Hudson River Sloop Clearwater's



Volunteer Handbook For the



Schooner Mystic Whaler

WELCOME ABOARD THE SCHOONER MYSTIC WHALER!

So many school groups want to sail aboard the *Clearwater* in the spring that we cannot accommodate them all. Instead of turning people away, Clearwater hires a second boat and crew to sail with us in the time of heaviest demand. Since 1996, the Schooner *Mystic Whaler* has left its home port of New London, CT each spring to become *Clearwater*'s sister ship on the Hudson River for the season.

Clearwater places two educators, several education interns, and up to six volunteers a week on board the *Mystic Whaler* in addition to the schooner's permanent crew. The *Mystic Whaler* educators coordinate the same hands-on, field-oriented Sailing Classroom program for which the *Clearwater* is famous. A spring on the Mystic Whaler is a well-rounded experience: The educators, interns, and volunteers learn how to sail and the crew members learn how to teach!

Aside from some subtle differences, your volunteer experience on board the *Mystic Whaler* will provide the same challenges and excitement as a week aboard the *Clearwater*.



ABOUT THE MYSTIC WHALER

Built in 1967 and rebuilt in 1993, the *Mystic Whaler* is modeled after the coastal trading schooners of the 1800's. The *Mystic Whaler* is not a replica of a whaling ship, but is named and painted in homage to the whaling ships in Mystic, CT, the schooner's original homeport. The *Mystic Whaler* is owned and operated by Captain John Eginton and offers a variety of sails throughout its regular sailing season in the summer and fall in New London, CT and the Chesapeake Bay.

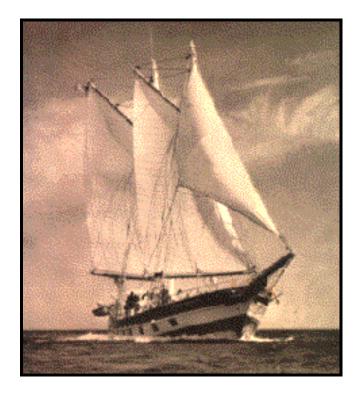
Designer: "Chub" Crockett
Built: 1967, Tarpon Springs, FL
Rig: Gaff-rigged schooner

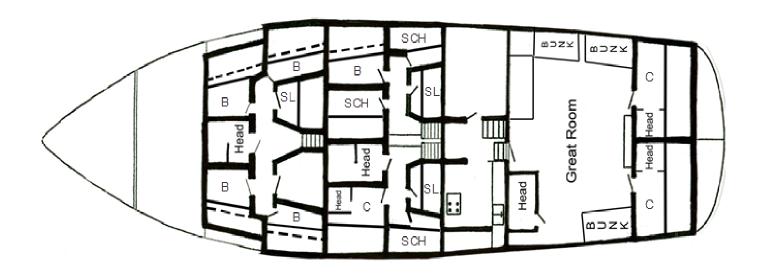
Home port: New London, CT

Sparred length: 110'
Length on deck: 83'
Length at water line: 78'
Draft: 7'6" (min); 13' (max)

Beam: 25' Rig height: 90'

Gross tonnage: 97 tons





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 40-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 Sailing Classroom 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 onboard 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 *Mystic Whaler* crew. And away we go....



Living on the Schooner

You are now living with more than a dozen people in a finite amount of space. We want you to feel like this is your home. Living aboard a boat requires cooperation and consideration from everyone. Here are some tips for better living during your stay with us.

- Your cabin has 3 lights that run off the same batteries that start the engine, make sure to turn them off when you leave your cabin.
- Your shower is outside your door (marked HEAD). Please take a "ship shower" (Water on, water off... soap up...water on, water off).
- There is one "head" (toilet) for us all to use. The light indicates that it is occupied. Remember to turn off the light when you are finished.
- Store personal items in your cabin, not in common areas. Cell phone conversations should be personal, and the dock is the best place.
- Dinner is a special time for all of us on the Mystic Whaler. It is a chance to relax, reflect and get to know each other. Be on time with hands washed, drink of choice, hats off and ABSOLUTELY no cell phones. If you will not be here for a meal, please let the cook know the day before or asap. A lot of planning goes into preparing meals for all of us and this bit of information will be very helpful.
- You are welcome to keep personal drinks in the ice chest on deck. Please take out only what you put in.
- The decks can be very slippery. Always wear shoes, (sandels with backs are ok).
- Quiet time is 10:00. You are never more than 6 feet away from someone's cabin that may have gone to bed before you. Please be aware of your surroundings and your voice level.

Every day you will learn something new about the boat, the routine and the beautiful river that you are on. When in doubt...ask a question, that's how we all learn.

Although living in close quarters can be challenging, the lifestyle on the *Mystic Whaler* tends to foster a close-knit camaraderie and community that 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 *Mystic Whaler*, but we always have room for the necessities listed below and a favorite instrument, camera, or sketchpad. 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
- 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 spring, the *Mystic Whaler* is on the estuary, teaching people about the Hudson. Our sailing territory includes the tidal river from Albany to New York City, as well as occasional ventures into New York Harbor, the East River and Long Island Sound. Volunteers typically arrive on Sunday and spend a portion of the first day training and getting acclimated to the boat. 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, as well as occasional transit sails 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 *Whaler* 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:

6:50:	Wake up bell
7:00:	Breakfast/Review of the Day
7:30:	Chores, Set up ed stations and trawl net
9:00-12:00:	Education Sail
12:00:	Lunch
12:30:	Lunch clean-up, reset trawl net
1:00-4:00:	Education Sail
4:00:	Furl sails, deck wash, ed equipment stowed
6:00:	Dinner
10:00:	Quiet time

Ah! the sailor's life.

Safety

Every week four new volunteers come aboard the schooner, 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 schooner carefully. Wet companionways and decks can be very slippery.
- 2. Stay off the foredeck when we are under sail.
- 3. Keep arms, legs, and head out from between the boat and the dock. Your body is more important than the rub rail.
- 4. Keep legs and feet clear of coils and lines when underway.
- 5. Do not stand on the cabin top when the boat is under sail.
- 6. Be mindful of moving parts (lines, blocks, sails, etc.)
- 7. Be quiet when docking, so the captain's commands may be heard.
- 8. Watch for the safety of passengers and guests while under sail.
- 9. 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.
- 10. Know your limits. This is not Outward Bound. We want you to have fun.

Rules and Regulations

Since the *Mystic Whaler* 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 schooner. Their presence endangers the boat, the crew, and the organization. The Coast Guard takes this subject *very* seriously, and so do we.
- 2. No one under the age of 21 may drink alcoholic beverages; no one under the age of 18 may smoke.
- 3. Drinking of alcohol before getting under way or while underway is not allowed.
- 4. If over 21, you may have alcoholic beverages at the end of the day at the discretion of the mate or captain.
- 5. We ask that, while dockside, the drinking of alcoholic beverages be done out of public view.
- 6. Passengers cannot go aloft. Volunteer crew may climb to the crosstrees after checking with the captain or mate.
- 7. Shirts must be worn in public view and at mealtimes.
- 8. Shoes must be worn at all times on the Schooner.
- 9. No stereos, headphones, or cell phones may be used while underway.
- 10.Quiet time is 10:00 PM. You do not need to go to bed, but be quiet for those who do.
- 11. Always check in with a crewmember before leaving the boat. The schedule can change on short notice and we may have places to go, and people to see.
- 12.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.
- 13.Remember you are Clearwater's ambassadors to our visitors under sail and dockside. Please be polite, courteous and respectful of others.



ABOUT CLEARWATER

Since we are asking you to be an ambassador between Clearwater and the public for the week that you are onboard, here is a bit of Clearwater history to arm yourself with.

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.

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* which occurs 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.

Volunteer Crew Duties

Once you arrive on the *Whaler*, the education staff will train you to assist them in the Classroom of the Waves program. Included in this packet is a description of some of the typical learning stations taught onboard the schooner. Do not be worried if you have little teaching experience. By the end of the week, you will feel comfortable teaching a group of fourth graders anything from how to identify a hogchoker to the finer points of a dissolved oxygen test.



Occasionally, adult groups or Clearwater members will want a less-structured sail. In these cases, learning stations may be set up as options in which the passengers can participate. Your role on these sails will be to engage the guests, to answer questions about the organization and the boat and to enjoy the ride.

Sailing duties for volunteers are limited on the *Mystic Whaler* because the permanent sailing crew's sole responsibility is the nuts and bolts of sailing the schooner and keeping it safe. But do not be shy. This is your experience. If you see the crew doing something that intrigues you, ask questions. The captain and crew are experienced in dealing with volunteers new to big boat sailing, and asking questions is the best way to get involved and find a task to which you can lend a hand.

And everybody is expected to lend a hand with general upkeep and chores onboard the schooner. After all, it is your home and community for a week. So do not be surprised to participate in deckwash, or be assigned to help clean the galley. Everyone will be doing it.

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 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 boat life. 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 12 to 20 minutes, depending on age and scheduling.



During less-structured sails, passengers may bring snacks or drinks, and will usually be focused on enjoying the Hudson River. 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 boat is a unique and engaging environment for teaching. The 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.



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.

What follows is an outline of the 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 a neutral buoyancy. In this manner, a fish can maintain its depth without expending energy from its muscles and fins.

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 predators, 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 thorough 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 it 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 on board 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 oils on our hands do not harm 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 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:

- 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:

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*) but later boats have metal hulls (like the *Mystic Whaler*)- 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 boat is in motion, our motion creates an "apparent wind" that moves the tell tales. 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 (Chemistry) 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 travelling 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, O₂, 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 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 usually 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 snow melt, 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 Great Room)

Objectives:

Students at this station will:

- Visit the Great Room area on the Schooner *Mystic Whaler*
- ♦ 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 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
- **♦** Literature
- ♦ Government
- ♦ Peace/War

- ◆ Energy
- ◆ Transportation
- ♦ Ecosystem
- ◆ Technology

On the timeline we've selected the following components:

- ♦ The Arts
- ♦ Government & Economy
- ♦ Science & Technology

- ◆ Ecosystem
- Hudson Valley Milestones
- ♦ Global Context

- Procedure -

- 1) The students sit
- 2) The educator welcomes the students to the Great Room explaining that this is where the crew has their meals together. This is also 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 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 you 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 *Mystic Whaler* reveals that it is an ideal platform for discussing and experimenting with physics. The equipment on the boat 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.

Many things onboard the boat could not be moved without the mechanical advantage provided by levers. 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 foresails 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 the mainsails 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 the crew hauls up the mainsail and ties 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 the line during the tug-owar that burning you feel in your hands...that is friction, too!

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 annunciation. 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 conned (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.

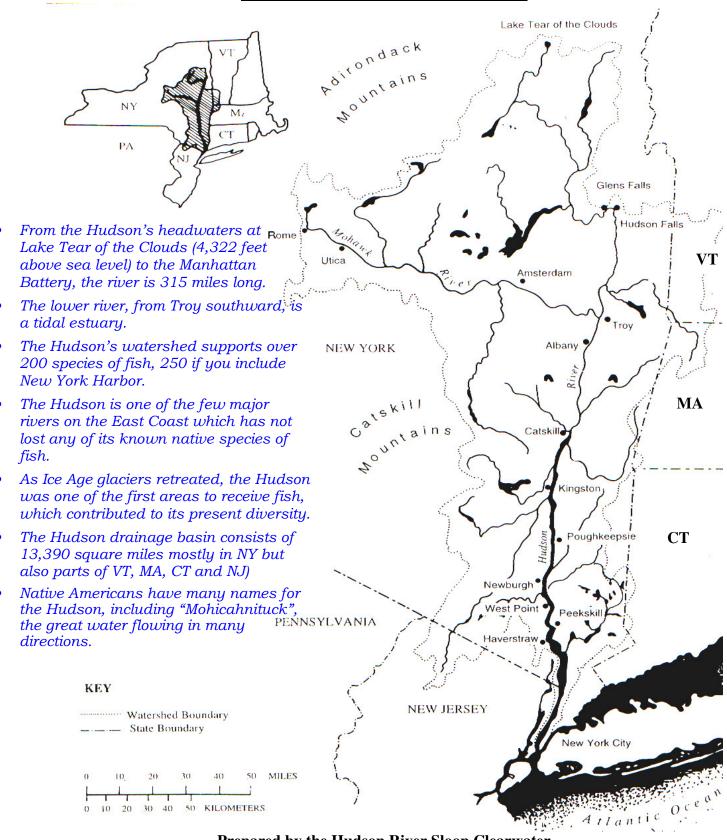
STARBOARD - the right side of a vessel when facing forward.

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.

The Hudson River Watershed



Prepared by the Hudson River Sloop ClearwaterWatershed 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 *Whaler* library when you get on board. **The Hudson: An Illustrated Guide to the Living River** provides the best overview of all the topics we cover on board. 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

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