underwater naturalist

Vol. 24, No. 4

AMERICAN LITTORAL SOCIETY

Thirty-eighth Annual Meeting
Chincoteague, Virginia - October 7-10, 1999

Once more to the Virginia seacoast for an annual meeting weekend of boat trips, hikes on beaches and in and near wetlands, visits to the Wildlife Refuge's wading bird and waterfowl ponds, the Chincoteague ponies, Delmarva fox squirrels, Sika deer, a seafood buffet, evening slide shows and talk, and the now traditional nighttime ghost crab beach walk. Two- and three-day packages will be available. We will sleep and eat at the Marine Sciences Consortium at nearby Wallops Island.

An invitation with schedules, details, and prices will be mailed to all members by the end of summer. For now, please circle and save the dates.

AMERICAN LITTORAL SOCIETY REGIONAL OFFICES

The Society maintains regional offices where members may keep up with local issues and events. Call the chapters for newsletters and local field trip information.

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732-291-0055

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P.O. Box 1306
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Olympia, WA 98508

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Bulletin of the American Littoral Society

Volume 24, Number 4

Cover Photography
by Pat McCarthy
Tidal wetlands on the Delaware Bay, New Jersey

Underwater Naturalist is the bulletin of the American Littoral Society, Sandy Hook, Highlands, NJ, 07732, and is mailed to members only as part of their dues. $15 for students, $25 for individuals, and $30 for clubs.
Note: Past volumes of Underwater Naturalist and individual articles are available on microfiche from UMI, Ann Arbor, MI 48106.

To the editor

DISCERNING READER CHECKS IN

...Your "last page" in the last UN was a tour-de-force (if one page can be so described). Witty, timely, lively... Socko. Thanks!

John Clark
Ramrod, Fl.

(I may use some of it in the novel I'm starting.) (OK?)

ALS JOURNAL SCOOPS NY TIMES BY 39 YEARS

Editor's Note:

July 6, 1999 marks the day THE NEW YORK TIMES *caught up with* UNDERWATER NATURALIST*: The lead story in the Times Science section that day was headlined "Evidence Puts Dolphins in New Light, As Killers" and went on to report that ... "scientists, following a trail of bloody clues, are discovering that dolphins are far from the happy, peaceful creatures that humans think they know...They have even been observed in recurring acts of infanticide."*

Such would hardly be news to veteran ALS members who need only consult their UNDERWATER NATURALIST *of fall 1967 (Vol.4, No. 2), where David and Melba Caldwell write that "the world of (the bottlenosed dolphin) is not always one of mutual helpfulness, or even tranquility...Aggression may take the form of a dominant animal simply facing and looking at one that is subordinate, body postures, open-mouth threats, chases and even physical butting and biting. The latter two often result in the recipient's being pinned to the bottom...or receiving deep tooth gashes anywhere on its body and extremities."*

We cite this as yet more proof that ALS membership and its publications are the one sure source of up-to-date information about the shallow sea and what lives there.

CREDIT, WHERE DUE

Editor's Note:

Much to our embarrassment, in Volume 24, Number 2 of the UNDERWATER NATURALIST *we failed to give credit where credit was certainly due. On pages 16 and 17, in the article titled "Living on Limulus", the illustrations of animals living on the body of horseshoe crabs are by Sue Draxler, a naturalist with the Monmouth County Parks System and a frequent illustrator for* UNDERWATER NATURALIST *as well as other ALS publications. Our apologies for this omission.*

The Mystery of Brown Tide

by DAVID K. BULLOCH

In the summer of 1985, a mysterious microorganism appeared in the waters of Peconic and Great South Bay in Long Island, New York, Barnegat Bay in New Jersey, and Narragansett Bay in Rhode Island. A miniscule creature, only 2 micrometers in diameter, which is about a fiftieth of the diameter of a human hair, it reproduced until its numbers exceeded a million cells in a milliliter of seawater. This phenomenal superabundance of life turned the water a dark color. The media quickly dubbed it "brown tide."

Since then it has reappeared in varying intensities every summer except 1996 in one or more of the bay systems of eastern and southeastern Long Island, including Great South Bay, West Neck Bay, South Shore Bay, and all or parts of Peconic Bay. It has also recurred sporadically in parts of Barnegat Bay. As autumn approaches and the waters cool, it abates and the waters turn clear. The cause of this recurring catastrophe is an organism new to marine science. It has since been named *Aureococcus anophagefferens*. This alga, in the size range of small bacteria, far exceeds normal levels of all other microscopic algae in seawater combined, which normally range from 100 to 10,000 cells per milliliter. (A milliliter is about a twenty-ninth of an ounce.)

A growing number of harmful algal blooms (HABs) occur along our coasts with increasing frequency each passing year. Red tides are among the more common. These are caused by population explosions of small organisms called dinoflagellates. Over a dozen species can cause HABs. These blooms do their damage via powerful neurotoxins carried within the single cell of these organisms.

The author directs the Society's southeast regional office from Sarasota, FL. He has written frequently in this journal.

While rarely toxic to shellfish, which filter them out of the water column for food, the residual toxins accumulate in clams and mussels to levels high enough to cause serious illness, even death, in whoever eats their flesh, be it fish or man. Still other microorganisms, commonly blue-green algae, do damage by proliferating quickly. They outrun their food supply then die off en masse. In death, their decaying cells rapidly deplete oxygen in the surrounding waters, suffocating fish and invertebrates.

Brown tide devastation takes another path. Because the organism reproduces in such astronomical numbers and is able to maintain those numbers for months until cold weather or some other factor shuts them down, the effects of the bloom damage the ecosystem by blocking out sunlight, absorbing the available dissolved nutrients and crowding out major portions of the plankton, the drifting life of the sea. The turbidity produced by their huge numbers is often so great that sunlight is cut off from all but the shallowest bay bottom. These bay bottoms are normally covered with rich beds of eelgrass, *Zostera marina*. Without sunlight, the eelgrass perishes and with it, the life the eelgrass beds sustain.

At the height of a bloom *Aureococcus* makes up over ninety percent of the biomass of the plankton. Larger forms, mainly zooplankton that normally feed on smaller (10 to 40 micrometers) phytoplankton, are almost non-existent in the bloom. As a consequence, the microorganism's prolific growth severely disrupts links in the food chain provided by the plankton. The web of life in the sea has at its base edible phytoplankton; the equivalent of grass to the herbivores among the zooplankton. *Aureococcus* is a phytoplankton. Either because it is too small to be easily captured or is rejected for an as yet unknown reason, it does not provide a decent meal for zooplankters who subsequently die off. Its prolific growth presents yet another problem for other small plankton. It absorbs most of the dissolved organic nutrients from the water column, depriving those organism of a source of food. Also, small phytoplankters depend on sunlight to photosynthesize food. Sunlight penetration into the water is very much reduced by the presence of so many *Aureococcus* cells in the water.

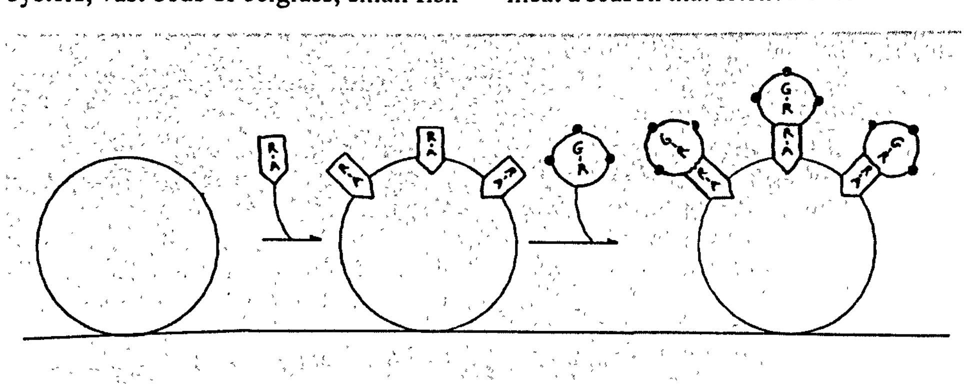
Larger filter-feeding invertebrates suffer as well. *Aureococcus* is too small for them to capture efficiently. Simultaneously, the bloom eliminates the planktonic creatures on which they depend. And those who can catch this miniscule alga don't seem to want it and stop feeding, suggesting it may have a toxic or inhibitory component within it that makes it unpalatable.

As the proliferation of this minute algae wipes out their food sources, the bay scallop, mussel, and oysters are decimated, and the hardshell clam, which can withstand long periods of starvation by using stored reserves, are not fit to harvest.

The impact on the ecosystems of the affected Long Island bays has been severe. Peconic Bay has lost its scallops, oysters, vast beds of eelgrass, small fish and invertebrates that depend on the eelgrass, and larger migrant species of fish that normally fed on baitfish in these waters. Massive blue mussel (*Mytilus edulus*) mortalities, over 95 percent in some areas, occurred in Narragansett Bay during the 1985 brown tide event. Hard clams in Narragansett Bay and Great South Bay survived but their tissue weight significantly declined during those summer episodes.

For the bay scallop, *Argopecten irradians*, the recurring reemergence of the alga over multiple seasons has had disastrous consequences. The bay scallop has a life span of 18-22 months. Its survival strategy is to mature rapidly and breed at the end of its first year, just one time before dying at the end of its second year. Unfortunately, the larval stage of the scallop suffers 100% mortality in the presence of the bloom. The persistence of the bloom for more than two seasons leaves all the adult breeding population dead from old age and starvation and all their offspring dead from the effects of the bloom. Thus the scallop is near extinction in these waters.

The demise of the bay scallop has caused considerable hardship among the baymen in the area. Bay scallop harvests prior to the appearance of the organism averaged 250,000 to 500,000 pounds of meat a season that fetched over a million



Diagrammatic representation of the immunofluorescence method. Rabbit antisera attaches to A. anaphagefferens *in the first step and a generic anti-rabbit sera that carries a fluorescent tag then attaches to the rabbit antisera in the second step. This technique is widely used to identify bacteria as well.*

dollars at market. Since the onset of the blooms the harvests have been next to nothing. The state of New York and Suffolk County have tried reseeding scallops, as well as replanting eelgrass, but the yearly reappearance of the algae has thwarted their efforts.

Attempts to explain the original bloom and its recurrence in Peconic Bay and the South Shore Bays, in part, hinge on unusual environmental conditions. Water temperature has to reach 25C and salinity 28 to 30 parts per thousand (ppt). The year the first bloom appeared, 1985, had been preceded by several years of drought in the northeastern United States. Peconic Bay was much saltier than normal. The Bay averages 25 ppt in normal years. In 1985 it was closer to 30 ppt. If the organism was present in northeastern waters for some time prior to the bloom why did it suddenly bloom and then persist year after year in certain waters and not elsewhere?

Aureocuccus is similar, but not identical, to an open ocean phytoplankter, *Pelagococcus subvirida*, which has shown up in water samples from the mid-Pacific Ocean to the shores of Norway. Whether *Aureococcus* has always inhabited local waters or is a newcomer has yet to be resolved. First, it escaped notice completely before the bloom. In concentrations that are normally considered high for phytoplankton, it went undetected. A thousand cells per milliliter would have been completely overlooked, and, if noticed, would have been impossible to identify.

As the bloom began in 1985, short pulses of heavy rainfall brought stormwater runoff into the local waters. Did this water bring with it ingredients that played a role in sustaining the bloom? Once the bloom got underway in Peconic Bay it is thought to have persisted there because of the configuration of the Bay and its slow flushing rate. The Bay is enclosed by the north and south forks of Long Island and partially blocked to the east by Shelter Island. Water in the Bay has a residence time of 56 days. Both the geographic setting and the reduced flushing might have prevented the bloom from dissipating by dilution.

In subsequent years the rapid reappearance of the bloom in late spring, usually late May, suggests the organism forms resting spores in the previous fall which reemerge as the waters warm up. So far no one has been able to demonstrate that this is so or that a benthic cyst stage exists. It may be that the cells of *Aureococcus* simply stop reproducing in cold water and either remain suspended in the water column or sink to the bottom and await spring. Both the alga itself and its direct effects on other organisms are still something of a mystery. In some waters, it has coexisted with other minute plankton; in very high concentrations, it appears to outcompete all rivals.

Aureococcus is so small and so nondescript that it is well nigh impossible to identify with an ordinary light microscope. It appears as little more than dots at the highest magnifying limits of the instrument. Initially, the study of these picoplankters, as all miniscule sea forms less than 20 micrometers in diameter are collectively called, required the use of a transmission electron microscope (TEM), which involves much specimen preparation, an expensive device, a skilled operator, and an expert interpreter. Dr. John Seiburth of the University of Rhode Island classified it as a chrysophyte using ultrastructure information obtained by TEM.

TEM is meant for that sort of work, not for day-to-day observations. There is another instrument called a scanning electron microscope (SEM) which looks at surfaces and is less expensive and easier to operate than TEM. The problem is the microorganism has no distinguishing features under SEM. It looks like a fuzzy ball with a slight dent in it. Unfortunately, so do a lot of other things in nature.

An immunofluorescence technique

has come to the rescue and allowed some basic questions to be answered. It works by obtaining antibodies specifically targeted to the outer cell wall of *Aureococcus*. It works using a simple immune response principle. When a surface containing foreign proteins enter the blood stream of a mammal, the animal's immune system recognizes it as a stranger and begins to produce antibodies that attach to it and attack it.

When cells of *Aureococcus anophagefferens* are injected into the blood stream of a rabbit, the rabbit develops antibodies that respond to the surface proteins of *A. anophagefferens* which are unique to that species and no other. The antibodies the rabbit produces can be harvested from rabbit's blood. The antibodies contain not only an affinity for the specific proteins on the surface of the alga but also contain proteins specific to rabbits. One can get commercial preparation of a goat antibody that will specifically attack and attach to rabbit antibodies. This preparation has an additional modification; a flourescent tag has been attached to it. Thus a sample of water suspected to contain the cells of this alga can be filtered and treated with rabbit antibodies, or antisera as it is called, and washed well. The antisera will adhere only to the cells of *A. anaphagefferens*. Then the goat-derived anti-rabbit antibody (that is, a generic antisera that will attach to proteins found only in rabbit antisera) to which a fluorescent marker has been attached is added. It adheres only to the rabbit antisera.

Now we still have very small particles to deal with, but we can find and positively identify them by illuminating them with fluorescent light. Only *A. anaphagefferens* will have the fluorescent tag attached to it. The specimen is now ready to be observed with a microscope adapted to use fluorescent illumination.

Fluorescence is a process whereby short wavelength light is absorbed by a substance and longer wavelength light is emitted. What is absorbed and what is reemitted is fairly specific to the fluorescent tag used. Generally, near ultra-violet or blue light is used as the exciter and green, yellow, or red light is emitted. Since the emitted light is weak, a filter cutting out all the reflected short wavelength light is placed in the optical path of the microscope. Only the longer wavelength emissions reach the eye. The marked cells light up, appearing bright against a black background, and can be counted.

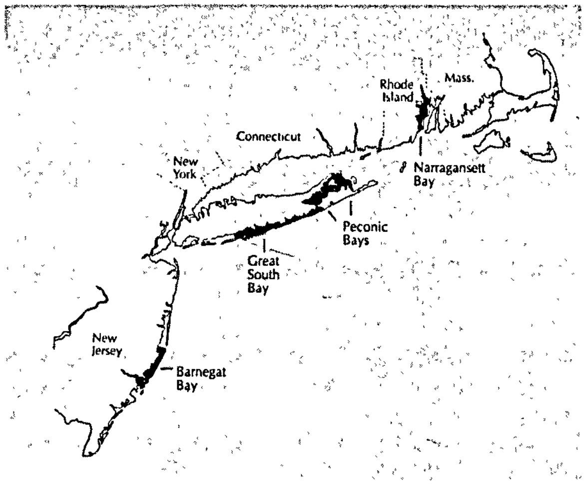
This is a specific way to identify *Aureococcus* algae in a mixed culture. Prior to the development of this technique, unless *Aureococcus* existed in large numbers and a lab had a TEM available to examine a plankton sample, such an elusive creature of such small size and undistinguished appearance would completely escape detection or could easily be confused with other picoplankton. Thus, until this technique was developed, scientists had no idea how widespread this organism was off our coasts. We now know it is remarkably common off New England, New York, and New Jersey shores but in relatively small numbers.

The alga is a coccoid, non-motile chyrsophyte (maybe not; new evidence suggests it may be a pelagophyte), a single-celled, nucleus and chloroplast bearing organism that grows and reproduces using carbon dioxide and nutrients in the water by photosynthesis, i.e. an autotroph. The alga is also capable of obtaining all its nutrient needs from dissolved organic matter in the water, i.e. a heterotroph. It can multiply at a pace as high as three divisions a day but, on the average, closer to once per day. The organism was originally very difficult to cultivate in the lab. Lab cultures grew faster in seawater taken from the bloom area than from synthetic seawater or natural seawater from non-bloom areas of the sea. This suggested bloom water contained a growth promoter.

Classically, phytoplankton blooms

occur in waters containing high nitrogen and phosphorus loads. But, in the waters affected by the bloom, neither nitrogen nor phosphorus were high. Many other locales along nearby coastlines have higher N,P loads than Peconic Bay, which is considered a relatively pristine body of water. Baymen have commented that prior to brown tide blooms, water clarity has been good enough to see the bottom at a depth of 16 feet.

Perhaps the bloom removed most of the N,P from the water, but scientists found N,P was not substantially different in Bay waters in years before or after the onset of brown tide blooms. Nor were the forms of nitrogen particularly important; cultured *Aureococcus* grew just as well whether the source of nitrogen was nitrate, nitrite, ammonium, or urea.



Extent of the brown tide bloom in the summer of 1985. In later years the bloom was confined to Long Island bays. The bloom has not occurred in open water or in Long Island Sound.

The findings that culture success depended on the source of the seawater led to work on micronutrients. Culture studies showed the organism required trace elements, a chelating agent, and dissolved organic matter for rapid growth. The trace elements most important were iron and, to a lesser extent, selenium. As for a chelating agent, citric acid worked well. A chelate is a compound that can hold a metallic ion in solution, modifying its properties, and make it available for biochemical reactions.

Field work justified lab work on iron. Iron levels in afflicted waters fluctuate above and below levels needed in cultures to sustain rapid growth. Iron-rich water from deep water aquifers has come into common use on Long Island and this water finds its way into the bays via runoff. The uptake rate of iron in a growing bloom can strip the dissolved iron from water within an hour. It is thought that is what happened during the initial 1985 bloom. The drought, followed by pulses of rain, brought iron rich water to the bays at just the right time.

Citric acid, one of many chelating agents that will hold iron, has come into common use as a replacement for phosphate in household detergents. This is likely to be entering the Bay through secondary sewage effluent or septic tank leachate.

The alga is thought to be non-toxic although there is some evidence that certain filter feeders reject it as though it were toxic. Why then has it been so destructive? For the eelgrass, it's a shading effect. The enormous concentrations of algae simply cut off the light. Eelgrass can survive only in water whose clarity is equal to Secchi Disk depth, that is, it will only grow a distance down where an 8-inch white disk can be seen from the surface on a clear, calm day. In summer, the brown tide can reduce the Secchi Disk depth to less than a foot and a half in most of Peconic Bay. Unfortunately the peak concentrations of brown tide coincide with the peak growing season of the grass.

With shellfish the problem is partly starvation and partly something else, as yet unknown. Most shellfish don't retain such small particles well but that is not the whole story. Either the high number of particles, their toxicity, low nutritional value, or something else causes the shellfish to either stop feeding or not use what they are able to filter out.

The variations in concentrations of *Aureococcus* in different parts of the Long Island bay systems from year to year and over the course of the season has prompted studies on the grazing pressure of select plankton on this organism. One, in particular, a ciliate, *Strombidium*, common to Bay waters will consume *Aureococcus* selectively even when other prey are available. Most other plankton carnivores won't touch it.

An organism similar but not the same as *A. anaphagefferens* is present in the hypersaline lagoons in the Laguna Madre ecosystem along the Gulf coast of Texas. Its diameter is twice that of *A. anaphagefferens*, 4 - 5 micrometers. It does not bloom as explosively as its northern cousin, perhaps because it is heavily grazed by the dwarf surf clam, Mulina lateralis. Nevertheless, sea grasses have diminished or have been completely lost in depths below four feet, benthic creatures have declined both in abundance and diversity, zooplankton populations have been reduced, and larval fish are down in impacted areas. Its scientific name is *Aureoumbra lagunensis*.

During the original work using TEM to delineate the ultrastructure of *A. anaphagefferens*, a phage-like virus was seen within some cells. In later experiments, the virus was isolated, grown in cultures, and concentrated. When added to cultures of healthy *Aureococcus*, the cells were rapidly attacked and burst apart (lysed). Investigators tried to use the virus culture to attack five other chrysophytes common in Long Island waters but none were lysed.

The discovery that there exists a virus that specifically invades and destroys only this brown tide organism suggest this might be the mechanism that causes occasional population crashes and that inhibits it from reaching bloom proportions under some circumstances. As yet no on has proposed using the virus as an agent to stop the yearly occurrences of the bloom.

The destructiveness of this little organism has spawned a cottage industry among investigating scientists. At least 14 marine science organizations are involved. Reams of peer-reviewed papers in scientific journals have been published. Symposia devoted wholly to this organism are held regularly. New York Sea Grant now publishes "Brown Tide Research Initiative" and holds an annual BTRI informational symposium for the public in which the latest information and the thrust of future scientific work is presented. (For more on this, contact Patrick Dooley at New York Sea Grant, 121 Discovery Hall, SUNY Stony Brook, Stony Brook, NY 11794-5001.)

For all the work done to date, this creature is still an enigma. It poses many more questions than have been answered. Fourteen years have passed since it made its first appearance, and eastern Long Island still suffers from this summertime plague with no end in sight, no answers on why it recurs, nor more than a few vague clues on what stimulates its growth in these waters. □

A Brief History Of Ocean Exploration

by J. MURRAY, T.H. TIZARD, H.N. MOSELEY and J.Y. BUCHANAN

This is the first chapter of a planned series of pieces describing the early annals of marine exploration. This first history will bring all readers up to 1872 when the British launched the Challenger Expedition for a systematic, worldwide exploration of the ocean, shallow and deep. Ocean study began with Aristotle 2300 years ago; he studied the Aegean Sea as well as could be expected, the authors note, for someone who lacked scientific apparatus. This article was edited by David Bulloch.

A brief review of the efforts made to acquire a knowledge of the ocean, and a general account of the opinions held prior to the year 1872 as to the physical and biological conditions of the great ocean basins, may form an appropriate introduction to the narrative of the voyage of H.M.S. *Challenger*. The objects which the promoters had in view when they urged Her Majesty's Government to fit out and dispatch an expedition on a special scientific investigation of the depths of the sea will thus be indicated.

The sea and life in its waters were little studied by the learned men of the ancient civilizations, which were clustered round the nearly tideless Mediterranean. Their sea-lore consisted in great part of wildly exaggerated descriptions of the more striking marine phenomena woven into a vague mythology. The sea was an object of terror, for navigation was uncertain in the extreme; what lay beyond the Pillars of Hercules was veiled in mystery, and what lay beneath the surface of the waters crossed by the ancient navies was equally unknown.

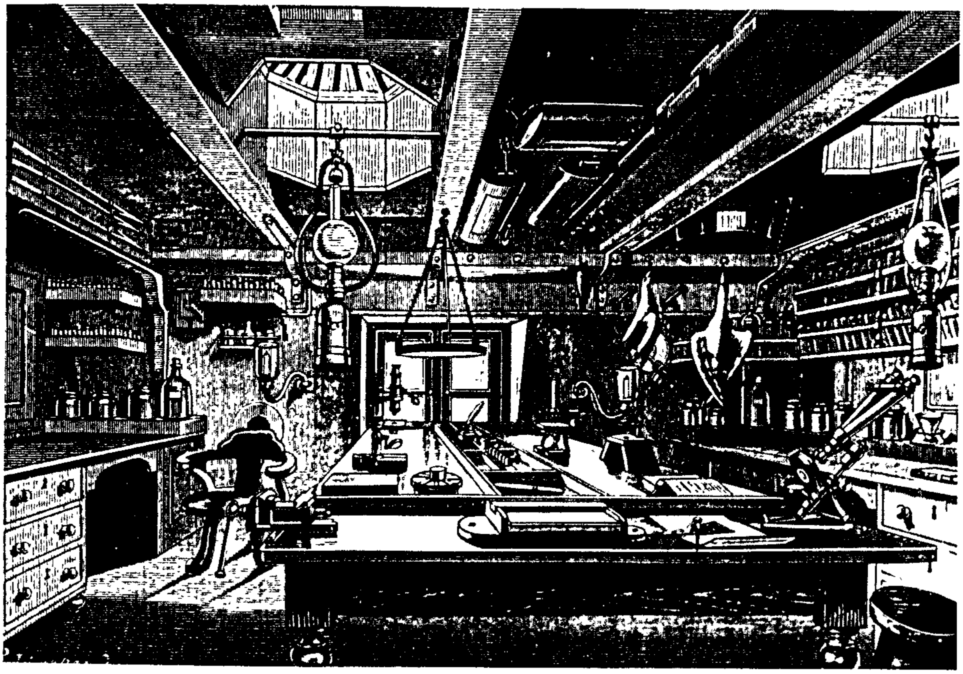
The sea was not, so far as is known, made the subject of close attention until Aristotle (384-322 B.C.) brought his mind to bear on it in common with the other departments of natural history. Aristotle studied the physical conditions of the sea as far as a man without apparatus could study them. He thought that in the ocean the water was warmer and saltier at the surface than at the bottom; he considered that as the sun's heat was always evaporating the water the sea would ultimately be dried up. Aristotle's opinions regarding ocean physics must be viewed as mere speculations, but his researches on marine animals were of distinct scientific value. He named and described more or less minutely one hundred and sixteen species of fishes, about twenty-four species of crustaceans and annelids,and some forty molluscs and radiates, making a total of one hundred and eighty species inhabiting the Aegean Sea; and the student is still reminded of his study of the anatomy of *Echinus* by the significant name "Aristotle's Lantern" applied to its masticatory apparatus.

After Aristotle no original inquirer into these matters appeared for many centuries.

Pliny the Elder (23-79 A.D.) in his gossipy "Natural History" presents Aristotle's discoveries modified by much subsequent superstition and tradition. He concisely catalogues marine animals into one hundred and seventy-six species, being four less than the number recorded by Aristotle in the Aegean Sea alone.

Pliny had to confess himself unable to give a detailed account of the depth of the ocean, some parts he stated to be 15 stadia (over 1500 fathoms) deep, others "immensely deep, no bottom having been found;" but he makes up for this in a way by explaining very clearly "why the sea is salt." He says:

> "Hence it is that the widely diffused sea is impregnated with the flavour of salt, in consequence of what is sweet and mild being evaporated from it, which the



The zoological laboratory on the main deck of the Challenger.
(From the Challenger Report, *Narrative,* Vol. 1, First Part*).*

force of fire easily accomplishes; while all the more acrid and thick matter is left behind, on which account the water of the sea is less salt at some depth than at the surface."

In this explanation Pliny followed Aristotle, and helped to open up a magnificent arena for the hair-splitting scholastics of the Middle Ages to dispute in. Bishop Watson [1782] says:

> "There are few questions respecting the natural history of the globe which have been discussed with more attention, or decided with less satisfaction, than that concerning the primary cause of the saltiness of the sea. The solution of it had perplexed the philosophers before the time of Aristotle; it surpassed his own great genius, and those of his followers who have attempted to support his arguments have been betrayed into very ill grounded conclusions concerning it. Father Kircher after having consulted three and thirty authors upon the subject, could not help remarking, that the fluctuations of the ocean itself were scarcely more various than the opinions of men concerning the origin of its saline impregnation."

It was not until the time of Boyle that the theory at present held regarding the origin of salt in the sea was propounded.

The rage for geographical exploration which set in after the discovery of America naturally brought the phenomena of the sea into greater prominence. Sir John Hawkins' story, as told by Boyle (1699), while almost poetical enough to suggest Coleridge's well-known lines,

> "The very deep did rot: O Christ!
> That ever this should be!
> Yea, slimy things did crawl with legs
> Upon a slimy sea."

has yet a flavour of scientific observation about it:

> "Were it not for the moving of the sea, by the force of winds, tides and currents, it would corrupt all the world. The experiences which I saw Anno 1599, lying with a fleet about the islands of Azores, almost six months, the greatest part of the time we were becalmed, with which all the sea became so replenished with several sorts of gellies and forms of serpents, adders and snakes, as seem'd wonderful; some green, some black, some yellow, some white, some of divers colours, and many of them had life, and some there were a yard and a half, and some two yards long; which had I not seen, I could hardly have believed, so that hardly a man could draw a bucket of water clear of some corruption."

The science of the sea may be said to date from the seventeenth century. The methods were crude, but they sometimes contained the germs of great ideas; the results arrived at were often erroneous, but they were steps in the right direction; and the researchers were animated by the true scientific spirit, the spirit of observation and experiment.

In his paper, "Of the Saltiness of the Sea" (1699), Boyle detailed a great number of experiments. He personally made a series of observations on the water of the English Channel, collecting it from various depths and observing its specific gravity. The samples from beneath the surface were probably procured by means of Hooke's water-bottle, an extremely ingenious valved box, which is fully described and figured in one of the early numbers of the "Philosophical Transactions" (vol. ii. p.442, 1667). Boyle investigated the saltiness of the water by a number of processes: he tried to estimate the total solids by direct evaporation and ignition, but not being satisfied with the result he ultimately took the density as an index of the saltiness, and determined this either by means of a glass hydrometer, by weighing in a phial which was afterwards weighed when full of distilled water, or by weighing a piece of sulphur in distilled water and sea water consecutively.

About this time Hooke invented a machine for ascertaining the depth of the sea without a line. It consisted of a sphere of light wood carefully pitched and varnished, which was sunk by means of a leaden sphere attached to it by a spring hook. When it reached the bottom the catch was released by the impact, the lead ball remained and the float rose to the surface. The depth was calculated, by means of a certain formula, from the time elapsed between letting it go and again seeing the float; and the machine answered well in shallow and still water. Hooke himself pointed out that in a current it would not show the true depth, but that the arrangement would be extremely valuable as a means of detecting under currents, and measuring their direction and velocity. The idea of self-detaching weights was not revived for two hundred years, when Brooke's sounding machine was invented.

Deep soundings in several parts of the ocean were recorded about the middle of the eighteenth century, but considerable caution must be used in discussing these, as the methods in use at that time were not such as to make any depth exceeding a few hundred fathoms a matter of certainty. In 1749 Ellis sounded at 891 fathoms off the northwest corner of Africa, and observed the temperature at that depth. Before the invention of the self-registering thermometer, the temperature below the surface was ascertained by taking a sample of water from the required depth in a bottle or valved box made of imperfect heat-conductors as possible, and noting the temperature when brought on deck; this, at its best, was unsatisfactory.

In 1558 appeared the fourth book of

Gesner's work on the HISTORY OF ANIMALS, which is devoted to the nature of fishes and marine animals, and John Jonston, who studied at St. Andrews in 1619, published in 1649 a treatise on aquatic animals, while other authors of less note contributed to the slowly increasing knowledge of littoral and pelagic animals and plants during the fifteenth, sixteenth, and seventeenth centuries.

The honour of first employing the dredge as a means of scientific investigation is claimed for two Italian naturalists, Marsigli and Donati, who about 1750, used an ordinary oyster dredge for obtaining specimens in shallow water. In 1779 Otto F.Muller, a Danish zoologist, invented a special naturalist's dredge, a net attached to a square iron frame, and with this arrangement he studied the marine fauna of the coast of Denmark to a depth of 30 fathoms. The rich variety of form and colour, the enormous abundance of living creatures of all kinds, seemed like a revelation of a new world. It may be imagined how those old explorers felt who first caught sight of the wonders hidden by the waves on reading Edward Forbes' enthusiastic description of his first deep-water dredging:

> "Beneath the waves there are many dominions yet to be visited and kingdoms to be discovered, and so he who venturously brings up from the abyss enough of their inhabitants to display the physiognomy of the country, will taste that cup of delight, the sweetness of whose draught those only who have made a discovery know. Well do I remember the first day when I saw the dredge hauled up after it had been dragging along the sea bottom, at a depth of more than a 100 fathoms. Fishing lines had now and then entangled creatures at as great, and greater depths, but these were few and far between, and only served to whet our curiosity, without affirming the information we thirsted for. They were like the few stray bodies of strange red men which tradition reports to have been washed on the shores of the Old World, before the discovery of the New, and which served to indicate the existence of unexplored realms inhabited by unknown races, but not to supply information about their character, habits, and extent. But when a whole dredgeful of living creatures from the unexplored depth appeared, it was if we had lighted upon a city of the unknown people, and were able, through the numbers and varieties taken, to understand what manner of beings they were. Well do I remember anxiously separating every trace of organic life from the enveloping mud, and gazing with delighted eye on creatures hitherto unknown, or on groups of living shapes, the true habitats of which had never been ascertained before, nor had their aspect, when in the full vigor and beauty of life, ever before delighted the eye of the naturalist. And when, at the close of day, our active labours over, we counted the bodies of the slain, or curiously watched the proceedings of those whom we had selected as prisoners, and confined in crystal vases, filled with a limited allowance of their native element, our feelings of exultation were as vivid, and surely as pardonable, as the triumphant satisfaction of some old Spanish Conquistador musing over his siege of a wondrous Astlan (Aztec) city, and reckoning the number of painted indians he had brought to the ground by the prowess of his stalwart arm" (Natural History of European Sea 1859).

Dredging in shallow water was found to be so easy, and its results so interesting, and often so unexpected, that it soon became popular among naturalists, and assisted in turning their attention more particularly to marine life.

The increased interest in the biological conditions was accompanied by a more careful study of the physical and chemical problems presented by seawater. A great many analyses were made towards the end of the last century, but the methods then employed were too imperfect to yield results of much scientific value, and the principle on which they were conducted was erroneous. It was assumed that a proximate analysis of the salts in sea water could be made by weighing the amount of each particular salt that could be separated from the water, and thus these analyses gave long and very conflicting lists, all claiming to present the precise quantity of sulphate and muriate of soda (sodium sulfate and sodium chloride), of sulphate and muriate of magnesia (magnesium sulfate and magnesium chloride), and of sulphate and muriate of lime (calcium sulfate and calcium chloride), in the water. It was not until 1818 that the different proportions in which these salts were procured were conclusively shown to be due, not necessarily, to any difference in the sea water, but to differences in the methods of analysing it. In that year Dr. John Murray of Edinburgh published an extremely valuable research on the water of the Firth of Forth; he showed that by treating portions of the same sample of water in different ways, widely different quantities of the various salts might be obtained, and that the only satisfactory method of proceeding was to determine each base and each acid separately. The samples could not be relied upon as properly collected or preserved, and much uncertainty remained on the subject.

Peron, a French naturalist who went round the world in the year XII of the republic (1805) made a number of observations on the temperature of the ocean at different depths. He was strongly impressed by the importance of oceanic research, and wrote:

> "Of all the experiments in natural philosophy there are few the results of which are more interesting or more curious than those which form the subject of this memoir. The meteorologist must derive from them valuable data in regard to atmospheric observations in the middle of the ocean; they may furnish to the naturalist knowledge indispensably necessary in regard to the habitation of the different tribes of marine animals; and the geologue and philosopher will find in them the most certain facts in regard to the propagation of heat in the middle of the seas, and of the physical state of the interior parts of the globe, the deepest excavations of which can scarcely go beyond the surface. In a word, there is no science which may not derive benefit from the results of experiments of this kind. How much then ought we to be surprised that they have hitherto excited so little attention!"

Peron's results were very erroneous; he imagined that the bed of the ocean was covered with eternal ice, and that, as a consequence, life was impossible there. From the state of deep-sea research at the time this theory was quite plausible and required to be refuted before it was rejected. Sir John Ross's great Arctic voyage in 1818 furnished complete and most satisfactory evidence that Peron's deductions were wrong. Apart from the exploring work and the very valuable magnetic observations of Ross's expedition, it stands out in history as the first in which satisfactory soundings were made and sample of the bottom obtained. Ross had invented an arrangement, which he called the "Deep-sea Clamm," for gripping a portion of the bottom and bringing it up safely. He attached this to the line on a number of occasions, and succeeded in bringing up as much as 6 lbs. of mud from the great depth of 1050 fathoms in Baffin Bay; and on September lst, 1819, in Possession Bay, "soundings were obtained correctly in 1000 fathoms, consisting of soft mud, in which there were worms, and entangled on the sounding line, at a depth of 800 fathoms, a beautiful *Caput-Medusae*, thus proving that there was animal life on the bed of the ocean notwithstanding the darkness, stillness, silence, and enormous pressure produced by more than a mile of superincumbent water. Starfishes were frequently found attached to the line at depths of over 800 fathoms from the surface, but these discoveries were strangely lost sight of for many years. The zoological collections made on this voyage must have been of great scientific value, and it is much to be regretted that, on their arrival in this country, a large number of the specimens were in a state unfit for identification. The scientific work of the expedition had been entrusted to Sir Edward Sabine, who, while anxious to do justice to the whole circle of the sciences, naturally devoted himself most to his own department of physical and magnetic observations. Sir John Ross keenly felt the want of a naturalist. He writes:

> "An endless variety of the class *Acalephae* were brought home, and sent to the Museum, but in a state so much contracted by the spirit as to render it impossible for Dr. Leach to make out their genera. Observations on these animals whilst living accompanied by accurate drawings, are quite necessary to render the preserved specimens of any degree of use; and it is to be regretted that no naturalist capable of performing these indispensable parts of his duties accompanied the expedition."

Considerable attention was also paid to meteorology and ocean physics, and the record of the voyage includes a number of tables of continuous meteorological observations. The density of the surface water was observed daily, and occasionally that at a depth of 80 fathoms. Deep-sea temperatures were taken at short intervals of time and of depth by means of a self-registering thermometer with a protected bulb, resembling that devised by Sir William Thomson and Professor W.A. Miller half a century later.

In his second Arctic voyage, from 1829 to 1833, Sir John Ross continued his scientific observations, and frequently dredged in shallow water, his limit of depth being 70 fathoms. The large zoological collections were unfortunately lost to science, as they had to be abandoned with the *Victory*, and since there was no naturalist on the expedition the loss was complete.

The researches of Mr. Darwin during the voyage of H.M.S. *Beagle* (1831-1836), remarkable in so many respects, are to be noted in this connection chiefly for his observations on the bathymetrical limit of reef-forming corals, and on the structure and origin of coral reefs and islands.

About this time appeared Sir John Dalyell's interesting investigations on Scottish zoophytes and the first microscopic researches of Ehrenberg upon living and fossil marine organisms. The microgeologic studies of the latter, pointing out the relation between modern marine deposits and geological formations, added a new interest to the investigation of marine life. In 1837 Mr. Alan Stevenson applied the method still in use for ascertaining the direction and velocity of marine under-currents.

The next great advance in marine zoology was the invention of Ball's dredge in 1838. The special features of this dredge were such as to give it at once the first place as a naturalist's appliance, and after the lapse of nearly half a century it remains practically unexcelled.

The great importance of dredging as a means of zoological research was recognized in 1839 by the British association, which appointed a committee "for researches with the dredge, with a view to the investigation of the marine zoology of Great Britain, the illustration of the geographical distribution of marine animals, and the more accurate determination of the fossils of the Pliocene period under the superintendence of Mr. Gray, Mr. Forbes, Mr. Goodsir, Mr. Patterson, Mr. Thompson of Belfast, Mr. Ball of Dublin, Mr. George Johnston, Mr. Smith of Jordan Hill, and Mr. A. Strickland."

From the number of eminent men on this committee valuable reports were looked for, and not in vain. One alone, professor Edward Forbes, did more than any of his contemporaries to advance marine zoology. He conducted long and patient investigations into the bathymetrical distribution of life in various seas; and by the fascination of his literary style he invested his reports with an interest that carried the knowledge of his work far beyond the limits usually set to the labors of specialists. Forbes's ideas on many points are no longer entertained; had he lived longer he himself would doubtless have been the first to discover and proclaim the falsity of many of them.

> "To Forbes is due the credit of having been the first to treat these questions in a broad philosophical sense, and to point out that the only means of a acquiring a true knowledge of the rationale of the distribution of our present fauna, is to make ourselves acquainted with its history, to connect the present with the past. That is the direction which must be taken by future inquiry. Forbes, as a pioneer in this line of research, was scarcely in a position to appreciate the full value of his work. Every year adds enormously to our stock of data, and new facts indicates more clearly the brilliant results which are to be obtained by following his methods, and by emulating his enthusiasm and his indefatigable industry."
> (*Depths of the Sea*, 1874)

Forbes believed with all the intensity of the old school of naturalists in the immutability of species, and in specific centres of distribution; he based his beliefs on facts of his own observation, and if these now appear insufficient and unsatisfactory, it must be remembered that he worked before Darwin's ORIGIN OF SPECIES gave to naturalists the modern ideas of natural selection and evolution.

Forbes's name is inseparably associated with the bathymetrical distribution of marine life, and his clearly defined zones- the Littoral, Laminarian, Coralline, and the Region of Deep-sea corals- enormously facilitated the work of descriptive naturalists. The region of deep-sea corals extended from 50 fathoms to an unknown depth, and Forbes points out that vegetable life is entirely absent from it, and "as we descend deeper and deeper in this region, the inhabitants become more and more modified, and fewer and fewer, indicating our approach towards an abyss where life is either extinguished, or exhibits but a few sparks to mark its lingering presence. Its confines are as yet undetermined, and it is in the exploration of this vast deep-sea region that the finest field for submarine discovery remains." In another place he indicates the plateau between Shetland and the Faroe Islands, on which the depth nowhere exceeds 700 fathoms, as the place on which dredging is most likely to settle the question of the existence of a zero of life, and he points out that while life-zero is probably about the 300 fathom line-in the Mediterranean, the researches of Arctic voyagers have shown it to be much deeper in the polar regions. The disciples of all great

Rear Admiral Charles Wilkes. In 1838, the United States Government sent out its first purely scientific expedition under the command of then Lieutenant Wilkes.

men tend to assert dogmatically what their master suggested hypothetically, and it was so with the followers of Edward Forbes. They viewed the life-zero, not as a probability, but as a certainty, building their belief more on the a priori absurdity of creatures being able to live in the absence of light and air, and under great pressure which must prevail in the depths of the sea, than on any direct evidence.

The United States Government sent out their first purely scientific expedition in 1838 under the command of Captain Wilkes. This expedition returned in 1842; its work was chiefly geographical and astronomical, but during the first year a few dredgings were made in shallow water, and a number of deep soundings were obtained at intervals during the voyage. The sounding line employed was copper wire, a great improvement on previous methods. The great American naturalist Dana, who accompanied this expedition, added much to the knowledge of several groups of shallow water and pelagic animals.

A British Antarctic expedition under Sir James Clark Ross sailed in the *Erebus* and *Terror* in 1839, and returned safely in 1843. Like Sir John Ross in the Arctic voyages, his nephew was determined to make the most of his opportunities in all directions, and was seconded in his efforts by the able cooperation of Sir Joseph Dalton Hooker, who accompanied the expedition as assistant surgeon. Without neglecting his main purpose, the exploration of ice-bound coasts of the southern hemisphere and the search for the South magnetic pole, Ross carried on astronomical, physical, and zoological work, and achieved results so important and hitherto so overlooked as to justify a somewhat detailed notice.

Sir Joseph Hooker first made known some of the results of Ross's deep-sea dredgings and investigations in 1845, and fuller details were given by Ross himself in the account of the voyage published in 1847.

A number of unsuccessful attempts were made to ascertain the depth of the water in mid-ocean, the failure being due to the want of a proper line. Sir James Ross accordingly had one made on board, 3600 fathoms long, fitted here and there with swivels to prevent it unlaying in its descent, and made strong enough to support a weight of 76 lbs.

On the 3rd January 1840, when in latitude 27°6'S. and longitude 17°29'W., the first abyssal sounding was satisfactorily made with the new line, the depth marked being 2425 fathoms. Such great depths could only be attempted in dead-calm weather, and the line was allowed to run out from an enormous reel in one of the ship's boats, the time each 100 fathom mark left the reel being noted in the usual way.

On the 3rd March 1840, a sounding of 2677 fathoms was made in latitude 33°21'S. and longitude 9°E., 450 miles west of the Cape of Good Hope. Water of equal depth was frequently sounded during the cruise, and on two occasions at least no bottom could be found with over 4000 fathoms of line.

The temperature of the water was observed very frequently at all depths down to 2000 fathoms, and its density at the surface and at various depths was determined almost daily. These observations were very valuable at the time, as giving the first real clue to the distribution of temperature at the bottom of the sea; but both in this expedition and.in those of Wilkes and D'Urville, the thermometers were not properly protected against pressure and consequently it came to be generally believed that in all open seas the water below a certain depth maintained a uniform temperature of 39°F right down to the bottom.

Ross lays special emphasis on the fact mentioned by earlier observers that the surface temperature of the water falls rapidly as the depth of the sea diminishes; he cites one instance when in a single day the temperature at the surface fell from 70°F where the depth was 400 fathoms, to 50.5°F where it was only 48 fathoms, a fact now known to be of local but not universal importance.

The dredgings, which were taken occasionally, turned out to be one of the most valuable parts of the scientific work of the expedition. On the 21st April 1840, a haul of the dredge was taken in 95 fathoms of water, and it came up full of coral. On the 18th January 1841, when in latitude 72°57'S. and longitude 176°6'E., a pycnogonid (*Nymphon gracile*) was found attached to the lead, after a sounding in 230 fathoms. Next day, when the depth was 270 fathoms, a dredge was put over, and when hauled up was found to be nearly full; it contained a block of granite, a number of small stones, some beautiful specimens of living corals, and, to quote Captain Ross's own words:

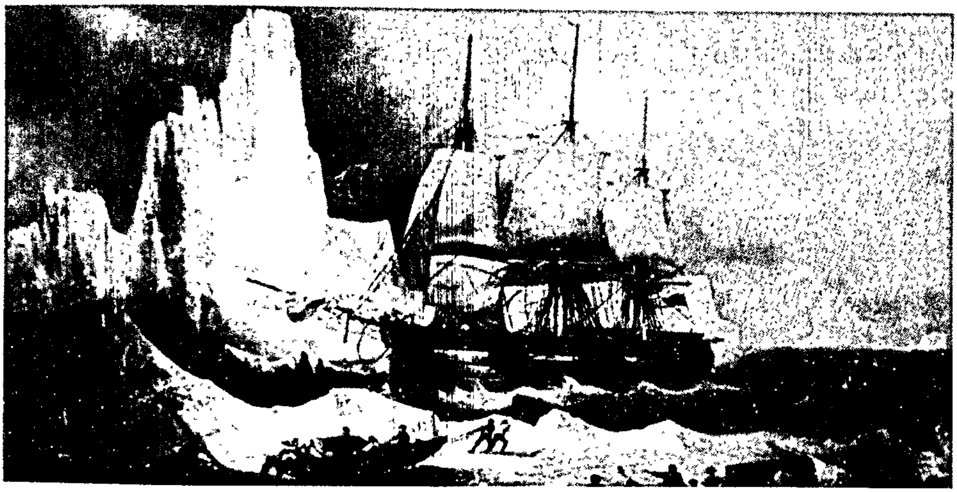
> "*Corallines*, *Flustrae*, and a variety of marine invertebrate animals, also came up in the net, showing an abundance and great variety of animal life. Amongst them I detected two species of *Pvcnogonum*, *Idotea baffini*, hitherto considered peculiar to Arctic seas, a chiton, seven or eight bivalves and univalves, an unknown species of *Gammarus*, and two kinds of *Serpula* adhering to the pebbles and shells."

On January 20th, 1841, the Deep-sea Clamm brought up stiff green mud containing corals and fragments of starfish from a depth of 320 fathoms. Two days later the dredge was put over and allowed to trail along the bottom for two or three hours in 300 fathoms, and its contents included "many animals, some corallines, and a quantity of sand, mud, and small stones."

Ross's deepest dredging was made at 10 A.M. on the llth August 1841, in latitude 33°32'S., longitude 167°40'E., when the dredge was let go in 400 fathoms; after being dragged along for a half hour, it was hauled on deck, and found to contain "some beautiful specimens of coral, corallines, *Flustrae*, and a few crustaceous animals."

The reflections of the accomplished leader of the expedition are extremely significant. So completely had Ross's researches faded from memory, that twenty years after they were made, the fact of living creatures being found under 400 fathoms of water was hailed as a great discovery. Yet Ross, referring to his dredgings in 1841, says:

> "It was interesting amongst these creatures to recognize several that I had been in the habit of taking in equally high northern latitudes; and although contrary to the belief of naturalists, I have no doubt that from however great a depth we may be able to bring up the mud and stones of the bed of the ocean, we shall find them teeming with animal life; the extreme pressure at the greatest



The Erebus, *shown here surrounded by ice in the Southern Sea, was used with the* Terror *by Sir James Clark Ross for a voyage of discovery in the Antarctic in the years 1839-1843.*

depth does not appear to affect these creatures; hitherto we have not been able to determine this point beyond a thousand fathoms, but from that depth several shellfish have been brought up with the mud."

From the fact that the same species were to be found at both poles, and that these animals are very sensitive to a change in temperature, he suggested that it would be possible for them to pass from one frigid zone to another, provided the temperature of the intervening sea bottom had a range not exceeding 5°F. Ross's observations confirmed his idea that the temperature at the bottom of the open sea was uniform in all altitudes and subsequent investigations prove it, generally speaking, to be correct.

Sir James Ross was an indefatigable zoological collector, but it is regretted that his large collections of deep-sea animals, which he retained in his own possession after the return of the expedition, were found to be totally destroyed at the time of his death. Had these been carefully described during the cruise or on the return of the expedition to England, the gain to science would have been immense, for not only would many new species and genera have been discovered, but the facts would have been recorded in the journals usually consulted by zoologists, instead of being lost sight of as was the case. A large number of zoological drawings made by Sir Joseph Hooker during the Antarctic cruise were recently handed to the various naturalists engaged in working up the *Challenger* collections, and these show that some of the *Challenger* discoveries had been anticipated by Ross. Sir Joseph Hooker, whose botanical researches are so well known, recorded the existence of immense numbers of diatoms on the surface of the Antarctic Ocean, and pointed out that the mud on the bottom, as obtained by Ross's dredgings, consisted of their dead remains.

When Sir John Franklin's ill-fated polar expedition set out in 1845, Mr. Harry Goodsir, a young zoologist of great promise, sailed on board the *Erebus* as an assistant surgeon and naturalist. The expedition never returned, and only fragmentary records are preserved of the valuable work which Goodsir had already accomplished.

"On the 28th June a dredge was

sunk to the enormous depth of 300 fathoms, and produced many highly interesting species of *Mollusca*, *Crustacea*, *Asteriadae*, *Spatangi*, and *Corallines*; such as *Fusus*, *Turritella*, *Venus*, *Dentalium*, &c., and also some large forms of *Isopoda*. As bearing upon the geographical distribution of species, Mr. Goodsir considers the occurrence of *Brissus lyrifer* (Forbes) and *Alauna rostrata* (Goodsir) as of the greatest interest, both of them being natives of Scottish seas. The remarkable depth also appears to us to give peculiar interest to these researches, as we believe that the deepest dredgings ever previously obtained were those of Professor E. Forbes in the Levant, the deepest of which was 230 fathoms, itself far beyond any made by other naturalists."

Up to this time all deep dredgings had been made during polar expeditions, though not necessarily in polar regions; the reason being that the time and trouble of working a dredge in deep water were too great to make it feasible except on scientific expeditions, and the only scientific expeditions of those days were despatched toward the poles. In 1846, however, Captain Spratt, R.N., dredged in 310 fathoms, 40 miles to the east of Malta, and found abundance of animal life, including eight distinct species of *Mollusca*.

During the period of rapid advance of marine zoology, the problems of ocean physics and meteorology were not lost sight of. Rennel had been collecting particulars of the currents, prevailing winds, and general meteorology of the ocean from 1810 to 1830, and his INVESTIGATIONS OF CURRENTS ETC, is still a valuable book of reference.

Maury also collected facts of all kinds bearing on these matters between the years 1648 and 1858, and published his famous *Sailing Directions* embodying these statistics. One important result of Maury's exertions was the maritime conference held at Brussels in 1653, which resulted in international observations being taken on so many naval and mercantile ships, thus obtaining several of the advantages of scientific expeditions at very little expense.

Michael Sars, a Norwegian naturalist and theologian, made a fine collection of bottom-dwelling-animals from depths of several hundred fathoms.

Before 1850 the attention of the Norwegian naturalist, Michael Sars, had been directed to the bathymetrical distribution of life on his native coasts, and he published the following year a list of thirteen species which lived at a depth of about 300 fathoms. His son, G.O. Sars, afterwards assisted him in the work of deep-water dredging, and the result was, in 1864, a list of ninety-two species, which lived between the depths of 200 and 300 fathoms. A few years later these untiring investigators found abundance of life on the bottom under 450 fathoms of water.

A great impulse was given to deep-sea soundings when Brooke, an officer in the United States Navy, invented his sounding machine in 1854. Its principle was that described by Hooke two centuries before; the sinker was detached when the weight struck the bottom, but it differed in that the sounding tube could be drawn up by the line, bringing with it a small sample of the deposit on which it struck. Bailey's description of the micro-organisms found in these deposits, as well as others obtained by the U.S.Coast Survey excited great interest among scientific men. A few years later the instrument was modified and improved by Commander Dayman, who employed it for his soundings across the Atlantic, when investigating the depths through which the Atlantic telegraph cable would require to pass. The necessity for ascertaining the form and conditions of the seabed for telegraph purposes was the occasion of considerable increase in the scientific knowledge of great depths.

The samples of "Atlantic ooze" procured from the greatest depths of that ocean by the sounding rods of the telegraph ships were eagerly examined by the leading European and American naturalists. The ooze was found to consist largely, and in some cases almost wholly, of the shells of *Foraminifera* and the siliceous skeletons of radiolarians and diatoms. The question soon came to be whether all the *Foraminifera* naturally lived on the bottom, or whether it was only their dead shells that collected there, the animals living and dying on the surface, or at some intermediate depth. The question was exceedingly difficult to settle from the data possessed by the disputants prior to the *Challenger* and other exploring expeditions.

In the preserved samples of the ooze it was believed that there was evidence of the existence of sheets of living protoplasm, a shell-less rhizopod named *Bathybius*,- covering the bottom of the ocean everywhere. The naturalists of the *Challenger* failed to detect *Bathybius* in freshly procured samples of the ooze, and have shown that the protoplasmic appearance arose from a great excess of alcohol used in the preservation of samples of the ooze, producing a gelatinous-like precipitate of calcium sulphate.

The voyage of the *Bulldog* in 1860, under Sir Leopold M'Clintock, is especially noteworthy amongst the cruises of surveying ships. The *Bulldog*, which was sent to examine proposed northern cable route, took soundings from Faeroe to Iceland and thence to Greenland and Labrador. Though bad weather prevailed for a great part of the cruise, a large number of soundings and many samples of mud were taken; as the expedition had the good fortune to be accompanied by Dr. G. C. Wallich as naturalist, these were carefully examined as they were brought up. The invention of the *Bulldog* sounding machine- a combination of Ross's Deep-sea Clamm with Brooke's detaching weight- made it possible to obtain larger samples of the bottom than had been usual before.

On one occasion a depth of 1260 fathoms was indicated. "That single sounding" says Dr. Wallich, "I may be permitted to say compensated for every disappointment that weather and accident may have previously engendered. At the eleventh hour, and under circumstances the most unfavorable for searching out its secrets, the deep has sent forth a long-coveted message." That message was conveyed by thirteen starfishes which had attached themselves to a portion of the sounding line that had been allowed to lie on the bottom for some time. This haul raised a storm of controversy. Dr. Wallich was firmly convinced that it was proof beyond question of the existence of highly organized animal life at great depths, but many eminent zoologists argued that it was quite probable that the starfishes had "convulsively embraced" the line somewhere on its way up. The idea of zero-life was far to firmly fixed in the zoological mind of that period to be readily displaced.

In the same year, 1860, a telegraph

cable which was being raised for repair in the Mediterranean under the direction of Mr. Fleeming Jenkin, now Professor of Engineering in the University of Edinburgh, was the means of definitely deciding the fact of highly organized creatures living at great depths. Parts of the cable which had been lying under 1200 fathoms of water for many years were found covered with animals that had fixed themselves at a very early stage of development and had grown to maturity there. Some of these were examined and described by Professor Allman of Edinburgh, others by M. Milne-Edwards of Paris.

During Otto Torell's expedition to Spitzbergen in 1864, a great number of creatures were taken at a depth of 1000 to 140 fathoms in the "Maclean nets." They included Rhizopoda, Bryozoa, Sponges, Annelids, Crustacea, and other forms. In subsequent expeditions to Spitzbergent creatures were frequently secured from a similar depth.

In 1865 a paper by Professor Forchhammer of Copenhagen on the Composition of Sea-water in different parts of the Ocean was published in the "Philosophical Transactions", recording the result of twenty years of patient work, and its publication made an era in the history of ocean chemistry. Forchhammer worked under great disadvantages; his samples of water were brought home by seafaring men from different parts of the world in corked bottles, and they were necessarily all taken from the surface or immediately beneath it. Forchhammer did not attempt to determine quantitatively all the elements that occur in sea water, but confined himself to the very accurate estimation of the principal components, viz, chlorine, sulphuric acid, magnesia lime, potash, and (by difference) soda. Although his methods have since been improved on, all the analyses were models of care and accuracy, and all his results have been confirmed and extended by Professor Dittmar's elaborate research, carried on under conditions so immensely more favorable on the water samples carefully collected on board the *Challenger*. Forchhammer's grand conclusion is, that although salinity of sea water may and does vary within certain limits, yet if samples be taken in all parts of the open sea, avoiding the vicinity of land and the mouths of large rivers, the proportion of each constituent to the total salts will be found to be the same everywhere. The differences in surface sea water then are merely differences due to dilution and concentration.

In 1867 Count L.F.de Pourales commenced, in connection with the United States Coast Survey, a series of deep dredgings on the margin of the Gulf Stream. Working in the U.S. Coast Survey steamer *Corwin*, he dredged down to a depth of 350 fathoms; and in the following year he resumed the work in the same place in the U.S.Coast Survey steamer *Bibb*, and dredged successfully in 510 fathoms, finding animal life exceedingly abundant. Although a great part of the collections made by Pourtale were lost in the great fire in Chicago, many new species have been described and brought under the notice of zoologists, and the wide bearing of the new facts obtained were comprehensively discussed by Professor Louis Agassiz, who took part in these explorations with Pourtales.

It has always been supposed that costly appliances and a large crew are absolutely necessary for successful dredging in water of any great depth. G.O. Sars indeed had worked down to 300 fathoms in a small boat manned by three men off the Lofoten Islands, but his example was not much followed. In 1868 Professor Perceval Wright proceeded to Setubal in Portugal, in order to investigate the occurrence of *Hyalonema*, which was reported to be frequently taken on the lines of shark-fishers who had long pursued their calling, at the great depth of 500 fathoms. He succeeded in getting abundance of specimens of *Hyalonema*, although six men were required to work the dredge, and the depth of the water was 480 fathoms. "This dredging" says Professor Wyville Thomson, "is of special interest, for it shows that although difficult and laborious, and attended with a certain amount of risk, it is not impossible in an open boat, and with a crew of alien fishermen, to test the nature of the bottom, and the character of the fauna, even to the great depth of 500 fathoms." But although possible, such dredging is too laborious and dangerous to be frequently resorted to, and for any systematic study of the depths of the sea more elaborate arrangements must be made.

The subject of deep-sea dredging was not being neglected in Great Britain. In the spring of 1868 Professor Wyville Thomson, in a letter to Dr. W.B. Carpenter, urged the employment of a government vessel in a dredging expedition off the coast of Scotland, and in consequence of this the Royal Society laid before the Admiralty a statement of the advantages to science likely to result from a short dredging cruise in the North Atlantic. The Admiralty responded by placing the surveying ship *Lightning*, Captain May, at the disposal of Drs. Thomson and Carpenter in the autumn of the same year. The conditions of work in the *Lightning* were very unfortunate both in regards to the vessel and the weather which prevailed during the six weeks that the cruise lasted. In spite of all the difficulties in the way, dredging was carried on to a depth of 650 fathoms, and temperature observations of the greatest interest were obtained, which ultimately led to the discovery of the Wyville Thomson Ridge in the Faeroe Channel in 1880. Professor Wyville Thomson thus sums up the results of the *Lightning* expedition:

> "It had been shown beyond question that animal life is varied and abundant, represented by all the invertebrate groups, at depths in the ocean down to 650 fathoms at least, nothwithstanding the extraordinary conditions to which animals are there exposed."
>
> "It had been determined that, instead of the water in the sea beyond a certain depth varying according to latitude having a uniform temperature of 4°C., an indraught of Arctic water may have at any depth beyond the influence of the direct rays of the sun a temperature so low as -2°C., or on the other hand, a warm current may have at any moderate depth a temperature of 6°C., and it had been shown that great masses of water at different temperatures are moving about, each in its particular course; maintaining a remarkable system of oceanic circulation, and yet keeping so distinct from one another that an hour's sail may be sufficient to pass from one extreme of heat to the extreme of cold."
>
> "Finally, it has been shown that a large proportion of the forms living at great depths in the sea belong to species hitherto unknown, and thus a new field of boundless extent and great interest is open to the naturalist. It had been further shown that many of these deep-sea animals are specifically identical with tertiary fossils hitherto believed to be extinct, while others associate themselves with and illustrate extinct groups of the fauna of more remote periods; as, for example, the vitreous sponges illustrate and unriddle the ventriculites of the chalk."

In consideration of the value and novelty of these results, the Royal Society urged the Admiralty to provide means of extending the observations. In 1869 the surveying ship *Porcupine*, Captain Culver, was appointed to this service. In addition to the temperature observations, which had turned out so interesting in the *Lightning*, it was decided to make a number of chemical observations on the water. For this purpose the chartroom was fitted up as a laboratory, and a chemist was invited to join the biologists on the cruise. A number of arrangements were also made for facilitating dredging and the subsequent observations. The *Porcupine* was a first-rate vessel for the purpose, and between May and September 1869 she made three distinct trips. The first of these was under the scientific direction of the late Mr. Gwyn Jeffrys, and it was chiefly devoted to dredging off the west coast of Ireland and in the channel between Scotland and Rockall. The deepest dredging made was in 1470 fathoms, and no lack of life was found at that depth. It was accordingly resolved that, during the second trip, under the direction of Professor Wyville Thomson, an attempt should be made to dredge in the deepest water within reach, so that a definite answer to the general question of the existence of life at great depths could be arrived at. The *Porcupine* was steered for the Bay of Biscay, and at a point about 250 miles west of Ushant two highly successful hauls of the dredge were taken over 2000 fathoms deep, and in both animal forms from the *Protozoa* to *Mollusca* were abundant. It was on this cruise that Captain Culver suggested the employment of hempen tangles attached to the dredge frame, an idea which Professor Thomson says inaugerated a new era in dredging.

The third cruise of 1869, during which Mr.Carpenter was the naturalist in charge, was a repetition of that of the *Lightning* in the previous autumn. The observations of the earlier expedition were confirmed and extended in new directions.

In 1870 Mr. Gwyn Jeffrys and Dr. Carpenter continued the work in the *Porcupine* by a highly interesting series of soundings and dredgings in the Mediterranean and current observations in the Strait of Gibralter. Dr. Carpenter resumed the study of this region in the following year in the *Shearwater*, commanded by Captain G.S. Nares, afterwards captain of the *Challenger*, and this expedition was no less interesting or important than those that went before.

The chemical and physical work of the *Porcupine* expeditions was not so satisfactory as might have been expected. Marine chemistry was so entirely new, that a great deal of preliminary work had to be done in order to gain the experience necessary for further more accurate experiments; and in was in the way of suggesting improvements for future use that the chemical work of the *Porcupine* was most valuable.

In December 1871 and early in 1872 the U.S. Coast Survey steamer *Hassler*, under the scientific direction of professor Louis Agassiz, dredged at considerable depths off the coast of South America.

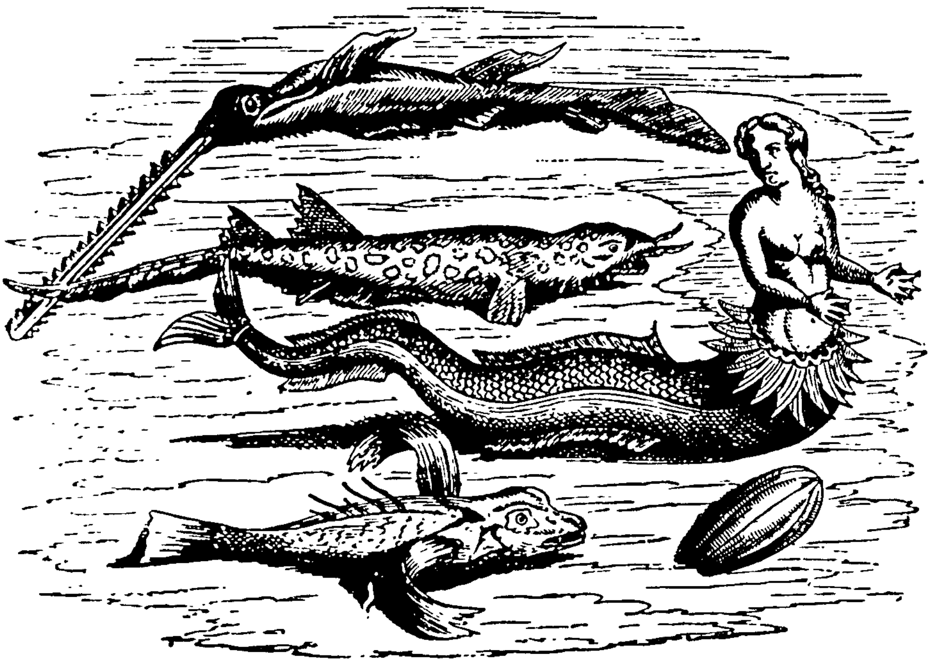
About this period appeared an important work by Delesse on the lithology and distribution of marine deposits in which littoral formations of the coast of France are described in detail, and our knowledge of the deeper deposits of the North Atlantic are reviewed.

This introductory chapter is not intended as a history of marine scientific research; its purpose is merely to trace the gradual growth of knowledge of the physical and biological-conditions of the ocean up to 1872, and to recall some of the more important of the earlier researches which have been allowed to fade from the attention of the scientific public.

The vast ocean lay scientifically unexplored. All the efforts of the previous decade had been directed to the strips of water round the coast and to enclosed or partially enclosed seas; great things had certainly been done there, but as certainly far greater things remained to be done. □

Here Dwell Mermaids

by CHERYL LYN DYBAS



In the early eighteenth century, some of the colonials believed that mermaids, along with other exotic sea creatures, lived in the waters of the Dutch East Indies. This drawing by Francois Valentijn appeared in A NATURAL HISTORY OF AMBOINA in 1727.

According to Irish legend, a man named Michael once made the acquaintance of a mermaid who dwelled in the depths of Ireland's River Shannon. But the acquaintance was short-lived, for this piscine beauty appeared and disappeared in the flick of a tail.

Michael, the story goes, lived in a cottage atop a grassy knoll overlooking the Shannon. Moored near the cottage was Michael's sailboat, the *Manannan McLir*, "king of the country under the waves."

The Shannon, Michael believed, was one of the world's most beautiful rivers and easy to cross by boat, except for its sprinkling of shifting shoals and tangled reed beds. But one bright day as Michael and the *Manannan McLir* threaded their way through an almost hidden channel, the sailboat was suddenly held fast. Dropping over the side and into cold gray water in an attempt to free the boat, Michael found a red cap shaped like a beret twisted around the propeller. Wrenching the cap free, he tumbled back onto the boat's deck to puzzle over the sodden circle of red wool. It was a wool unlike any he'd seen before. Its fibers shimmered with a strange light in the late afternoon sun. As Michael turned the cap over, a cry rang out, and he glimpsed a woman running up the riverbank through tall trees that lined the water's edge. Perhaps the woolen circle was hers? When

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the woman did not reappear by sunset, Michael decided to drop anchor for the night and await her return the next day.

Michael's vigil was not long. At darkest midnight, the mysterious woman swam from shore to the *Manannan McLir* and splashed aboard. There she told a stunned Michael, woken from deep slumber in a bunk aboard the boat, that she was a merrow, as mermaids are known in Ireland. Without her cap, called a cohuleen driuth, she could never return to her home beneath the waves. When Michael expressed doubt that merrows were real, and if they were, that she could be one as she had no fins, she remarked, "You're like the rest, you are. You don't believe we exist. You think all merrows have tails like fish, and live in a fairy land. They don't. Sometimes they are folk like you...and me."

Moved by the merrow's plight, Michael handed her the red cap. She slipped into the river in the blink of an eye, leaving behind no traces of her presence—no bits of seaweed on the gunwale, no wet footprints on the deck. To this day, or so the tale of "The Shannon Merrow" goes, Michael sails the *Manannan McLir* along the River Shannon, looking for the elusive merrow.

Although "The Shannon Merrow" takes place in the British Isles, legends of mermaids are found in every country with so much as a trickle of water flowing across its lands. Called by diverse names—nymphs, kelpies, selkies, Nereids, and others—accounts of merfolk float across time, from ancient Babylonia, to classical Greece, to pre-industrial Europe, early North America, and the United States of today, according to Peter Bartis, folklore specialist at the American Folklife Center at the Library of Congress in Washington, D.C. Over time, the legends have not faded; in many parts of the world, in fact, they've grown stronger, attracting hundreds if not

Odysseus and his men withstand the lure of the songs of the beautiful sirens by stuffing their ears with wax. This illustration and the one on the previous page are from the book MONSTERS OF THE SEA *by Richard Ellis, published by Alfred A Knopf, New York, NY.*

thousands of followers. What part of these fables, if any, is true? "As long as the world's oceans remain a mystery, no doubt people will continue to believe in the existence of hidden submarine beings like mermaids," writes Beatrice Phillpotts in her book MERMAIDS.

Ancient and modern theories about mermaids abound, from those that claim that manatees, or dugongs, have been mistaken for mermaids, to those that purport that seals are responsible for similar cases of erroneous identification.

Manatees, seals, and even eels have been widely cited as the basis for mermaid tales. But many people, including a few scientists, remain doubtful that any known animal can explain thousands of recorded sightings of mermaids. The seas have long swirled with tales of exotic creatures, some of which, like the giant squid, are now known to exist; there are those who remain open to the possibility that mermaids, too, may be real. As Samuel Hibbert, an early 19th century historian, wrote in his 1822 treatise A DESCRIPTION OF THE SHETLAND ISLES, "The people here are firm in their belief that in the depths of the ocean, an atmosphere exists adapted to the respiring organs of certain beings resembling the human race. They dwell far below the region of fishes." Maps of old of the seas surrounding the British Isles were often marked "Hic Sirene Habundant"; Here Dwell Mermaids.

Stories of the mermaid's eternal youth, strange, unnatural beauty, and the mysterious waters in which she dwells — whether ocean, lake, river, stream, pond, or well — have long captured imaginations. The same themes recur over much of the globe: the desire of the mermaid for a soul; her powers of prophecy; the vengeance she wreaks if injured; and her occasional sojourn on land with a mortal husband—or in the case of the lesser-known merman, a mortal wife—who has managed to secure her magic cap or sealskin or comb, without which she is powerless to return to the sea.

The river haunt of the Shannon merrow may seem an unlikely place to find a mermaid, for her presence has long been linked primarily with the sea. But the earliest mermaid, recorded many centuries before the birth of Christ, sprang from fresh waters, in a deep lake near the Syrian city of Ascalon. The goddess Dercato threw herself into the lake, after killing a handsome youth and leaving her daughter, whose boyfriend the youth was, to the elements. Dercato's body changed into the form of a fish, to forever swim the lake's waters. The first known merman also appeared at some 5,000 to 4,000 B.C. The fish-tailed god Oannes of Babylonia left the sea by day to walk on land as a man, and returned to the water by night. This "great fish of the ocean" was also the god of light and wisdom, and brought kindness and civilization to his people.

By classical Greek and Roman times fish divinities were commonly found on then-popular vase-paintings. Poseidon, king of the sea to the Greeks, usually appeared in human form, wielding a trident, symbol of his power over the marine realm. The Roman Neptune was originally a little-known freshwater god, but after the Romans came into contact with the Greeks, Neptune acquired the name "Father of the Seas."

The first known children of the oceans were the tritonids (females) and tritons (males) of Classical Greece. These sirens were heralded for their skill in music-making, but to those who passed close by as they sang their songs, the lilting tunes sometimes meant death. At other, luckier, times mermaid song—the music of the spheres—gave its listeners a glimpse of the eternal and the unknown.

Centuries later, curious water-creatures and lovely sirens with luring voices were widespread. One of the most enduring tales of this time involves Alexander the Great, who died in 313 B.C. Alexander dived, in a glass globe, to the bottom of the sea. That much, at least, is fact, as Alexander has been cited as the first deep-sea oceanographer. In the depths, he glimpsed "sea-monsters" which had long tails. Encased in his primitive bell-shaped submersible, Alexander observed that there was a marine counterpart for every form of terrestrial life. It was commonly believed at that time that all life originated in what was called the Great Deep. In this Great Deep were sirens who lived in the water like fishes, the mirror image in the sea of humans on land.

By the early centuries of the first millennium A.D., mermaid tales had moved beyond the centers of civilization to some of the most remote places on Earth. In the year 563 A.D., a mermaid visited the holy Irish shores of Iona, there to persuade a saintly monk to grant her a soul. To the mermaid's constant pleas, the monk always returned the same answer: she must forswear the sea forever. But despite her longing for a soul, the call of the sea proved stronger. Weeping, the mermaid returned to the briny depths, and the tears she shed formed into pebbles. To this day, the greenish-gray pebbles peculiar to Iona's shores are known as mermaid's tears.

In the Middle Ages the mermaid came fully into her own. With the rise of seafaring among the nations of Western Europe, sailors were once again brought into contact with strange inhabitants of the seas. In an unlikely twist, the Church of the time came to perpetuate beliefs in mermaids. The medieval Church sought to bring into its fold a population that held firmly to "heathenish" followings, such that the Church found it politic to adapt ancient legends to its own purposes. Thus mermaids appear, often carved into the wood and stone of these churches, as a warning against sin.

The Church's pronouncements were paradoxical, however, for the dawning of Easter Day brought with it more than Christ's resurrection, at least in one English town. There at sun-up on Easter, legend has it, if you look earnestly into a body of water known as the Mermaid's Pool—located at Chapel-en-le-Frith, Derbyshire — you will see the mermaid who dwells in its depths.

From earliest times, the British Isles have been the site of mermaid tales too numerous to recount. The most common of these legends is that of the selkies, or seal-folk. Perhaps the best known recent such selkie tale was featured in the film "The Secret of Roan Inish." Roan Inish is an all-but-abandoned islet off the coast of Ireland. There a young girl named Fiona Coneely (Coneely means "of the sea") discovers the truth about her heritage: Her great-grandmother was a selkie. Many years before, the selkie had married Fiona's great-grandfather. She had little choice, for he had managed to hide away the seal-skin she left behind when she came ashore one day to walk the coast of Roan Inish as a woman. Without this seal-skin, she could not return to the sea. Fiona is the latest in a long line of Coneelys, all products of this early union between a human and a selkie.

Like mermaid tales before it back to Babylonian times, "The Secret of Roan Inish" may be rooted in a real-life story: In the early 1900s, many Irish families with the name Coneely changed their surname to Connelly, it's said, in an effort to disguise their selkie heritage.

In the late 20th century, the mermaid has thousands of openly devoted fans around the world. Some believe in her only as legend, some profess to be "true believers," and some, like marine biologist Jahn Throndsen of the University of Oslo in Norway, are a bit of both. Throndsen has collected "almost every imaginable piece of mermaidabilia" over the years. His explanation? A Shakespearean quote: "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."

By day, Throndsen studies flagellates, microscopic swimming creatures of the sea ("micro-mermaids," he calls them); by eventide, he plies the mist-draped waters of the fjords near Oslo in his sailboat *Gyda*, named for a Viking seaqueen. "Mermaids are like flagellates," muses Throndsen in something of a riddle, "they're in the sea, but without special eyes with which to see them, they can't be found."

Then there's Throndsen's American colleague Karl Banse of the University of Washington in Seattle, who has taken inquiries about mermaids one step beyond where other scientists might have dared venture. Banse blurred the line between fiction and non-fiction with his paper in the scientific journal LIMNOLOGY AND OCEANOGRAPHY. The paper, published in 1990, addressed "Mermaids — Their Biology, Culture, and Demise." Banse puts forth a convincing argument for why numbers of mermaids in the world are declining, making a case for the mermaid as an endangered species. The culprit? According to Banse, an overabundance of jellyfish, which have competed with mermaids for food.

Celtic Mermaids

Although Karl Banse may have written with tongue-in-cheek of mermaids, summer visitors to Coney Island, New York, take mermaids a bit more seriously. Each June, hundreds of would-be mermaids gather in a costume parade that sashays along three miles of Brooklyn streets and past some half a million parade-goers. The old, the young, the disabled, women and men alike, swish down Coney Island's boardwalk-along-the-sea, their bodies gleaming in sparkling fish-tailed and seaweed-bedecked dress, looking as if they had just emerged from the nearby ocean.

As an infant mermaid lying in a baby carriage festooned with "seaweed" passed along the boardwalk, a young parade-viewer told her parents that although she knew these mermaids "weren't real," she was sure there were mermaids in the sea, "but only in the deepest parts."

At the sunset close of the parade, prizes are given for "Best Mermaid"; "Littlest Mermaid"; "Best Sea Creature"; and others. Last year's parade was the 16th annual. Among the more unusual participants were a mermaid ice hockey team, the crew of the sunken *"S.S. Mermaid,"* whose half-drowned members cavorted with mermaids at the bottom of the sea, and California's Bodega Bay Mermaid, perhaps the nation's only taxpayer who claims "mermaid" as her official occupation. Says Dick Zigun of Coney Island U.S.A., one of the parade's organizers, "The mer-folk 'open the Atlantic Ocean' on this day with a special key, making it safe for humans to go in the water and thereby allowing the start of the summer swimming season."

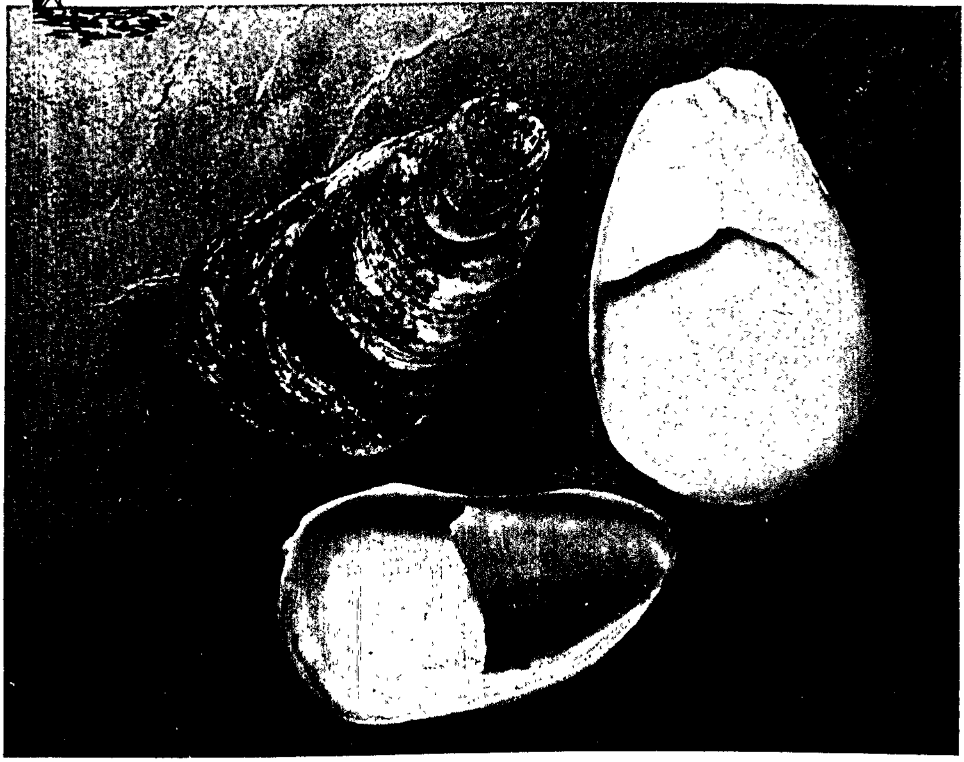
In the Coney Island mermaid festival, maintains Zigun, beliefs in mermaids that began long, long ago live on. In NORTH CAROLINA FOLKLORE, published by the Duke University Press, a local fisherman neatly sums up humanity's fascination with mer-folk. "If there are so many things in the ocean we don't know about yet, then probably there's fish-people there."Affirms Peter Bartis of the American Folklife Center, "The sea, across time, has always been our unknown. For some future generation, that unknown might be on another planet, but for us, who are likely permanent residents of earth, it's the ocean."

Will we ever know if tales of mermaids are fact or fiction? The mermaid may forever be a mystery, for nearly every mermaid story told through the ages reaches the same ending: When humans tried to catch her, she sank be-neath the waves, and where once a bit of magic had been, the sea was only sea. □

Slipper Shells

Field Note

by THOMAS ALLEN STOCK



Crepidula plana*; right and bottom shells show opalescent underside; shell on the left shows the rougher topside.*

Crepidula plana, a cousin to the much more common *Crepidula fornicata*, is a more fragile and smaller species with an interesting natural history. Its shell has a pure white, polished, porcelanous interior. Semicircular growth rings can be seen on the exterior. Females are much larger than males. Their shape depends on the object that they attach themselves to. These animals are mobile as velegers for their first two years of life. Then they become sessile in the intertidal zone or shallows below, on bottles, stones, large mollusk shells such as whelks or moon snails, and even on the underside of horseshoe crabs.

Thomas Stock is from Smithtown, N.Y. His last piece for this journal was About Toadfish in Vol. 23, No. 4.

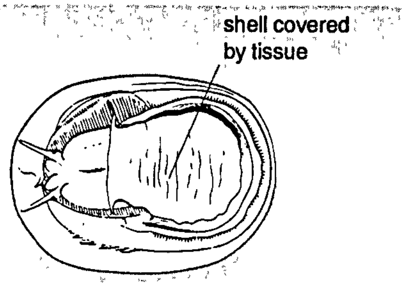
Although they are coiled as veligers, by the time they settle down to a permanent location, their coils are gone. They are said to be the only species that live inside dead shells. Their delicate, thin shell seems to favor calmer habitats without strong currents. This kind of habitat may assist it to feed on plankton. It feeds in a similar way to bivalves such as oysters: It lifts itself above the surface on its foot and catches plankton on mucous-covered gills. This is packaged into a small pellet for ingestion.

The scientific name *Crepidula plana* comes from a combination of Greek and Latin. *Crepidula* means a small sandal, planos means level. Lamark described the genus in 1799; Say described the species in 1822. There are over 60 species in the family Crepidulidae, half of which occur in North America. Other common names include the eastern white slipper snail, the flat boat shell, and the white slipper limpet. It can be found from Canada to Florida, Texas to Brazil, and Bermuda.

I've found plana inside Busicon and Polynices shells with live hermit crabs (*Pagurus pollicaris*) living inside. There is competition among crabs for these shells. When they find one occupied by plana they may eat some in order to fit themselves in. As these crabs grow, they may eat additional plana to accommodate their growth.

According to the book PRACTICAL GUIDE TO MARINE ANIMALS OF NORTHEASTERN NORTH AMERICA, *plana* has a parasite, a small flatworm living on or in the shell with the giant hermit crab called *Stylochus xebra*. It may attach itself to the gills of *plana*.

Another book describes sexual behavior..."*Crepidula* can change sex. The oldest animals are females, the youngest, males. The degree to which female characteristics are developed is controlled by a hormone given off in the water by males. Females produce thin-walled capsules containing 70 to 100 fertilized eggs, which are attached to a rock. They then brood the capsules until the free-swimming veligers hatch."



Underside of live snail. The shelf underside is covered over by tissue and cannot be seen when the animal is alive.

On a half-mile beach walk along the Long Island Sound in Southold, New York, I picked up two hundred plana shells near the wrack line. I found only two that had been drilled by oyster drill shells, and one that had been riddled by the boring sponge. Being so delicate, I conclude that empty shells don't last long. I think the bone-white shell is one of the most beautiful to be found on the beach. I find it amazing that this creature gave up its mobility to live in a "condo". Indeed, I'd like to meet the lady who wears these beautiful slippers. She may be the Cinderella of the littoral zone. □

Shell of the Crepidula plana *riddled with holes made by the boring sponge.*

Field Note

Trapped Tunny

by ART SCHWEITHELM

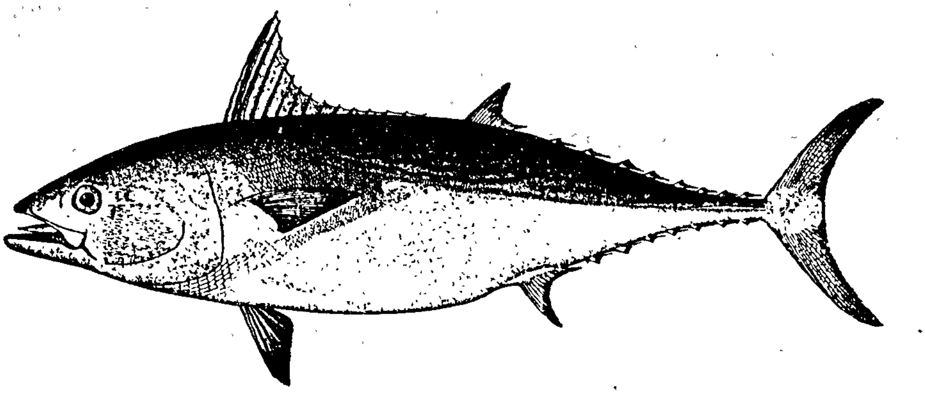
Editor's Note: The following field note was sent from Art Schweithelm, one of our taggers. If Art's experience sounds familiar to you, it's because you've heard this fish story before. In our UNDERWATER NATURALIST Vol.22 No.3., Stephen Sautner wrote about his tunny experience and it is almost identical to Art's. Not such an uncommon thing, to see a tunny in trouble.

November 1, 1998

Hit Crab Meadow around 3 PM as tide started to come in and saw one of the most amazing sights I've ever seen. The long, outer sandbar that has formed over the season has created a 200-foot long tidal pool behind it at low tide with no access to the sound. As I approached the tidal pool I noticed a large fish pushing water at the far end with dorsal and tail fins out of the water. As I started walking toward it in the water it raced past me in the deeper two feet of water along the steep sandbar's edge. It wasn't a bass or a blue and as it approached the shallows of the pool's west end it started splashing like a spawning salmon in a creekbed. To my disbelief it was a false albacore, or little tunny. For the next twenty minutes I manuevered back and forth thru the tidal pool trying to catch the speedy tuna who was as confused as I was. Finally I cornered him at the east end of the pool with several families who were walking the beach looking on in amazement. All of a sudden he was on his side splashing like crazy trying to get back to the deeper water. I grabbed him by the narrow tail and held on for dear life as the very strong 10-pounder almost got away. As I lifted him out of the water the people watching looked on in amazement and many questions were asked. Up over the sandbar and down to the Sound where I walked him out to three feet of water where he bolted out of my grip like a rocketship straight toward Connecticut. The only damage to the beautiful fish was red bruising and scrapes along his bottom where he had rubbed along the sand in the tidal pool.

Didn't get a bite for the next hour as wind driven waves crashed along the shoreline by the creekmouth. I left the beach tired but very happy that the little tunny had a chance to catch up with his family. □

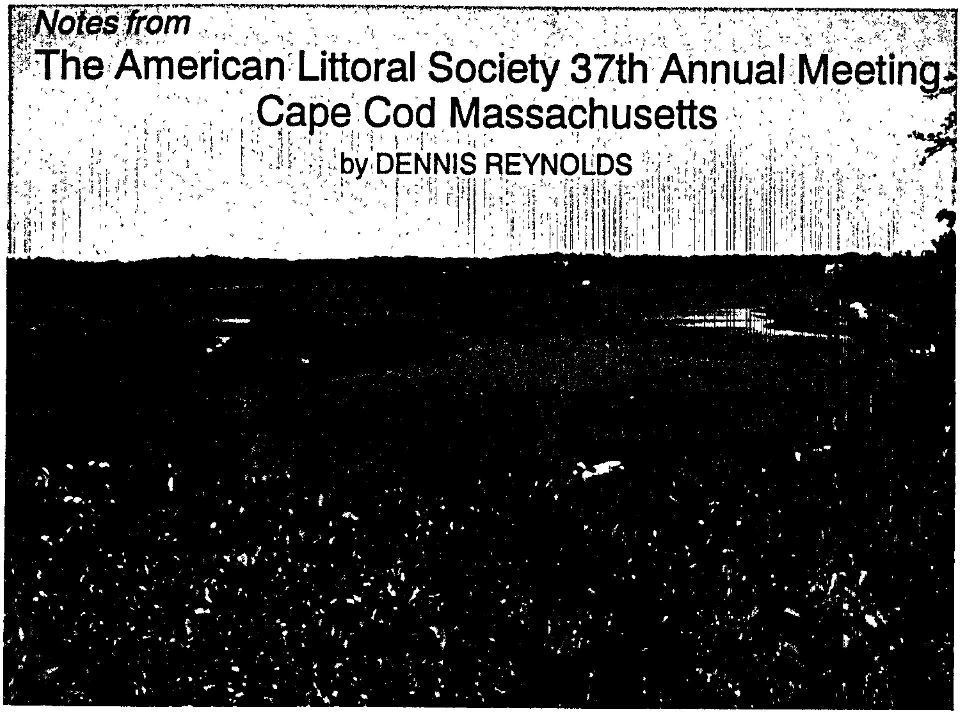
Art Schweithelm is a longtime member and avid fish tagger, primarily in the Long Island Sound.



False albacore also known as little tunny.

Notes from
The American Littoral Society 37th Annual Meeting: Cape Cod Massachusetts

by DENNIS REYNOLDS



Looking south from Fort Hill, a view of the eastern end of Nauset Marsh.

During the early fall of every year, at a different littoral location, ALS invites its members, board, and staff to gather for three days of hiking, touring, birding, talking, singing, communing, slogging, seining, learning, a little Society business, and an overall coastal experience. The time is not that far off. At the office of the American Littoral Society the planning has been going on for months. The Society's 38th annual meeting will soon be here. As this year's Annual Meeting, to be held at Chincoteague Virginia (see the inside front cover for details) approaches, we thought it a good idea to review last year's meeting.

On the afternoon of October 1, 1998, with the sun shining and the feel of autumn in the air, ALS members began arriving at the Cape Cod Sea Camps located in Brewster, Massachusetts, on the mid-cape section of Cape Cod. Cape Cod Sea Camps is positioned on 45 acres of fields, forest, and beach, on Cape Cod Bay. In the summer the camp is home to a children's summer camp. During the off season months the camp's facilities are available for group meetings, conferences, reunions, and other activities.

Reynolds is a longtime ALS member, now on the staff of both the Society and its Baykeeper project.

Each Annual Meeting features a series of field trips that typify the area where the meeting is held. The field trips for this meeting were worked out with the help and guidance of Nancy Church and the staff at the Cape Cod Museum of Natural History. To make field trips manageable ALS members are divided into groups and most trips are run concurrently at several different times. The following trips were done on a rotating basis on Friday and again on Sunday morning.

The Nauset Marsh Boat Trip

The Nauset Marsh is an inlet to the Atlantic Ocean. We left by flatboat, in groups of about 16, to view and discuss the workings of this natural inlet and salt marsh area. The marsh is open and wide;

the sensation is much like boating on a river. Terns, gulls, kingfishers, and other birds were spotted from the boat. At one point, through the exceptionally clear water, we could see striped bass swimming under the boat. On our way back, seals were spotted swimming near the mouth of the inlet. In addition to nature, local human impact and community history were discussed. As of this writing the Cape Cod Museum of Natural History is not offering this trip, but is doing boat trips on Pleasant Bay and at the Monomoy Wildlife Refuge, where gray seals can often be seen.

The Cranberry Bog Walk

Massachusetts is one of the country's largest producers of cranberries. So what would a fall trip to Cape Cod be without a visit to a local cranberry bog? Just south of Brewster, off route 124, Lee Baldwin of the Cape Cod Museum of Natural History led the groups on walking tours of a nearby bog in scenic harvest mode. She regularly leads this and other trips as part of the Museum's Cape Cod Walking Club program.

The Red Maple Swamp Hike

This hike took place at Fort Hill in Eastham. Fort Hill is part of the Cape Cod National Seashore. From the top of Fort Hill (where there never was a Fort) is a sweeping view of the ocean and beaches below. To the south can be seen the eastern end of Nauset Marsh, and to the north the Coast Guard Station at Orleans and the Nauset Light. A trail leads through a saltmarsh area and then through old farmlands of thickets and hedgerows. An excellent area for birds. After leaving the farmlands area the trail leads through the Red Maple Swamp, a good example of coastal forest succession. This trail turns into an elevated boardwalk over the wetter sections of the swamp. The trail comes out onto the grounds of the Captain Penniman House with its whale jawbone archway. The 19th century sea captain's homestead is part of the Cape Cod National Seashore.

Nickerson State Park Kettle Pond Walk.

As the name implies, Nickerson is part of the Massachusetts State Park system and is located in Brewster. Here we hiked the edge of Flax Pond. Flax Pond, like the other ponds in the park, is a beautiful example of the kettle ponds that can be found throughout the southern two thirds of Cape Cod. Kettle ponds were created when the glaciers that had extended southward into North America began melting. Large blocks of ice would dislodge and become covered with glacial debris. When these blocks melted they created deep depression that filled with water and formed kettle ponds. Flax Pond is ringed with a mixed pine and hardwood forest and is good place to see warblers, waterfowl, amphibians, fox, deer, and wildflowers.

Cape Cod Museum of Natural History Visit

A trip to the Cape Cod Museum offers changing natural history exhibits indoors, and a wildflower garden and several interesting woodland-to-beach trails outside. Of particular note here is Wing Island Trail. Beginning at the museum the trail winds through the hardwood forest down through a beautiful salt marsh to Wing Island. A plaque at the base of the island tells of the island's days as a salt works. Trails lead through the island and out on to a wide sandy area and to Cape Cod Bay. A good walk to see song birds, shore birds, herons, and hawks.

Saturday was dedicated to activities for the entire group, beginning with an early excursion to see some whales.

Whale Watch

ALS is no stranger to whale watches. For years the Society ran an annual trip out of Provincetown and currently does an annual trip from Gloucester, Massachusetts, on Cape Ann. For the annual meeting the Society used the services of Dolphin Fleet in Provincetown. We departed early Saturday morning for four

ALS group gathers at the edge of a kettle pond at Nickerson State Park.

hours of whale watching. With the help of calm seas and clear weather the group was treated to sightings of humpback and minke whales.

Hike At Coast Guard Beach

What would an ALS annual meeting be without a beach walk? We explored the Coast Guard Beach starting at the red and white Nauset Lighthouse and walking down along the ocean beach looking for shells, beach critters, plants, birds, and butterflies. While at the beach some members took time to visit the Salt Pond Visitors Center, the Nauset Lighthouse, and a little to the west on Cable Road, the diminutive Three Sisters Lighthouses.

Later, back at the camp, the gang gathered at the camp mess hall for a clambake that featured lobsters for all. After dispensing with the official business of the annual meeting we adjourned to the campfire area. Around the campfire, folks talked, remembered and sang songs of their youth to the guitar accompaniment of Jim Fields, enjoyed marshmallows, unlimited s'mors, conversation, and unwound from a long day of boats, beaches, whales, butterflies, and lighthouses.

Sunday morning while many left for home, others caught up on missed trips and departed after lunch.

If you missed the annual meeting and would like to try these hikes and trips, all of them can be enjoyed on your own. All the trips described here, with the exception of the whale watch, are within minutes of Brewster. Often, like almost all coastal areas, the best time to enjoy the natural beauty of Cape Cod is just before or after the summer season. Cape Cod can be particularly beautiful in the early to mid-fall. If you would like to try some of these walks the following phone numbers should be of help. We hope to see you at Chincoteague, Virginia for this year's Annual Meeting.

For the Cape Cod Museum of Natural History, Nauset Marsh or local boat trips, the cranberry bog walk, and others, call the Cape Cod Museum of Natural History at 508-896-3867.

For the Red Maple Swamp Hike at Fort Hill, and the Coast Guard Beach call the Cape National Seashore headquarters at 508-349-3785.

For Flax Pond kettle walk call Nickerson State Park at 508-896-3491.

For whale watching call the Dolphin Fleet in Provincetown at 1-800-826-9300. □

TAGGING REPORT

compiled by PAM CARLSEN

This issue of the UNDERWATER NATURALIST covers the winter months of December 1997 - March 1998. During these months, we received 160 striped bass returns. Where do these fish go in the cold months?

- Eight were in coastal Virginia and North Carolina.
- Sixty-nine were in Chesapeake Bay and its tributaries.
- Thirty-nine were in other coastal rivers from Maine to Delaware.
- Fifteen were in Delaware Bay.
- Eleven "hung out" at Northport, NY, where there is a large warm water outflow from a power plant.
- Fourteen were still on the coast of New York and New Jersey and two each in New York and Connecticut.

Ten of the eleven fish recaptured at Northport, were also tagged there, all but one tagged by the same person, Terry Marburger.

The tagging figures for all of 1998 were processed by our self imposed deadline of April 15, 1999 (just like the I.R.S.) and shipped to the NMFS computer at Woods Hole, MA. Our taggers topped previous numbers with 30,118 fish tagged of which, 23,215 were striped bass; 2,975 were fluke and 1,264 were bluefish. All species numbers were up from 1997. Recapture numbers were up with 100 more fish recorded then in 1997. We are experiencing more cooperation with fishermen, recreational and commercial in the Chesapeake. This has helped to increase our recapture numbers. Thanks for all you do to make this program the success it is.

Also in this issue, we have other interesting returns: The incomplete story of Paul Westcott's 57" Atlantic sturgeon tagged just south of Charlestown, RI, in May of 1994, found dead three years later, outside of St. John's, New Brunswick, Canada. What happened to this beautiful fish?

Dr. Jim Wright's 46" Greater Amberjack, tagged 50 mi. SE of Virginia Beach, VA, made its way south to be caught on 3/24/98, south of American Shoal Light off Sugarloaf Key, FL. A neat return on a species of fish we don't tag often.

Keith Leopold's 9" winter flounder tagged in March of 1996 at Hecksher State Park on Great South Bay, NY, was recaptured 9/30/97 onboard a scalloper, 12 mi. SW of Montauk Point, NY, in 21 fathoms. This fish was landed in New Bedford, MA.

Taggers please note that we have sent out two new memos with tag orders. One concerns Mycobacteriosis, a "new" disease affecting striped bass, which leaves a bloody rash on the fish, and the second concerning the use of circle hooks. If you haven't received these and want to know more, please contact Pam or Vicki.

Tag cards are important, no matter how "old" they are. "Would you believe only four and a half years late? I was doing a little drawer cleaning and came across these two cards. Hope this didn't foul up your records." Sincerely, George. Sending them in as soon as possible is the best and in order is preferred, but we give George credit for "fessin' up."

TAGGING RETURNS

Species Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Atlantic Cod							
20	T Stanik	Stellwagon Bank, MA	07/03/97	M Terwilleger	Stellwagon Bank, MA	20	10/24/97
17	T Stanik	Stellwagon Bank, MA	07/04/97	P Hoysradt	Stellwagon Bank, MA	27	04/04/98
Atlantic Sturgeon							
57	P Westcott	Charlestown, RI	05/27/94	R Williams	St. John, New Bruns., CDA		10/16/97
Black Grouper							
14	J Wright	Venice, FL	07/15/97	F Corbin	Venice, FL	14	02/09/98
Black Sea Bass							
12	G Ruest	Conanicut Pt., RI	09/18/97	F/V C.J.	S. of Block Is., RI		11/28/97
Bluefish							
21	C Wilcox III	Moriches Inlet, NY	09/12/97	R Conklin	Moriches Inlet, NY	21	10/21/97
15	B Shillingford	Whale Cr., NJ	09/19/97	R Colonna	Chincoteague, VA		10/29/97
14	S Keiper	Indian R. Inlet, DE	10/09/97	R Blessing	Hatteras Inlet, NC		10/29/97
29	A Anderson	Block Island, RI	11/12/96	M Hacku	Guilford, CT	36	11/11/97
30	A Anderson	12 Mi. S Block Is., RI	07/15/97	P Cardi	Pt. Jefferson, NY	31	11/15/97
Florida Pompano							
15	T Walker	Stuart, FL	11/06/97	L Yarbrough	Cocoa Beach, FL	15	03/06/98
Fluke							
13	C Kennedy	Lower DE Bay	07/17/96	S Semlear	Noyack Bay, NY		10/18/97
14	T Stanik	Hatteras Inlet, NC	10/15/97	B Duncan	Hatteras Is., NC	15	10/26/97
15	W Filce	Mantoloking, NJ	09/17/97	C Marotta	Brick, NJ	15	10/28/97
11	T Stanik	Hatteras Inlet, NC	10/06/97	J Davidson	Hatteras Inlet, NC		10/29/97
12	T Stanik	Hatteras Inlet, NC	10/13/97	R Josemans	Hatteras Inlet, NC	13	10/30/97
12	T Stanik	Hatteras Inlet, NC	10/04/97	J Crisp	Cape Hatteras, NC	12	11/08/97
13	W Filce	Ortley Beach, NJ	08/18/96	I Moore	Offshr., Cape Charles, VA	20	11/18/97
16	A D'Amato	Lower DE Bay, NJ	05/29/97	NC DEHNR	Offshr., Chincoteague, VA		01/10/98
14	W Filce	Mantoloking, NJ	07/20/97	Pamlico Pking Co.	Offshr., Drum Inlet, NC		01/15/98
13	W Filce	Sea Girt, NJ	09/13/97	Co-op Seafood Inc.	Landed Pt. Pleasant,, NJ	14	01/17/98
13	J White	Fire Is. Inlet, NY	08/09/97	F/V Carolina Dream	Offshr., Ocean City, MD	15	01/22/98
15	J Gibbons	Breezy Pt., NY	08/31/97	F/V Wallaby	Offshr., Barnegat, NJ	17	03/06/98
12	R Dykas	Deal, NJ	07/20/96	P Westcott	10 Mi. E Montauk, NY	15	04/14/98
Greater Amberjack							
46	JC Wright	50 Mi. SE VA Beach, VA	08/14/97	D Dreifort	Sugarloaf Key, FL	46	03/24/98
Grouper							
8	F Waltzinger III	Marathon, FL	01/12/98	W McWhorter	Marathon, FL	08	01/13/98
16	F Waltzinger III	Bahia Honda Key, FL	01/19/98	J Stars	Bahia Honda Key, FL		01/28/98
10	F Waltzinger III	Bahia Honda Key, FL	01/23/98	D Yorkings	Bahia Honda Key, FL	12	03/04/98
Red Drum							
16	T Stanik	Hatteras Inlet, NC	10/20/97	T Stanik	Hatteras Inlet, NC	16	10/20/97
16	T Stanik	Hatteras Inlet, NC	10/20/97	J Grier	Cape Lookout Pt., NC	16	10/25/97
24	J Wright	Venice, FL	01/03/98	G Piper	Venice, FL		01/11/98
Sheepshead							
10	D Sherman	Savannah Reef, GA	03/14/98	B Parker	Savannah Reef, GA	10	04/14/98
Southern Flounder							
13	J Wright	Venice, FL	10/21/97	L Jones	Venice Inlet, FL	13	11/21/97
Striped Bass							
19	E Wills Jr.	Cape Cod Bay, MA	09/19/96	T Martin	Stratford, CT	22	09/26/97
16	T Shaheen	Navesink, NJ	05/05/96	M Lazar	Manhasset Bay, NY	24	10/16/97
20	C Tomkins	Watch Hill, RI	08/07/97	M Kamm	Noank, CT	20	10/16/97
27	R Grobarz	Sandy Hook, NJ	06/12/96	R Rusznak	Sandy Hook, NJ	29	10/16/97
30	A Anderson	Block Is., RI	06/14/97	B Celico	Block Is., RI	30	10/17/97
25	R Nystrom	Stratford, CT	05/28/96	R Mendez	Stratford, CT	32	10/18/97
32	F Casey	Boston, MA	07/09/96	J Calhoun Sr.	DE Bay, NJ		10/18/97
18	H Bergere	Stratford, CT	07/14/92	N Sousa	Sea Bright, NJ	30	10/18/97

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
26	S Kellner	Mattituck, NY	06/30/97	W Bowers	Mattituck, NY	29	10/18/97
31	K Katz	Eatons Neck, NY	06/24/97	N Zerille	Montauk, NY		10/18/97
30	R Conklin	Moriches Inlet, NY	09/26/97	J Novello	Moriches Bay, NY	33	10/18/97
16	C Kennedy	Cape May Inlet, NJ	10/02/97	S Hsieh	Stone Harbor, NJ	16	10/18/97
19	T Kazimiroff	W.L.I. Sound	07/13/93	C Barbato	Eatons Neck, NY	25	10/18/97
18	P Grippo	Jones Inlet, NY	11/14/96	J Sweet	Mt. Hope Brdg., RI	22	10/18/97
20	R Nystrom	Fairfield, CT	06/29/97	V Adley	Bridgeport, CT	21	10/18/97
9	A Perednia	East R., NY	05/14/96	J Mercado	East R., NY		10/19/97
20	J Della Porta	Swampscott, MA	08/11/97	R McRae	Cape Cod Canal, MA	20	10/19/97
26	J Karolides	Beverly, MA	07/26/97	S DeSisto	Beverly, MA		10/19/97
24	R Nystrom	Bridgeport, CT	09/06/97	J Segarra	Bridgeport, CT	26	10/19/97
26	G White	Piscataqua R., NH	07/09/96	E Taber Jr.	Westport, MA	29	10/19/97
26	F Laskowski	Bridgeport, CT	08/02/97	H Olsen	Fairfield, CT	27	10/19/97
28	G Ciriello	Sandy Hook, NJ	06/10/96	M Caruso	1 Mi. S Norton's Pt., NY	29	10/19/97
34	S Jakubowski	Sandy Hook, NJ	10/26/97	A Jost	Delaware Bay, NJ	34	10/20/97
13	J Drew	Providence R., RI	05/20/97	V Morales	Providence R., RI	15	10/20/97
38	F Coronato	Sandy Hook, NJ	06/14/94	N Eckert	Sandy Hook, NJ	41	10/20/97
32	D Brodeur	Milford, CT	06/11/96	J Walsh	Milford, CT	33	10/20/97
20	H Sweet	Warren River, RI	06/10/97	B Mussia	Narragansett Bay, RI	20	10/20/97
27	G Ciriello	Pt. of Sandy Hook, NJ	05/21/96	B Mussia	Narragansett Bay, RI		10/20/97
17	D Wright	Linkhorn Bay, VA	12/05/96	D Ghion	Tilghman Is., MD	20	10/20/97
21	A Anderson	Block Is., RI	06/15/97	K Court	Block Is., RI	22	10/21/97
22	M Mercer	Quick's Hole, MA	08/02/97	J Shea	Little Compton, RI	22	10/21/97
23	T Marburger	Shinnecock Inlet, NY	06/11/96	F Ach	Shinnecock Bay, NY		10/21/97
29	O Van Helmond	Westhampton, NY	09/06/97	F Hazard	Ocean City, MD	30	10/22/97
26	R Conklin	Moriches Inlet, NY	07/25/97	R Conklin	Moriches Inlet, NY	26	10/22/97
18	T Shaheen	Rumson, NJ	08/29/95	J Abrams	Shrewsbury R., NJ	24	10/22/97
14	A Perednia	East R., NY	10/25/96	G Matteson	S. Kingstown, RI	15	10/23/97
31	R Nystrom	Bridgeport, CT	07/28/96	P Spacek	Montauk, NY	33	10/23/97
24	M Simmons	Barnegat Light, NJ	06/06/97	S Levey	1 Mi. off Seaside, NJ	28	10/23/97
18	A Anderson	Charlestown, RI	11/05/96	A Lehmann	Cape Cod Canal, MA	22	10/23/97
21	W Perlman	Atlantic Beach, NY	09/13/97	F Quijano	Silver Pt., NY		10/24/97
17	E Petronio Jr.	Pt. Judith, RI	07/04/97	J Hooper Jr.	E. Matunuck, RI		10/24/97
21	A Young	Mattituck, NY	09/27/97	W Olsen Jr.	E. Marion, NY	21	10/24/97
19	R Grobarz	Seaside Park, NJ	05/22/97	F Bierd	East R., NY		10/24/97
24	W Perlman	Atlantic Beach, NY	06/15/96	R Vars	S. Portsmouth, RI	29	10/24/97
27	J McAfee	Quicks Hole, MA	08/23/94	D McGeady	Montauk Pt., NY		10/24/97
33	D Kelly	Orient Pt., NY	09/21/96	F Noto	Raritan Bay, NJ	39	10/25/97
28	B White	South Beach, NY	09/19/97	J Clayton	Townsends Inlet, NJ		10/25/97
25	W Draesel	Island Beach St. Pk., NJ	11/28/91	J Augustine	Esopus, NY		10/25/97
19	H Sweet	Warren, RI	08/13/97	B Tirrell	Barrington R., RI	20	10/25/97
23	A Anderson	Block Is., RI	07/16/97	C Stevens	Block Is., RI	29	10/26/97
23	A Anderson	Block Is., RI	06/19/97	C Bischoff	Block Is., RI		10/26/97
20	R Leja	Bridgeport, CT	04/13/97	T Hendrickson	Stonington, CT	24	10/26/97
18	C Wilcox III	Moriches Inlet, NY	11/17/96	A Lehmann	Boston, MA	22	10/27/97
29	A Anderson	Block Is., RI	06/14/97	A Hoke	Block Is., RI		10/27/97
32	A Anderson	Montauk Pt., NY	06/01/97	M Harris	Delaware Bay, NJ	32	10/28/97
20	H Sweet	Warren, RI	09/04/97	D Pickering	Narragansett, RI	20	10/28/97
15	W Brett	Marshfield, MA	10/19/95	J Walton	Montauk, NY	17	10/29/97
34	P Walther	Chatham, MA	07/28/95	S Maciura	Mecox Bay, NY	38	10/29/97
29	B Semasek	Indian R., DE	12/02/94	R D'Amour	Indian R., DE		10/29/97
25	F Tenore	Sandy Hook, NJ	06/08/96	M Derfler	Atlantic City, NJ	28	10/29/97
22	S Kellner	Mattituck, NY	07/13/97	J DiGiorgio	Northville, NY	24	10/29/97
15	H Sweet	Warren, RI	09/05/96	D Pickering	Charlestown, RI	19	10/30/97
15	R Grobarz	Sandy Hook, NJ	05/12/96	W Neumann	Cliffwood Beach, NJ	22	10/30/97
17	JC Wright	Ches. Bay Brdg. Tun., VA	11/19/96	M Tomasik	Chesapeake Beach, MD	18	10/30/97
24	A D'Amato	Cape May, NJ	11/07/96	J Ginsburg	Margate, NJ	26	10/30/97
25	A Anderson	Block Is., RI	07/18/97	D Wells	Block Is., RI		10/30/97
17	R Grobarz	S. Mantoloking, NJ	11/20/96	A Canino	Far Rockaway, NY		10/30/97
18	A Perednia	East R., NY	11/20/96	W Denning	Throgs Neck Brdg., NY	20	10/30/97
30	P Bombino	Sheepshead Bay, NY	06/10/92	A Guskind	West Bank Lt., NY		10/31/97
32	W Firth	Quick's Hole, MA	06/21/97	J Orcsi	Reeds Beach, NJ	33	10/31/97
25	R Kalenka	Shinnecock Bay, NY	06/29/97	M Andres	Fire Is. Inlet, NY	26	10/31/97
20	R Leja	Bridgeport, CT	07/21/96	F Brown	Jamaica Bay, NY	27	10/31/97

Species Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
18	G D'Amato	Housatonic R., NJ	05/18/94	B White	West Bank Lt, NY	27	10/31/97
27	R Conklin	Moriches Inlet, NY	10/22/97	J Walton	Holgate, NJ	29	11/01/97
16	W Jarvis	Cape Cod Canal, MA	06/15/97	T Bruce	Bourne, MA	16	11/01/97
17	E Petronio Jr.	Pt. Judith, RI	07/17/96	T Thomas	Staten Is., NY	22	11/01/97
16	N Kittredge	Essex R., MA	09/23/97	R Clark	Charlestown, RI	16	11/01/97
21	P Grippo	2nd Wantagh Brdg., NY	07/01/97	R Drinkwater	Jones Inlet, NY		11/02/97
14	A Anderson	Connecticut R., CT	05/18/97	M Kus	Old Saybrook, CT		11/02/97
21	R Leeds	Ocean City, NJ	07/08/97	J Andrews	Ocean City, NJ	25	11/02/97
18	M Simmons	Barnegat Lt., NJ	11/05/96	T McCormick	Barnegat Lt., NJ	20	11/03/97
20	G Lundquist	Sandwich, MA	11/07/95	L Schobel	E. Rockaway, NY	20	11/03/97
20	G Blank	Beacon, NY	04/13/96	L Schobel	E. Rockaway, NY	20	11/03/97
19	F Stunkel	Stamford, CT	07/06/95	J Rozas	Triborough Brdg., NY	23	11/03/97
18	E Petronio Jr.	Pt. Judith, RI	06/15/97	L Schobel	E. Rockaway, NY	20	11/03/97
33	F Tellefsen	Old Orchard Lt., NY	11/03/94	W Couch	Virginia Beach, VA	36	11/04/97
27	F Stunkel	Darien, CT	09/19/95	J Katsaror	Mattituck, NY	36	11/04/97
18	P Lowcher	Rumson, NJ	06/13/97	J Schmitz	Pt. Pleasant, NJ	21	11/04/97
21	M Simmons	Barnegat Lt., NJ	09/30/97	J Scully	Surf City, NJ		11/04/97
25	M Vargas	Milford, CT	10/09/97	W Weisser	Eatons Neck, NY	25	11/04/97
16	A Schweithelm	Fort Salonga, NY	05/11/97	D Schnaars	Manhasset Bay, NY	19	11/05/97
16	H Sweet	Warwick, RI	08/25/97	RI F.G. & W.	Palmer R., RI	16	11/05/97
26	J Brittin	Cape May, NJ	11/28/96	T Nichols	Newport, RI		11/05/97
28	J Daly	Deal, NJ	10/27/96	N Fiorillo Jr.	Deal, NJ	28	11/05/97
16	T Marburger	Northport, NY	12/15/96	W Holland Jr.	Westerly, RI		11/06/97
21	D Kelly	Orient Pt., NY	08/23/97	F Piccolella	Mantoloking, NJ	23	11/06/97
18	R Conklin	Moriches Inlet, NY	07/22/97	R Koster	Fire Is. Inlet, NY	22	11/06/97
31	S Fries	Montauk, NY	07/29/97	M Melito	Montauk, NY		11/07/97
33	S Fries	Montauk, NY	07/31/96	M Melito	Montauk, NY		11/07/97
29	D Dibblee	Esopus, NY	05/10/96	R Lynch	Rockaway Beach, NY	30	11/08/97
28	JC Wright	Rudee Inlet, VA	12/10/96	R Bernhard	Montauk Pt., NY	32	11/08/97
34	J Foti	Staten Is., NY	05/17/97	M Johnson	Ches. Bay Brdg. Tun., VA	37	11/09/97
27	D Kelly	Orient Pt., NY	08/11/95	J O'Keefe	Long Beach, NY	30	11/09/97
16	P Lowcher	Rumson, NJ	06/03/97	J Gibbons	Sandy Hook, NJ	19	11/09/97
23	G Blank	East R., NY	10/19/97	F Mauer	Seaside Park, NY	23	11/10/97
27	R Vogel	Sandy Hook, NJ	07/08/97	R de la Prida	Raritan Bay, NJ	28	11/10/97
30	D Sowerby	York Harbor, ME	07/03/96	D McBride	Delaware Bay, NJ	32	11/11/97
20	D Magnasco	Boston, MA	06/09/92	A Anello	Gravesend Bay, NY	29	11/11/97
28	R Kyker	Norwalk, CT	09/11/96	G Ciriello	Coney Is. Flats, NY	30	11/11/97
24	M Simmons	Barnegat Lt., NJ	06/05/97	S Poage	Barnegat Lt., NJ	25	11/11/97
23	B Cairns	Charlestown, RI	05/24/96	R Matteau	New London, CT		11/11/97
24	A Anderson	Block Is., RI	06/17/97	R Schaeffler	Baiting Hollow Bch, NY		11/12/97
21	F Jessup	Moriches Inlet, NY	09/24/97	R Amberg	Breezy Pt., NY	22	11/13/97
30	A LoCascio	Prospect Pt., NY	05/27/97	J Waldman	Prospect Pt., NY	30	11/13/97
26	F Coronato	West Bank Lt., NY	09/07/97	H Parker	Sheepshead Bay, NY	29	11/13/97
33	A Anderson	Block Is., RI	06/17/97	F Haraburda	Kitty Hawk, NC	33	11/13/97
22	R Canfield	Westport, CT	06/28/97	J Angelini	Monmouth Beach, NJ		11/13/97
26	H Templeton	Charlestown, RI	10/04/97	P Cardi	Pt. Jefferson, NY	27	11/13/97
25	R Grobarz	Sandy Hook, NJ	06/19/96	C Whitt	Shrewsbury R., NJ	28	11/14/97
25	C Kollett	Prudence Is., RI	08/23/97	A Orme	Bartlett's Reef, CT	28	11/14/97
30	R Paganini	E. Rockaway Inlet, NY	10/22/96	J McEntee	Jamaica Bay, NY	32	11/15/97
23	D Sowerby	York Harbor, ME	09/10/94	T Laverde	Nantucket, MA	35	11/15/97
22	G DeFoe	Spring Lake, NJ	11/24/95	E DeVincenzo	Cape May Rips, NJ	28	11/15/97
22	R Pearson Jr.	Croton Bay, NY	04/05/97	R Volland	Darien, CT		11/15/97
25	J Rand	Eaton's Neck, NY	06/12/97	E Opilac	Earle Naval Base, NJ		11/15/97
22	W Perlman	Atlantic Beach, NY	06/22/97	H Conover Jr.	Monmouth Beach, NJ		11/15/97
21	A LoCascio	Manhasset Bay, NY	10/21/96	M Strober	Governors Is., NYC	23	11/15/97
17	G Ottavio	Cape May, NJ	09/07/96	L Phillips	2 Mi. N Hooper Is., MD		11/15/97
18	G Ottavio	Cape May, NJ	09/15/96	L Phillips	2 Mi. N Hooper Is., MD		11/15/97
18	P Lowcher	Rumson, NJ	05/13/97	D Eichin	Verrazano Brdg., NY	19	11/15/97
18	G Ottavio	Cape May, NJ	09/25/97	L Phillips	2 Mi. N Hooper Is., MD		11/15/97
14	A Perednia	East R., NY	11/06/97	C Vena	Williamsburg Brdg., NY	14	11/16/97
21	M Simmons	Barnegat Lt., NJ	10/21/96	C Severino	Manasquan, NJ	22	11/17/97
20	R Spiro	Merrimack R., MA	07/17/97	J Mitchell	Lavalette, NJ	24	11/17/97
28	A Anderson	Block Is., RI	09/10/96	A Wesche	Ocean City, MD	30	11/17/97
28	F Coronato	West Bank Lt., NY	07/01/96	A Guskind	Sandy Hook, NJ	34	11/17/97

Species Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
22	R Leja	Bridgeport, CT	10/04/92	J Szekely Jr.	Montauk Pt., NY	31	11/18/97
22	A LoCascio	Throgs Neck Brdg., NY	10/29/94	C Tomasullo	Pier 40, Hudson R., NY	28	11/18/97
22	R Allen	Cape Charles, VA	03/12/97	G Sawicki	Ches.Bay Brdg.Tun., VA	24	11/18/97
27	A Anderson	Block Is., RI	07/22/97	A Wesche	Ocean City, MD	27	11/18/97
31	F Stunkel	Stamford, CT	11/13/93	D Chapman	Raritan Bay, NJ	36	11/19/97
16	J Karolides	Beverly, MA	06/03/95	H Hall	Windmill Pt., VA	23	11/19/97
27	T Marburger	Northport, NY	02/04/97	L DeFonteny	Island Beach St. Pk., NJ		11/19/97
21	A LoCascio	Manhasset Bay, NY	10/14/95	P Warny	Manhasset Bay, NY	24	11/19/97
21	A Piszczatowski	Glen Cove, NY	05/31/97	T O'Brien	Island Beach St. Pk., NJ	26	11/19/97
19	F Jessup	Moriches Inlet, NY	10/06/97	M Lowcher	Pt. Pleasant, NJ		11/19/97
27	C Jasmin Jr.	Somers Pt., NJ	10/21/97	D Milner	Sandbridge, VA	24	11/19/97
27	G Kerkhan	Sea Bright, NJ	07/14/96	S Mariano	Raritan Bay, NJ	30	11/19/97
13	R Kalenka	Glen Cove, NY	09/08/96	Y Nguyen	Hempstead, NY	15	11/19/97
16	A Perednia	East R., NY	11/14/96	Y Nguyen	Hempstead, NY		11/19/97
18	J Della Porta	Boston, MA	07/30/97	J Harakal	Mantoloking, NJ	18	11/19/97
21	R Grobarz	Cliffwood Beach, NJ	04/12/95	R Frey	Moriches Bay, NY	27	11/20/97
27	A Dangelo	Montauk, NY	11/13/94	B Dubecky	Montauk Pt., NY	33	11/20/97
19	N Fiorillo Jr.	Deal, NJ	11/11/96	H Hachemeister	East Rockaway, NY	26	11/20/97
15	M LeBlanc	Swansea, MA	01/01/96	J Battaglia	Somerset, MA	20	11/20/97
16	F Jessup	Moriches Inlet, NY	11/06/96	R Green Jr.	Seaside Heights, NJ	18	11/20/97
19	R Pearson Jr.	Breezy Pt., NY	10/25/97	M Sherak	Elberon, NJ	21	11/20/97
21	F Stunkel	Stamford, CT	10/27/97	F Larkin	Seaside Park, NJ	24	11/21/97
18	C Kennedy	Cape May Pt., NJ	04/28/96	Unknwn Fisherman	3 Mi. S of Seaside, NJ		11/21/97
23	JC Wright	Linkhorn Bay, VA	10/23/97	F Silcox	Yancy Wreck, VA	23	11/21/97
34	M Pickering	Narragansett, RI	08/16/96	D Beacham	Sandy Hook, NJ		11/22/97
16	G Blank	Piermont, NY	04/20/97	R Ferraro	Narragansett Beach, RI		11/22/97
20	D Kelly	Sag Harbor, NY	05/10/97	W Rogers	Seaside Heights, NJ	23	11/22/97
18	R Kalenka	Glen Cove, NY	10/01/95	N Mavros	Breezy Pt., NY	20	11/22/97
33	M Grabherr	Mystic, CT	08/01/96	M Owen	Eatons Neck, NY	40	11/23/97
36	J Posh	Fishers Is., NY	07/25/96	J Bartz Sr.	Potomac R., VA	39	11/23/97
15	B Shillingford	Corson's Inlet, NJ	10/01/94	J King	Strathmere, NJ	22	11/23/97
30	R Pearson Jr.	Croton Bay, NY	05/10/97	F Schmitt	Montauk, NY	34	11/23/97
20	R Leja	Bridgeport, CT	10/26/95	K Baracchini	Martha's Vineyard, MA	29	11/23/97
18	H Sweet	Barrington, RI	05/29/97	K Garvin	Providence, RI	18	11/23/97
21	A Perednia	East R., NY	11/14/96	A Perednia	East R., NY	23	11/23/97
18	S White	Long Branch, NJ	10/19/90	G Stover	Sandy Hook, NJ	26	11/23/97
30	P Johnson Sr.	Pt. Judith, RI	08/12/96	T Metcalf	VA Beach, VA	33	11/23/97
20	R Paganini	E. Rockaway Inlet, NY	11/14/96	D DiBenedetto	Montauk, NY	22	11/23/97
23	F Stunkel	Stamford, CT	10/19/93	A Wesche	Ocean City, MD	25	11/24/97
23	K Carson	Watch Hill, RI	09/24/97	P Giacalone	Gilgo Beach, NY	24	11/24/97
27	R Conklin	Moriches Inlet, NY	10/24/95	A DeMarco	Old Orchard Lt., NY	34	11/24/97
18	D Hawkins	Smithtown, NY	07/07/93	R Keller	Monmouth Beach, NJ	30	11/24/97
18	P Lowcher	Sea Bright, NJ	11/20/97	R Pfaff	Island Beach St. Pk., NJ		11/25/97
25	JC Wright	Ches.Bay Brdg.Tun., VA	10/24/96	J Randolph	Ches. Bay Brdg. Tun., VA		11/25/97
15	M Murphy	Douglaston, NY	04/11/97	T Marburger	Northport, NY	19	11/25/97
28	R Kyker	Norwalk, CT	07/12/97	L Jweid	Romer Shoal, NJ	33	11/26/97
21	D Hoxsie	Charlestown, RI	08/18/97	J Kwortnik	Seaside Heights, NJ	24	11/26/97
20	T Marburger	Northport, NY	04/22/97	N Saling	Seaside Pk., NJ	22	11/26/97
19	G Ottavio	Cape May, NJ	09/12/97	D Piacentine	Cape May, NJ	22	11/26/97
28	A Anderson	Montauk Pt., NY	07/04/97	A Wesche	Ocean City, MD		11/26/97
33	R Maimone	Rye, NH	06/12/97	H Williamson	Fisherman's Is., VA		11/27/97
32	D O'Rourke	Old Orchard Lt., NY	06/06/97	K Goldstein	Ches.Bay Brdg.Tun., VA		11/27/97
19	B Kosinski	Sandy Hook, NJ	05/10/97	T Engle	Mantoloking, NJ		11/28/97
24	R Baumann	Sandy Hook, NJ	11/05/97	S Nixon	Ches. Bay Brdg.Tun., VA	27	11/28/97
26	R Lewis	Island Beach, NJ	11/22/90	D Malaszczyk	Montauk Pt., NY		11/28/97
18	T Marburger	Northport, NY	05/12/96	R Starr	Brigantine, NJ	21	11/28/97
19	G Kerkhan	Surf City, NJ	05/31/97	G Hahn	Lavallette, NJ	19	11/28/97
22	R Conklin	Moriches Inlet, NY	06/14/97	A Wesche	Ocean City, MD	28	11/28/97
25	T Rinaldi	Duck Pond Pt., NY	06/27/97	A Wesche	Ocean City, MD	28	11/28/97
29	C Bassano	Nantucket, MA	07/01/97	S Smith	Delaware Bay	30	11/29/97
16	J Della Porta	Swampscott, MA	08/14/97	C Bee	Boston, MA		11/29/97
36	T Tavares	Revere Beach, MA	09/26/97	W Bradshaw Sr.	Ches. Bay Brdg. Tun., VA		11/29/97
27	R Grobarz	Sandy Hook, NJ	06/04/97	G Grazioso	Romer Shoal, NJ	29	11/29/97
23	J Lutz	Cape May, NJ	11/21/97	P Goetz	Cape May, NJ		11/29/97

Species

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
30	A LoCascio	Throgs Neck Brdg., NY	07/22/97	A Scarfone	Norton's Pt., NY	33	11/29/97
19	F Stunkel	Stamford, CT	10/19/94	H Leemann	Ellis Is., NY	26	11/29/97
27	J Stanislawczyk	Port Monmouth, NJ	04/11/97	R Conklin	Moriches Inlet, NY	28	11/29/97
18	L Tikuisis	Pt. Pleasant, NJ	11/21/95	R Shopanski	Cape May, NJ	24	11/30/97
31	A D'Amato	Cape May, NJ	12/07/95	J Legrande	Chadwick Beach, NJ	31	11/30/97
23	T Shaheen	Raritan Bay, NJ	07/07/96	D Forrest	Ches. Bay Brdg. Tun., VA	28	11/30/97
23	L Hickey	Cape May, NJ	06/28/97	C MacNamee	Money Is., NJ	24	11/30/97
17	J Della Porta	Swampscott, MA	07/14/97	C Adams	Norwich, CT	17	11/30/97
17	G Kerkhan	Provincetown, MA	06/22/96	M Dzindzio	Island Beach St. Pk., NJ	19	12/01/97
24	G Nigro	Sandy Hook, NJ	08/29/96	M Kemp	Ches. Bay Brdg. Tun., VA	25	12/01/97
21	F Stunkel	Stamford, CT	10/26/97	B Bergeron	Deal, NJ	21	12/02/97
21	R Leja	Bridgeport, CT	10/31/97	M Dzindzio	Island Beach St. Pk., NJ	23	12/02/97
18	J Hickey Jr.	Sandy Hook, NJ	11/23/96	J Schmitz	Pt. Pleasant, NJ	22	12/02/97
25	F Heal	Flynn's Knoll, NJ	07/01/96	K Ashe	7S Sandy Hook, NJ	27	12/03/97
26	A Dangelo	Block Is., RI	06/14/97	J DeJesus	Sandy Hook, NJ	31	12/03/97
17	H Sweet	Barrington, RI	05/28/97	E Tran	Croton Pt., NY	17	12/04/97
35	J Posh	Block Is., RI	09/16/97	N Willard	Cape Hatteras, NC		12/04/97
18	M LeBlanc	Brayton Pt., MA	01/01/97	J Battaglia	Somerset, MA	19	12/04/97
30	A Anderson	Montauk Pt., NY	06/08/97	J Thornton	Newport News, VA	32	12/04/97
33	JC Wright	Rudee Inlet, VA	12/10/96	W McGlaughlin	Barren Is., MD		12/05/97
38	J Caputo	Hempstead, NY	05/28/97	W McGlaughlin	Barren Is., MD		12/05/97
28	A Anderson	Montauk Pt., NY	10/27/96	A Malheiros	Avon by the Sea, NJ	30	12/05/97
27	A Anderson	Montauk Pt., NY	06/07/97	A Lalli	Throgs Neck Brdg., NY	27	12/06/97
17	C Flaherty	Boston, MA	06/14/96	D Sweeney	Island Beach St. Pk., NJ	22	12/07/97
16	T Marburger	Northport, NY	04/14/97	G Tortorelli	Northport, NY		12/07/97
36	JC Wright	Rudee Inlet, VA	12/10/96	T Weatherly	Cape Charles, VA	36	12/07/97
35	R Kalenka	Montauk Pt., NY	10/04/97	J Wycoff	Ches. Bay Brdg. Tun., VA		12/08/97
16	D Zurheide	Secaucus, NJ	10/30/96	A Rennick	Liberty State Pk., NJ		12/09/97
17	R Kyker	Norwalk, CT	11/18/96	A Perednia	East R., NY		12/09/97
26	P Grippo	Wantagh Brdg., NY	05/27/97	R Collins	Ches. Bay Brdg. Tun., VA	28	12/09/97
20	F Stunkel	Stamford, CT	11/25/96	D Talerico	Seaside Hts., NJ	25	12/10/97
21	M Simmons	Barnegat Light, NJ	06/06/97	L Hill	Ches. Bay Brdg. Tun., VA	24	12/10/97
20	A Schweithelm	Northport, NY	11/29/97	F Burd	Flynn's Knoll, NJ	20	12/11/97
21	K Gleason	Darien, CT	07/02/97	V Minafo	Rockaway, NY	24	12/11/97
20	B Shillingford	Whale Creek, NJ	06/29/97	L Pettersen	Ches. Brdg. Bay Tun., VA	25	12/14/97
19	M Simmons	Barnegat Light, NJ	11/05/97	D Whiteman	Barnegat Inlet, NJ		12/14/97
28	T Galletta	Great Kills, NY	05/25/97	J Rosario	Perth Amboy, NJ	32	12/15/97
23	B Semansek	Indian R., DE	11/22/96	D Everist	Chesapeake Bay, VA		12/15/97
14	M LeBlanc	E. Providence, RI	09/01/95	A Pearson	Providence R., RI	24	12/15/97
21	T Shaheen	Raritan Bay, NJ	06/29/96	M Herts	Lido Beach, NY	22	12/15/97
14	D Hoxsie	Charlestown, RI	08/18/97	R Hasnosi	Milford, CT		12/16/97
21	K Hollins	Island Beach St. Pk., NJ	11/18/96	P Clark	Chincoteague, VA	22	12/16/97
20	T Shaheen	Raritan Bay, NJ	05/29/96	D Hancock	Chesapeake Bay, VA	26	12/16/97
17	T Marburger	Northport, NY	01/07/96	R Nystrom	Devon, CT	21	12/17/97
17	GS Gray	Charlestown, RI	06/13/97	J Juska	Manasquan, NJ	17	12/17/97
33	D Kelly	Orient Pt., NY	09/22/97	R Minor	VA Beach, VA		12/19/97
29	A D'Amato	Cape May, NJ	11/04/96	D Eason	Cape Charles, VA	36	12/20/97
18	T Marburger	Northport, NY	05/14/96	C Tolefson	Cape Charles, VA	24	12/20/97
20	H Sweet	Bristol, RI	07/31/96	J Fabryka	Mispillion Inlet, DE	22	12/22/97
34	R Conklin	Moriches Inlet, NY	09/26/97	R Whitaker	Buxton, NC	35	12/24/97
27	J Hunt	Cape Cod Canal, MA	05/26/97	J Rawls	Nags Head, NC	29	12/24/97
20	P Grippo	Black Banks, L.I., NY	07/23/97	J Bond	Ches. Bay Brdg. Tun., VA		12/25/97
30	S Sturgeon	Cape Cod Bay, MA	06/29/95	R Harris	Cape Henry Lt., VA	35	12/26/97
22	R Conklin	Moriches Inlet, NY	06/14/97	B Bolling	Chesapeake Bay, VA	25	12/26/97
21	H Sweet	Barrington, RI	08/13/97	J Fabryka	Mispillion Inlet, DE		12/27/97
13	H Sweet	Warren, RI	08/28/97	B Tirrell	Providence R., RI		12/27/97
19	J Gibbons	Sandy Hook, NJ	04/22/97	J Fabryka	Mispillion Inlet, DE	23	12/27/97
17	M LeBlanc	Somerset, MA	01/01/97	G Marceau Jr.	Somerset, MA	19	12/28/97
23	R Leja	Bridgeport, CT	10/24/97	J Fabryka	Mispillion Inlet, DE		12/30/97
19	L Gordon Jr.	Ches. Bay Brdg. Tun., VA	11/24/96	W Falls III	Piankatank R., VA		12/31/97
20	R Conklin	Moriches Inlet, NY	06/08/97	M Graham	James R., VA	24	12/31/97
29	A Anderson	Montauk Pt., NY	10/24/97	G Golinski	NE of Rudee Inlet, VA	29	01/01/98
18	D Holland	Barrington, RI	07/15/97	R Pickering	Providence, RI	20	01/02/98
19	B Vesloski	Glen Cove, NY	05/20/97	R Beaulieu	Norwich, CT	19	01/03/98

Species Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
31	J Foti	Staten Is., NY	05/23/97	M Nuzum	2 Mi.E Cape Henry Lt., VA		01/04/98
31	B Glynn	Great Kills, NY	05/17/97	D Parker	Cape Henry Lt., VA		01/04/98
15	H Sweet	Providence, RI	09/11/97	A Pearson	Providence R., RI		01/05/98
25	H Sweet	Barrington, RI	06/18/97	J Yu	Manasquan R., NJ	27	01/08/98
16	A LoCascio	Manhasset Bay, NY	05/20/94	G Groves	Cape Henry, VA	27	01/10/98
18	D Stratton	Mystic, CT	10/07/97	E Messina	Scarborough Pk., NY		01/10/98
26	R Nystrom	Fairfield, CT	08/10/97	A Martin	King George, VA		01/14/98
21	G Clusman Jr.	Sandy Hook, NJ	10/06/96	E Cantler	Chesapeake Bay, MD	23	01/15/98
15	A Piszczatowski	Glen Cove, NY	05/31/97	A Fersterman	Baltimore, MD	20	01/15/98
19	D Wright	Linkhorn Bay, VA	12/07/96	A Fersterman	Baltimore, MD	25	01/15/98
17	D Kelly	Sag Harbor, NY	05/11/97	A Fersterman	Baltimore, MD	22	01/15/98
17	R Grobarz	Sandy Hook, NJ	04/27/97	A Fersterman	Baltimore, MD	18	01/15/98
19	C Wilcox III	Moriches Inlet, NY	08/14/97	A Fersterman	Baltimore, MD	20	01/15/98
21	J Zaffuto	Democrat Pt., NY	06/28/96	A Fersterman	Baltimore, MD		01/15/98
16	A Anderson	Pt. Judith, RI	10/31/97	A Kempf	Edgewater, NJ	16	01/15/98
18	T Marburger	Northport, NY	04/14/97	D Caron	Norwich, CT	20	01/17/98
33	J Scully	Prouts Neck, ME	07/29/97	J Jackson	Saco R., ME	38	01/20/98
27	A Anderson	Block Is., RI	06/18/97	T Bastian	Nanjemoy, MD		01/28/98
15	T Marburger	Northport, NY	01/19/98	W Kobel	Northport, NY		01/30/98
20	M Simmons	Barnegat Lt., NJ	11/13/96	D Ashley	Chesapeake Bay, MD		01/31/98
17	E Petronio Jr.	Pt. Judith, RI	07/02/97	D Caron	Norwich, CT	20	01/31/98
31	F Coronato	West Bank Lt., NY	09/22/97	J Hardin	Buxton, NC	31	01/31/98
15	T Marburger	Northport, NY	01/20/98	T Marburger	Northport, NY	15	02/01/98
16	T Marburger	Northport, NY	04/23/95	R Brown	James R., VA		02/01/98
23	A Anderson	Block Is., RI	07/26/97	R Brown	James R., VA		02/01/98
23	P Krueger	Atlantic Bch Brdg., NY	05/29/96	R Brown	James R., VA		02/01/98
22	N Fiorillo Jr.	Navesink R., NJ	05/10/97	R Brown	James R., VA		02/01/98
16	J Karolides	Beverly, MA	06/03/95	R Brown	James R., VA		02/01/98
16	T Marburger	Northport, NY	02/10/98	J Palma	Northport, NY	16	02/03/98
16	T Marburger	Northport, NY	01/20/97	E Trimble	Northport, NY		02/05/98
21	M McCredie	Lambertville, NJ	09/18/97	Gill netter	Aberdeen, MD	21	02/05/98
14	A Schweithelm	Northport, NY	12/13/97	T Marburger	Northport, NY	14	02/05/98
32	T Marburger	Northport, NY	02/16/97	T Marburger	Northport, NY	32	02/05/98
19	B Shillingford	Corson's Inlet, NJ	07/04/98	B Arnold	Newport News, VA		02/07/98
19	J Mulkerin	Sandy Hook, NJ	07/13/94	J Calamia	East R., NY	29	02/07/98
17	H Sweet	Warren, RI	09/04/97	J Hyde	Palisades, NY	17	02/08/98
16	W Anderson	Provincetown, MA	09/23/96	T Marburger	Northport, NY	16	02/10/98
17	M LeBlanc	E. Providence, RI	08/07/97	N Hermann	Providence, RI		02/11/98
16	B Waas	Barnstable, MA	10/22/96	P Harper	James R., VA		02/12/98
15	J Mulkerin	Union Beach, NJ	04/16/96	A Pearson	Providence R., RI	23	02/12/98
18	G Kerkhan	Provincetown, MA	06/16/97	A Pearson	Providence R., RI		02/12/98
16	S Fries	Coney Is. Flats, NY	05/04/97	P Harper	James R., VA		02/12/98
17	R Grobarz	S. Mantoloking, NJ	11/20/96	P Smith	Gunpowder R., MD		02/13/98
20	L Gonnello	Old Orchard, NJ	05/24/97	R Arnold	James R., VA		02/14/98
28	B Quick	Loveladies, NJ	10/25/96	R Arnold	James R., VA		02/14/98
25	A Anderson	Montauk Pt., NY	10/10/96	R Arnold	James R., VA		02/15/98
14	W Brett	Charlestown, RI	11/06/97	K Smith	Bridgeport, CT		02/15/98
25	D Kelly	Orient Pt., NY	08/10/97	R Arnold	James R., VA		02/15/98
20	R Kyker	Norwalk, CT	10/25/95	J Burch	Swan Pt., VA		02/16/98
21	G Ciriello	Romer Shoals, NJ	10/01/96	J Jones	Popes Creek, MD	24	02/17/98
20	P Hierholzer	Offshr., Sea Isle City, NJ	11/28/97	G LeCompte	Choptank R., MD		02/19/98
21	J Della Porta	Swampscott, MA	08/19/97	C Norris	Pooles Is., MD		02/20/98
17	B Suer	Manasquan Bch., NJ	11/13/96	W Roe	Magothy R., MD	26	02/20/98
19	C Wilcox III	Moriches Inlet, NY	07/14/97	C Norris	Pooles Is., MD		02/20/98
26	G White	Piscataqua R., NH	08/26/97	R Merriam	Montville, CT	29	02/21/98
25	G Nigro	Sandy Hook, NJ	06/11/97	R Jenkins	James R., VA		02/23/98
14	J Holland	Warren, RI	07/31/97	D Pickering	Providence, RI	14	02/25/98
37	A Anderson	Montauk Pt., NY	10/04/97	D McCulloch	VA Beach, VA		02/25/98
15	H Sweet	Warren R., RI	09/14/95	C Norris	Gunpowder R., MD	19	02/25/98
17	GS Gray	Charlestown, RI	05/29/96	E Elwell	S of Cohansey R., NJ		02/26/98
17	P Grippo	3rd Wantagh Brdg., NY	07/22/97	K Fletcher Sr.	Swan Pt., MD		02/26/98
30	A Anderson	Block Is., RI	06/16/97	P Hayden Sr.	Cobb Is., MD		02/27/98
21	G Kerkhan	Deal, NJ	10/05/96	M Morse	Cohansey Cove, NJ		03/03/98
16	GS Gray	Charlestown, RI	06/01/96	D Paul	Norwich, CT		03/07/98

Species Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
28	T Marburger	Northport, NY	01/14/97	J Wiacek	Northport, NY	32	03/07/98
29	A Anderson	Block Is., RI	07/19/97	H Killen	Off Leipsic R., DE		03/08/98
26	A Anderson	Block Island, RI	11/14/96	H Killen	Off Leipsic R., DE		03/08/98
24	F Stunkel	Eatons Neck, NY	09/02/97	H Killen	Off Leipsic R., DE		03/08/98
26	H Sweet	Prudence Is., RI	05/24/97	J Melzer Jr.	James R., VA	27	03/09/98
25	A Anderson	Montauk Pt., NY	07/03/97	J Melzer Jr.	James R., VA	27	03/09/98
20	J Spahr	Atlantic Bch. Brdg., NY	06/29/96	J Melzer Jr.	James R., VA	27	03/09/98
26	L Gonnello	West Bank Lt., NY	07/09/97	J Melzer Jr.	James R., VA	27	03/09/98
35	A LoCascio	Manhasset Bay, NY	06/18/97	R Colonna	Saxis, VA		03/09/98
17	A Anderson	Jerusalem, RI	05/22/97	D Feague	Milford, DE		03/10/98
16	A Anderson	Thames R., CT	05/01/97	D Feague	Milford, DE		03/10/98
24	R Grobarz	Monmouth Beach, NJ	06/15/97	R Colonna	Chincoteague, VA	27	03/12/98
18	M LeBlanc	E. Providence, RI	08/12/96	W Haring Sr.	Nyack, NY	19	03/13/98
28	D Kelly	Sag Harbor, NY	05/12/97	S Rollins	Dahlgren, VA		03/15/98
26	A Schweithelm	Montauk, NY	06/06/97	S Rollins	Dahlgren, VA		03/15/98
16	D Sowerby	York, ME	09/18/95	R Arnold	Newport News, VA		03/15/98
25	A Anderson	Block Island, RI	06/14/97	R Arnold	Newport News, VA		03/15/98
22	R Nystrom	Bridgeport, CT	08/24/97	S Rollins	Dahlgren, VA		03/15/98
12	E Petronio Jr.	Pt. Judith, RI	07/02/97	M Cohen	Housatonic R., CT	15	03/15/98
26	G Blank	East R., NY	11/02/97	R Arnold	Newport News, VA		03/15/98
25	A Anderson	Montauk Pt., NY	06/01/97	R Arnold	Newport News, VA		03/15/98
20	GS Gray	Charlestown, RI	09/29/97	R Nystrom	Devon, CT	20	03/16/98
18	T Marburger	Northport, NY	01/27/98	T Marburger	Northport, NY	18	03/17/98
23	G Nigro	Romer Shoal, NJ	05/19/96	C Ortiz	Hudson R., NYC	26	03/17/98
20	J Casey	Cape May Pt., NJ	05/28/96	NJ Div. F.G. & W.	Delaware Bay, NJ	22	03/20/98
24	G Epple	Charlestown, RI	06/17/96	NJ Div. F.G. & W.	Delaware Bay, NJ	28	03/20/98
18	A Anderson	Thames R., CT	11/29/97	R Remaud	Thames R., CT	18	03/21/98
16	P Chowansky	Sea Girt, NJ	11/30/97	E Elwell	S of Cohansey R., NJ		03/22/98
17	D Stratton	Niantic, CT	09/23/97	R Lesniewski	Norwich, CT	18	03/22/98
21	R Conklin	Peconic R., NY	05/30/97	W Berrell	Harve de Grace, MD	24	03/23/98
22	F Stunkel	Eatons Pt., NY	09/02/97	NJ Div. F.G. & W.	Delaware Bay, NJ	23	03/24/98
17	T McCandless	Jamestown, RI	10/30/97	D Stratton	Norwich, CT	18	03/24/98
13	A Perednia	East R., NYC	10/14/97	F Handlowitch	Weehawken, NJ	13	03/26/98
15	D Hoxsie	Charlestown, RI	06/19/97	J Jones	Stratford, CT		03/26/98
11	T Lake	Bay Ridge Flats, NY	11/28/97	P Picon	Hudson R., NYC		03/28/98
20	R Kyker	Norwalk, CT	10/26/97	E Grant	Derby, CT	20	03/29/98
22	P Hartsgrove	Shrewsbury R., NJ	06/09/97	NJ Div. F.G. & W.	Delaware Bay, NJ	25	03/30/98
17	T Marburger	Northport, NY	03/01/98	R Fink	Northport, NY	18	03/30/98
17	C Wilcox III	Moriches Inlet, NY	11/10/97	W Snyder	Piermont, NY	17	03/30/98
20	M Simmons	Barnegat Light, NJ	07/27/97	C Clark	Beach Haven, NJ	20	03/31/98
17	G Ottavio	Cape May, NJ	09/13/96	H Wittmeyer Jr.	Deptford, NJ	20	04/01/98
23	T Shaheen	Sandy Hook, NJ	06/21/97	A Micalizzi	Little Egg Harbor, NJ	26	04/02/98
27	A Anderson	Pt. Judith, RI	11/01/97	L D'Antonio	E. Haddam, CT	28	04/03/98
14	G Blank	Piermont, NY	02/01/98	R Ruiz	Hudson R., NYC		04/03/98
22	C Kennedy	Offshr., Cape May, NJ	04/18/98	T Heeber	Fire Is. Inlet, NY	22	04/03/98
19	F Stunkel	Stamford, CT	09/03/96	H Anderson Jr.	Delanco, NJ	22	04/03/98
17	E Petronio Jr.	Pt. Judith, RI	07/12/96	P Hoang	City Island, NY	20	04/04/98
18	A Young	Mattituck, NY	08/10/97	M Morales	Bridgeport, CT	18	04/05/98
22	A LoCascio	Throgs Neck Brdg., NY	10/29/94	L Cruz	Pelham Bay Pk., NY	28	04/05/98
19	A Young	Mattituck, NY	08/13/97	J DiPersio IV	DE River, DE	20	04/06/98
17	E Petronio Jr.	Pt. Judith, RI	07/17/96	S Mathias	Norwich, CT	21	04/06/98
23	F Dyer	Mystic R., CT	06/06/97	J Schwendeman	Mouth of Nandua Cr., VA	26	04/07/98
16	A Anderson	Thames R., CT	05/01/97	S Rorick	Montville, CT	19	04/07/98
19	F Stunkel	Stamford, CT	09/21/96	A Hernandez	Coney Is., NY	26	04/07/98
21	J Karolides	Beverly, MA	08/02/98	M Carfero	Staten Is., NY	21	04/07/98
24	M Simmons	Barnegat Lt., NJ	10/17/96	M Sebastiani	Mullica R., NJ	27	04/08/98
16	R Kyker	Norwalk, CT	09/01/95	R Panio	Little Neck Bay, NJ	20	04/08/98
26	P Krueger	Atlantic Bch Brdg., NY	05/29/96	R Arnold	Newport News, VA		04/09/98
27	D Kelly	Sag Harbor, NY	05/23/97	R Arnold	Newport News, VA		04/09/98
27	A Anderson	Block Is., RI	08/05/97	J Johnson	Rappahannock R., VA	28	04/09/98
19	G Nigro	Sandy Hook, NJ	05/18/97	P Batley	Rappahannock R., VA	24	04/10/98
14	C Carroll Jr.	Keyport, NJ	03/25/98	D Jenkins	Pt. Jefferson, NY	15	04/11/98
18	J Hunt	Cape Cod Canal, MA	05/26/97	J Lamotte	Norwich, CT		04/11/98
15	N Kittredge	Old Lyme, CT	05/17/97	L Bialobrzski	Old Saybrook, CT	16	04/12/98

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
Striped Bass (cont.)							
22	P Johnson	Cape Cod Canal, MA	10/19/97	C Streb	Augustine, DE		04/13/98
16	T Marburger	Northport, NY	03/31/98	A Schweithelm	Crab Meadow Beach, NY	16	04/13/98
17	A Anderson	Thames R., CT	01/04/98	A Martin	Norwich, CT	17	04/13/98
13	J Zimardo	South Amboy, NJ	04/10/98	F Sydlosky	South Amboy, NJ	13	04/13/98
27	F Tellefsen	Hoffman Is., NY	11/10/96	J Majoros	Shelton, CT	30	04/14/98
17	J DeLuca	Keansburg, NJ	04/26/96	K Wicenski	Princess Bay, S.I., NY		04/14/98
17	T Shaheen	Navesink R., NJ	06/02/97	F/V Top Dog	Barnegat Lt., NJ	20	04/15/98
24	C Fiorillo	Asbury Park, NJ	11/19/97	F/V Top Dog	Barnegat Lt., NJ		04/15/98
19	R Pearson Jr.	Breezy Pt., NY	10/18/97	W Brown	Croton on the Hudson, NY		04/15/98
17	W Brett	Provincetown, MA	06/24/97	A Chudoba	West Haven, CT	18	04/15/98
13	N Kittredge	Old Lyme, CT	05/17/97	T Yankowski	Housatonic R., CT	14	04/16/98
20	W Brett	Provincetown, MA	07/31/97	B Sampson Jr.	Thames R., CT	20	04/16/98
20	R Pearson Jr.	Breezy Pt., NY	06/09/97	R Craig	Island Beach St. Pk., NJ	20	04/17/98
28	W Kobel Jr.	Eatons Neck, NY	06/29/97	C Roberts	Reedy Is., DE		04/17/98
24	R Allen	Cape Charles, VA	12/03/97	W Prather	Patuxent R., MD		04/17/98
18	D Alves	Barrington, RI	07/27/97	J Scanlan	Little Neck Bay, NY		04/17/98
15	A Anderson	Thames R., CT	05/06/97	G Germe	New Haven, CT	16	04/17/98
19	W Kobel Jr.	Northport, NY	02/03/98	J Orisino	Great Kills, NY		04/17/98
15	GS Gray	Charlestown, RI	06/02/96	T Eggie	Graveling Pt., NJ	18	04/17/98
16	T Shaheen	Navesink R., NJ	05/24/97	J Trautmann	Union Beach, NJ	18	04/18/98
21	R Leja	Bridgeport, CT	10/26/95	F/V Top Dog	Barnegat Lt., NJ	24	04/18/98
	R Richardson	Democrat Pt., NY	04/15/96	W Catino	Egg Harbor Twp., NJ	22	04/18/98
23	D Stratton	Norwich, CT	04/27/97	R Croft	Montville, CT	24	04/18/98
15	H Sweet	Warren R., RI	11/06/97	A Hoegemann	Croton Pt., NY		04/18/98
29	G White	Piscataqua R., NH	06/08/96	A Ciok	Island Beach St. Pk., NJ	31	04/18/98
14	J Calamia	Astoria Park, NY	10/18/96	D Eichin	Verrazano Brdg., NY	16	04/18/98
25	G Nigro	Sandy Hook, NJ	05/17/97	F/V Top Dog	Barnegat Lt., NJ		04/18/98
16	A Anderson	Thames R., CT	04/25/97	C Croft	Montville, CT	17	04/18/98
17	D Kelly	Sag Harbor, NY	07/10/97	A Daniels	Sag Harbor, NY		04/20/98
22	S Knapik	Montauk, NY	10/15/96	A Daniels	Sag Harbor, NY		04/20/98
17	G Blank	Jersey City, NJ	02/07/98	J Pearce	Belford, NJ		04/20/98
21	JC Wright	VA/NC Border	12/11/97	E Durell	Quantico, VA	22	04/21/98
23	D Kelly	Sag Harbor, NY	07/03/97	M McGovern	Jamaica Bay, NY	23	04/21/98
19	H Sweet	Warren, RI	06/25/97	A Perednia	East R., NYC	20	04/21/98
17	T Shaheen	Navesink R., NJ	06/02/97	T Shaheen	Navesink R., NJ	22	04/21/98
18	D Hoxsie	Charlestown, RI	08/19/97	J Bowe	Piermont, NY	19	04/21/98
22	C Malta	Shrewsbury Rocks, NJ	10/29/97	T Shaheen	Navesink R., NJ	22	04/21/98
15	B Merrick	Lyme, CT	04/28/96	R Bala	Island Beach St. Pk., NJ	18	04/22/98
18	R Conklin	Moriches Inlet, NY	08/19/97	J Dotsey	Long Beach, NY	19	04/22/98
24	R Kyker	Norwalk, CT	10/30/97	NJ Div. F. G. & W.	Reeds Beach, NJ	24	04/22/98
19	H Sweet	Warren, RI	08/07/97	P Hulsopple	Green Is., NY	24	04/24/98
20	W Woodroffe	Riis Park, NY	10/22/97	K Stackhouse	Middletown, CT	24	04/24/98
24	F Stunkel	Stamford, CT	11/13/97	J Skurka	New Brunswick, NJ	26	04/24/98
26	D O'Rourke	Raritan Rch Chan., NY	11/12/97	L Codino	Saugerties, NY		04/24/98
17	T Shaheen	Navesink R., NJ	05/30/97	P Lowcher	Navesink R., NJ	20	04/24/98
Tautog							
12	R Allen	Cape Charles, VA	04/27/97	M Urbaneck	Fisherman's Is., VA	15	11/23/97
11	J Gibbons	Offshr., 17 Fathoms	11/24/96	E Hnat		11	12/18/97
10	C Fiorillo	Long Branch, NJ	09/09/96	T Bailey	Long Branch, NJ		04/15/98
Triggerfish							
12	D Sherman	Offshr., Savannah, GA	08/30/97	E Richards	8 Mi. SE Tybee Is., GA	12	10/17/97
Weakfish							
25	G Buono	Staten Is., NY	07/28/97	Lynnhaven Seafood	Landed, VA Beach, VA	28	01/16/98
16	K Carson	Raritan Bay, NJ	10/11/97	R Burcaw	50 Mi. S Morehead City, NC		01/20/98
Winter Flounder							
9	K Leopold	Heckscher St. Pk., NY	03/20/96	S Tonnessen	Montauk Pt., NY	14	09/30/97
10	E Feret	Great South Bay, NY	03/27/93	T Molloy	Baldwin, NY	16	11/09/97
11	S Carlsen	Shrewsbury R., NJ	03/28/95	T Buban	Sandy Hook Bay, NJ	13	04/20/98

Book Reviews

DISCOVERING THE UNKNOWN LANDSCAPE
A History Of America's Wetlands
By Ann Vileisis
Island Press
Washington, D.C.
440 p. $27.50 (cloth)

A look at wetlands as part of the history that shaped this country. When the first Europeans came to these shores they brought with them a long held anti-wetlands prejudice, which for the most part was, fill or drain wetlands to get rid of bugs and disease, to create farmland, to build towns and cities. This was the American mind set for the first 350 years of settlement.

Much of the focus and energy of the environmental movement in the United States has been invested in the issues that concern wetlands. Indeed, in many ways the history of the environmental movement in this country is largely the history of wetlands and how Americans see them.

Early on, you realize that this is an in-depth treatment of a wide and varied subject, and that the author's grasp of the subject is impressive. It is clear that she understands both history and nature.

Vileisis starts by giving the reader a good grounding in the science and ecology of wetlands and explains to us how she came to be enamored of them. But, in a way, this is almost beside the point. What captures your imagination here, as is intended, is not so much biology or geology but history, and what a surprising and interesting history it is.

Two aspects of this story were particularly interesting. First, was the conflicting ways in which wetlands were seen. At the same time that much of the populace viewed them as places to be avoided or eliminated at any cost, others (admittedly a small minority) saw them as places of extreme beauty, tranquility, and abundance. Second was the extent to which wetlands have been a driving force in the politics of America. Almost from the beginning they where used as an important chip in the games of power politics. In many cases the issue was not so much the wetlands themselves but how the control of them could be used to influence an amazing variety of issues. Much of the book is dedicated to this political history.

Ann Vileisis has presented us with an interesting and important book. Well written, well researched, well worth reading.

SEA LIFE

A Complete Guide to the Marine Environment

Edited by Geoffry Waller

Smithsonian Press

Wash.D.C. 1996 504pp., $49.95 (cloth)

Nothing short of a ten-foot shelf of treatises could hope to cover all the world's marine life between the covers, so take the word "complete" in the subtitle with a grain of salt. What this book does do, however, is set the stage for exploring the creatures of the ocean world in greater detail somewhere else.

It comments on the elements of oceanography, the biology of the marine environment, the invertebrates, and vertebrates including fishes, reptiles, seabirds, cetaceans, sirenians, pinnipeds, otters, and the polar bear. It is filled with illustrations, from line drawings showing simple anatomy to paintings of the major families of animals. Its utility lies mainly with the newcomer to the ocean realm and as a starting point for delving deeper.

Unfortunately the text is not error free, the result of trying to cover too much ground. Some of it is outdated. It also lacks a bibliography and simple reference, so where to go for more information is the reader's problems.

DKB

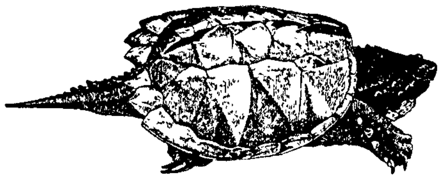
In Search Of Swampland:

A Wetland Sourcebook and Field Guide

by Ralph W. Tiner

Rutgers University Press,
New Brunswick, New Jersey
380 p. $26.00 (paperback)

The word swamp has almost always carried a negative connotation. Until about 25 years ago, the only word the average person knew of to describe a wetland was swamp. In these days of heightened wetlands awareness, if you see the word swamp used in print you can pretty much rest assured that you are about to read why someone thinks it's a good idea to fill some wetlands. It is good to see the honored word in the title of this wonderful book by Ralph Tiner. A wetlands ecologist for almost 30 years, he

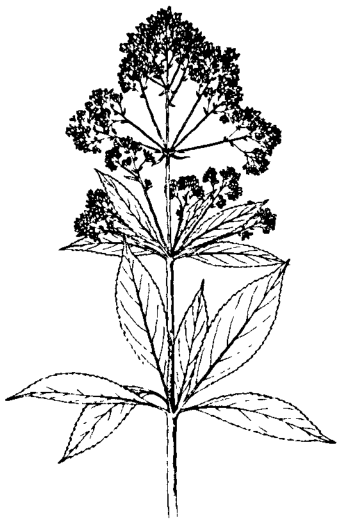


Snapping Turtle.

has written a book for anyone interested in wetlands. From the amateur swamp explorer to the scientist, all will find it useful, and valuable.

The author divides the book in two parts. The first portion of the book he calls a "Wetland Primer" and gives the reader a good overview of the science and ecology of wetlands. This section covers history of wetlands, hydrology, wetland definitions (scientific and regulatory), plant communities, natural and human impacts, and more.

The second portion of the book is a pick it up and take it out to the swamp with you field guide. Chapters here help identify not only plants, and wildlife, but also hydric soils, and wetlands themselves. Descriptions are clear and precise, and illustrations abound. Each chapter (in both portions of the book) ends with



Joe Pye Weed.

a list of additional readings or field guides.

In Search of Swampland focuses on wetlands of the northeast United States, from Maine to Maryland and west to Ohio and Kentucky but many of the principals and descriptions will apply to wetlands in other parts of the country. If you like wetlands, if you're curious about wetlands, if want to better understand the wetlands in your community, the ones seen as you drive by on the interstate, or the ones you plan your trip around, this is a book you'll want to have.

THEIR FATHER'S WORK
Casting Nets with the World's Fishermen

by William McCloskey
International Marine Press
(a division of the McGraw Hill Companies)
Camden, Maine
1988 370pp., $24.95 (cloth)

The author has hauled nets with fishermen from the Grand Banks to Indonesia. Although he often ships aboard as a supernumerary to take notes and pictures, when the work begins he pitches in and is as good at the job as his newfound mates. This has allowed him to gather stories about the fisheries and those who make their living at it that few outsiders would be privy to.

The tales and events are up to date and give the reader a feel for the current status (or at least the author's view of the current status) of a number of fisheries of worldwide importance.

The dangers of the sea get full billing as well. When paying out a net or line one must be very careful of just where one's feet are lest a bight in a line whisk you overboard to a chilly grave in the blink of an eye. Or where you stand. A loose door (one of the two heavy wings that hold an otter trawl open) can crush an arm or a leg in an instant. It still is the world's most dangerous commercial occupation.

McCloskey writes pretty much as he sees it. Although he often ships out with men he has known since his Coast Guard days and tends to sympathize with their trials and tribulations, he is fully aware of the depletion of fisheries and that better care and management is a must. A good read.

DKB

LIFE ITSELF

by Boyce Rensberger
Oxford University Press
New York 1996 290 pp., $15.95 (cloth)

The third edition of "Molecular Biology of the Cell" by Alberts et al recently rolled off the press and fully fits the definition of a tome; that is, a book heavy enough to kill you instantly if dropped on your head from a four-story building. Rensberger's book is considerably lighter, easier on the lap, and, although not a summer page-turner for the beach, covers important aspects found in MBC in readable fashion.

Biologists have come a long way from their initial conception of the cell as a bag containing a nucleus in a mush they called protoplasm. The cell is a microsystem replete with a myriad of specialized machinery, internal structure, gates, messengers, carriers, factories and more. All this has come to light in the last 50 years and more is being unraveled every day.

Rensberger takes you through the labyrinth, pointing out how the major tasks are done from the household chores basic to every cell to the specialties found only in some cells. His story is a handy way to get a sufficient grasp on this basic unit of life and to understand the remarkable discoveries that appear regularly in better newspapers.

This is no accident. The author has long been associated with the Washington Post and the Science Writing Fellowships at the Marine Biological Laboratories at Woods Hole. Each summer selected members of the scribbling trade get a hands-on acquaintanceship with the rigors and delights of the new biology, in the hope that they will go forth and make sense of it to their readers.

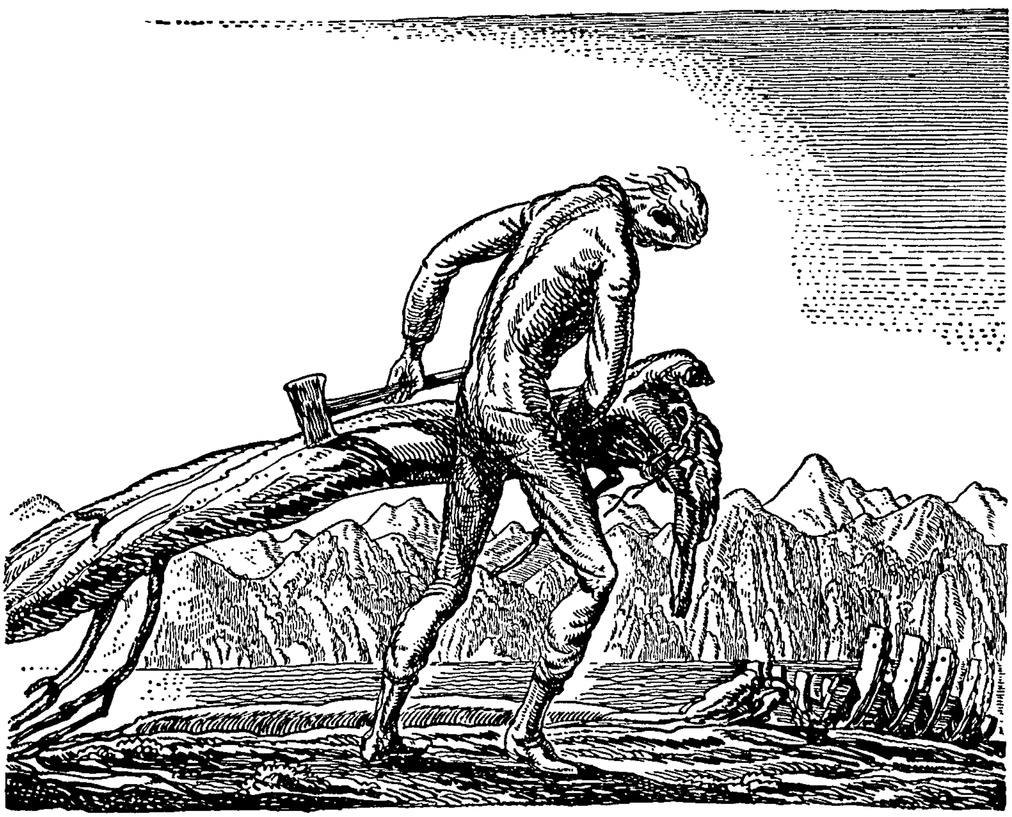
DKB

Wilderness:
A Journal of Quiet Adventure in Alaska
By Rockwell Kent
Wesleyan University Press
204 p. $12.95 (paper)

On August 28, 1918, Rockwell Kent and his nine-year-old son, also Rockwell, landed their small, fully packed dory on the shore of Fox Island, a rock rampart at the mouth of Resurrection Bay, the opposite end of the Bay from Seward, Alaska. The Kents spent nine months on the island, fixing up an old goat shed as a one-room cabin/home, there to draw and write, and for the senior Kent to pull himself through a difficult marriage, an on-going affair, and financial and artistic uncertainty. This is Kent's journal of the Fox Island time.

What drew the Kents there was the solitude and the stark landscape (the older Kent was drawn to cold rocky shore habitats all his life). The stay was successful, and they left with a better outlook on life, a promising financial future, and highly developed artistic skills most notably seen later in Kent's illustrations for Shakespeare's "Complete Works" and the classic wookdcuts in his illustrated "Moby Dick."

ALS Alaska trippers pass close to Fox Island when they explore the Bay by cruise boat during the annual Alaska field trip, during which it is explained that for a time, foxes were ranched there, with the idea that they could be raised for their pelts being fed the salmon that swing into Resurrection Bay in waves to spawn in the summer. Fox farming didn't work, but Fox Island helped Kent through difficult times by providing a brisk winter of exploring and sketching, the base of a spectacularly productive artistic life.



How to Open Clams, or Maximize Use of Your Suburban Attack Vehicle

Your problem is widespread. You have a brand new Suburban Attack Vehicle (SAV) and you have put it through its paces, like going to the drugstore for aspirin and driving four rugged miles to the commuter lot. Now, you want some real challenges. Pull up a chair and get ready to take notes:

(1) **Abalone Tenderizing.** Any West Coast diver will tell you that abalone are unedible unless pounded into tender submission. Try this technique (especially good for Chevy Suburbans). Get four bumper jacks. Tie stout rope around each jack, and crank the SAV a foot off the ground. Place an abalone under each tire. Yank all four ropes at the same time. Presto — yum yum abalone.

(2) **Sand Dune Ripping.** Best SAV: the 1999 stretch Mercedes Geronimo, 14 cylinders of pure torque mounted on a Penske racing chassis with Mylar seat cushions, Goretex windshield wipers, and titanium mudflaps, designed by Eddie Bauer exclusively for LL Bean. First, let all the air out of the tires. Then get a running start in first gear of at least 35 mph. Hit the dune at a 45-degree angle. Watch the dune grass fly. (For extra thrills, try this in the fall when monarch butterflies are on the seaside goldenrod.)

(3) **Piping Plover Nest Squishing.** The only SAV for this job is the Land Runner, a British import with two in-line Rolls Royce V-10 motors, forest green paint job, and rhinoceros proof radiator grill. Weighing in a 5.1 tons, this baby will take out any plover nest and eggs in a minute. Also good for least and common tern nests, and it can do a job on ghost crabs, in and out of their burrows.

(4) **Clam/Oyster Opening.** Get yourself a Jeep Inuit Cochise with a snow plow and Yukon River snow chains on all four wheels. Spread the shellfish around on hardtop (concrete is best, blacktop will do). Drive back and forth and then at a 90-degree angle over the shellfish. Twenty passes should do it. Then plow the shells and meat into a pile and dump the whole mess into a big pot; you've got the makings of a great chowder.

(5) **Surf Fishing.** Sick of missing fish? Try this. Get yourself an SAV with a powerful reverse gear — we like the Ford TORQUEMADA! wide tread with six on the floor at 7700 pounds (the dashboard alone weighs 660). Park the TORQUEMADA! at the water's edge, front bumper facing the ocean. Bait up, cast out, and put the rods in the rod holders artfully mounted on the front bumper. Get in the driver's seat, keep the engine racing (about 4400 rpms), the car in reverse, and your foot on the clutch. When the rod tip twitches, pop the clutch. The SAV will leap backward about 40 yards, and the fish should be at the water's edge. Give some filets to your chiropractor.

(6) **Wetland Cruising.** Walking around wetlands and in tidal creeks has never been fun, especially with it's hot and muggy, when greenhead flies are out, or when blue crabs start biting your toes. The solution? A heavy duty BMW Bog Stomper, 340 horsepower...four tons of hell on wheels, factory air conditioning, cell phone, modem, fax machine, CD player, six cup holders, watertight with extra flotation. With this vehicle you can flatten *Spartina,* crush ribbed mussels and fiddler crabs, and flush rails, willets, and other marshland nesters. Wash your Bog Stomper frequently or it will rust out.

(7) **Canoe or Kayak Launching.** For this one, buy a Buick Big Buck, 497 cubic inches of nitro-ethanol fueled purgatory. Get one with a lion-photographing roof rack system (insist on a roof rack *system,* not just plain roof racks). Lash down kayaks and canoes loosely on roof rack system. Approach the launching ramp at 70 mph; hit the brakes. Vessels launched.

And, we have saved the best till last: any of the above described SAVs can also get you to the grocery store, the neighborhood bistro, or the espresso shop. (Next Issue: How to Park Your SAV).

D. W. Bennett

GENERAL STORE

Here is a sampling of books and items for sale. More selections are available in our BEACHLOVERS Catalog. Call or write for a copy.

BOOK SHELF

Fields of Sun and Grass by John R. Quinn. In the shadow of Manhattan, largely unnoticed by the millions of motorist zooming by on one of the worlds busiest highways, lies the Meadowlands. Naturalist John Quinn, through his sketches and writing, shows us the beauty, history, and political complexities of this great American urban wildernesses. $16

Life in the Chesapeake Bay by Alice & Robert Lippson. A guide to more than 100 kinds of fishes and species of crabs, clams, jellyfishes, sponges, and other invertebrates commonly found in the Chesapeake Bay and coastal inlets from Cape Hatteras to Cape Cod. Wonderful reading, beautifully illustrated. $14.

OTHER ITEMS

NEW! Golf Style Short Sleeve Knit Shirt: White with ALS logo, 60% combed cotton, 40% polyester. In sizes large and extra large. Was $25, now $20

ALS Walking Field Guide T Shirts - Color:
Series 1: Fishes of the Atlantic - Pacific Green
Series 2: Shore Birds - Caramel
Series 3: Coastal Ducks - Sandstone
Order by Series number. 100% cotton w/art work on the back and American Littoral Society on the front pocket. M. L. XL $15.

AMERICAN LITTORAL SOCIETY BOOKS

Anglers Guide to Sharks by Jack Casey. A classic field guide to the sharks that inhabit the waters from Maine to the Chesapeake Bay. $3.

New Jersey Coastwalks by D. W. Bennett. Pack a lunch, put on your walking shores, get in your car, and drive to Kearny, NJ. At this piont take out your copy of NJCW and follow the author's route from Kearny to Cape May and on to the Delaware Bay. Always changing, the coastline of New Jersey offers many surprises. This book will take you on a watery tour that will fascinate and teach you at the same time. $5

Seaside Reader edited by D. W. Bennett. A coastal anthology mixing nature writing and other casual coastal musings. $20.

The Whale Watcher's Handbook by David Bulloch. If you are just starting to learn about whales, dolphins, and porpoises or are an advanced watcher here is the perfect guide to have with you. $12.

SHIPPING CHARGES

$5.01 to $15.00	$3.20
$15.01 to $30.00	$5.10
$30.01 to $50 00	$6.10
over $50.00	$9.10

For all items in this notice send a check made out to:

AMERICAN LITTORAL SOCIETY, SANDY HOOK, HIGHLANDS, N.J. 07732

GUIDELINES FOR SUBMISSIONS

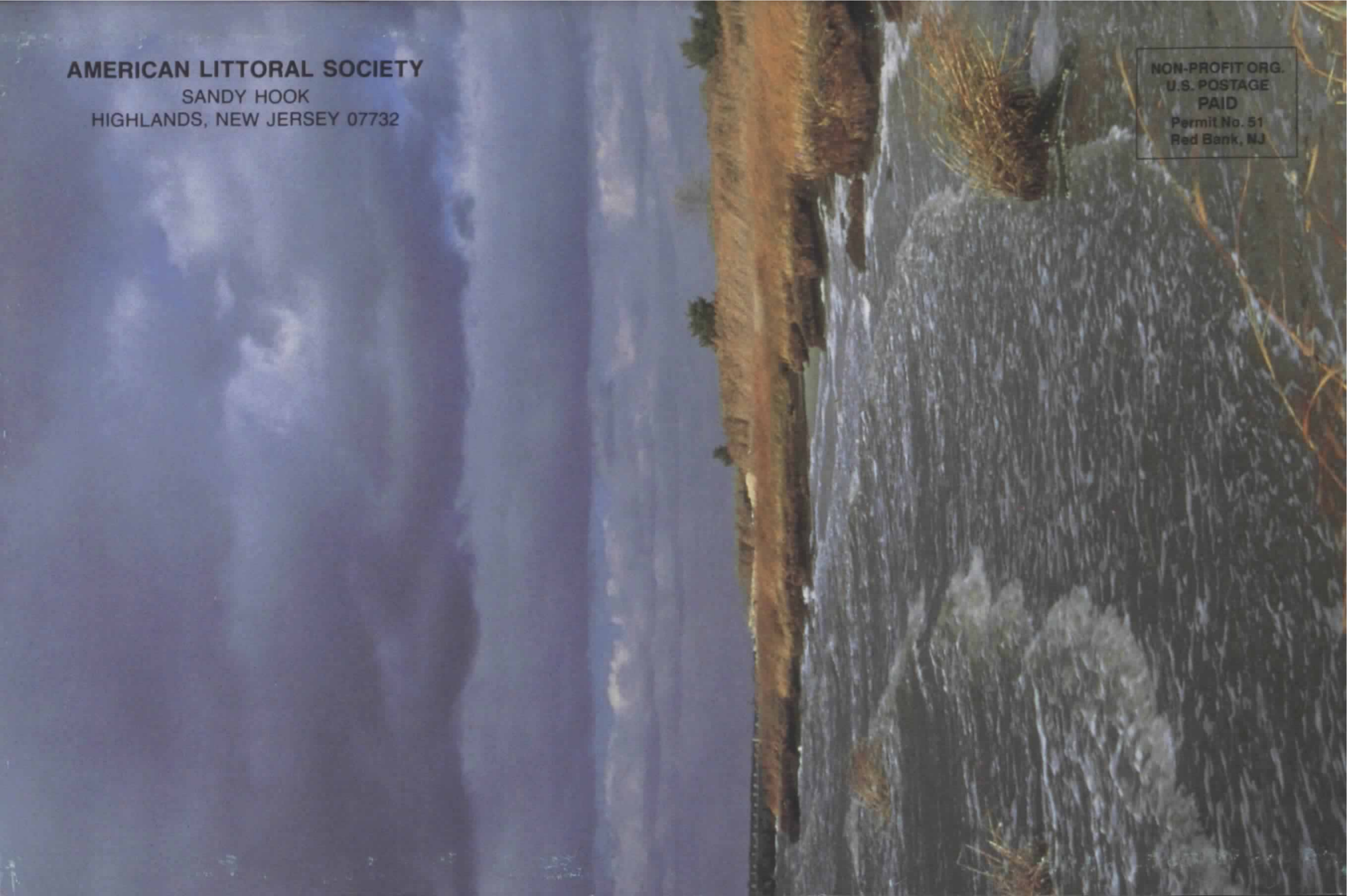
UNDERWATER NATURALIST is the Society's journal. We encourage members to submit articles, pictures, observations, comments, compliments or criticisms. Please follow these guidelines.

SUBJECT MATTER: Feature articles run 1,500-3,500 words (4-10 double-spaced, typed pages); please refer to back issues for guidance. For **Field Notes** and **Coast Issues**, submit no more than three pages of direct observations of interesting natural history found while walking, diving, or fishing in a coastal area. Topics can be of current interest, such as red tide in the Carolinas, whale deaths in New England, or mangrove preservation in the south; you can also submit a number of short observations or notes regarding a particular area. **Letters to the Editor** expressing thoughts on the magazine and its contents or general food for thought are especially appreciated.

ART WORK: For illustrations, black and white prints are preferred, but clear color slides or color prints with good contrast, drawings, maps and charts will also be considered. For **Cover Photos**, we need clear, sharp 35mm color slides or color prints, either horizontal or vertical, of littoral subjects above or below the water. Horizontals can wrap around from front to back. Action is not necessary. (Note: Unless otherwise requested, we keep all accepted art work until it is published).

HOW TO SUBMIT: Typed, double-spaced manuscripts, please. It would help, if you have access to a computer, to receive your manuscript saved as a "text only" file on a 3 1/2" double-sided, high-density disk. Use common, not Latin, species names. We do not carry footnotes; incorporate sources in your article. We edit for clarity using Strunk and White's Elements of Style as our guide and favor clear wording over specialized terminology. Send your work with a stamped, self-addressed envelope; we will acknowledge its receipt.

☐ We do not pay for articles or illustrations, but we do send five authors' copies when published. Thank you for your interest. We look forward to receiving your submission.



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