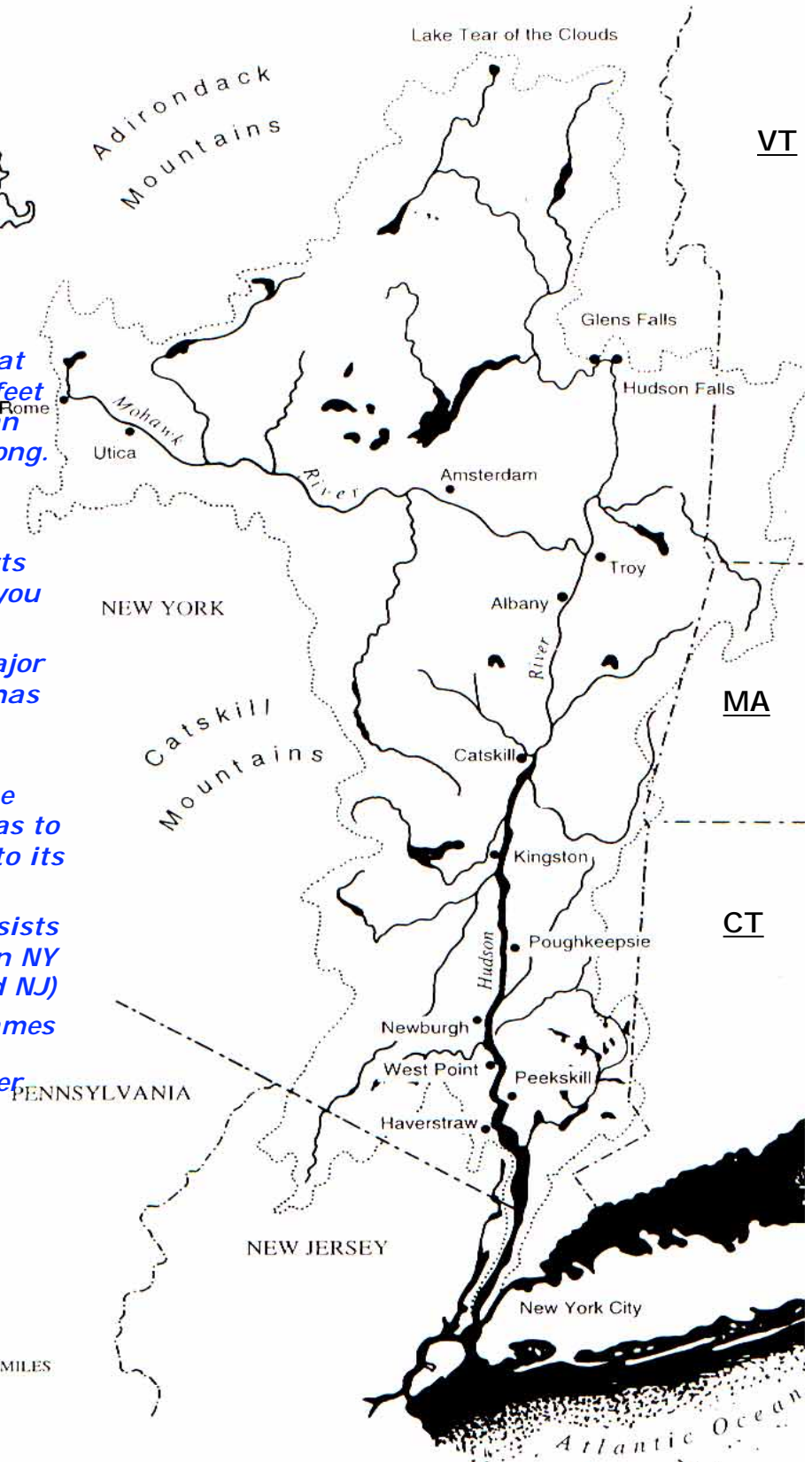
THROAT - the end of the boom or gaff that travels up the mast.

TILLER - the lever that moves the rudder while steering the boat.

The Hudson River Watershed

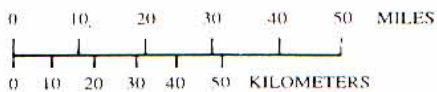


- From the Hudson's headwaters at Lake Tear of the Clouds (4,322 feet above sea level) to the Manhattan Battery, the river is 315 miles long.
- The lower river, from Troy southward, is a tidal estuary.
- The Hudson's watershed supports over 200 species of fish, 250 if you include New York Harbor.
- The Hudson is one of the few major rivers on the East Coast which has not lost any of its known native species of fish.
- As Ice Age glaciers retreated, the Hudson was one of the first areas to receive fish, which contributed to its present diversity.
- The Hudson drainage basin consists of 13,390 square miles mostly in NY but also parts of VT, MA, CT and NJ
- Native Americans have many names for the Hudson, including "Mohicahnituck", the great water flowing in many directions.



KEY

- Watershed Boundary
- State Boundary



Prepared by the Hudson River Sloop Clearwater
Watershed Map Courtesy of Hudson River Almanac NY DEC

RESOURCES

Most of these books should be in your local library. If you cannot find them ashore, you can find them in the *Clearwater* library when you come aboard. **The Hudson: An Illustrated Guide to the living River** provides the best overview of all the topics we cover onboard. This is not a required reading list!!! If you wish to delve into deeper detail these sources will guide you.

Clearwater's website - www.clearwater.org

Stephen P. Stanne, Roger G. Panetta, Brian E. Forist. **The Hudson: An Illustrated Guide to the Living River**; 1996, Rutgers University Press.

Robert H. Boyle. **The Hudson River: A Natural and Unnatural History**; 1969, W. W. Norton & Co., Inc. (out of print)

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The History of the Clearwater Volunteer Educator Guide,
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***Dedicated to the thousands of volunteers
who have been, and continue to be, the strength and
soul of Clearwater...***

THANK YOU