

A photograph of a beach covered with thousands of horseshoe crabs. The crabs are densely packed along the shoreline, extending from the water's edge onto the sand. In the background, there are several wooden houses built on stilts, and a small boat is visible on the beach. The sky is clear and blue.

# underwater naturalist

Vol. 24, No. 2

# American Littoral Society 37th Annual Meeting October 1-4, 1998

The Society's 37th Annual Meeting will be held from Thursday October 1 through Sunday October 4 on Cape Cod, Massachusetts. Headquarters for the weekend's events will be at the Cape Cod Sea Camp in Brewster. We have reserved a limited number of private rooms in cabins with shared baths at the Camp. Additional rooms have been reserved at the Governor Prence Motor Inn in nearby Orleans, a 10-minute drive from the Sea Camp.

## **Daytime activities**

Whale watch trips, visits to the National Seashore for dune walks and beach walks, visits to tidal rivers and flats, salt ponds, red cedar swamps, an exploration of Nauset Marsh, the Cape Cod Museum of Natural History.

## **Evening activities**

Clambake, cookout barbecue, slide show and talk, spider walk and star gazing.

*There are three attendance plans available:*

### **Plan A:**

Boarding for three nights, all meals Friday morning through Sunday morning. Cost \$210 per adult and \$100 per child under 12.

### **Plan B:**

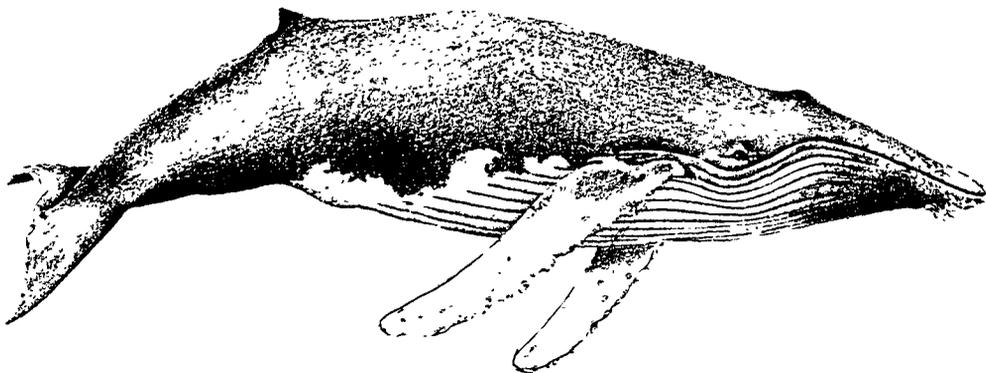
Boarding for two nights, all meals Friday morning through Sunday morning. Cost \$170 per adult and \$80 per child under 12.

### **Plan C:**

For commuters: All trips and activities without boarding. For three days: Cost \$125 per adult and \$50 per child under 12, or for two days: Cost \$100 per adult and \$40 per child under 12.

If you choose to room at the Sea Camp, deduct \$20 per adult for three nights or \$10 per adult for two nights, no discounts for kids.

For more details, please contact the office at (732) 291-0055, ask for Pat.



**Bulletin of the  
American  
Littoral Society**

**Volume 24, Number 2**

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<b>EDITORIAL STAFF</b>	D.W. Bennett, Editor Beth Hanratty, Membership, Copy Dennis Reynolds, Copy, Layout Pam Carlsen, Tagging Editor Dave Grant, Contributing Editor Mary Ann Griesbach, Circulation	

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## To the editor

### Book Reviews

...How do you decide what books to review? It seems that some worthy seaside books are ignored.

Janet Perkins  
Elmer, NJ

*(We sift through books that publishers have sent us, books that we hear about, see in the library, or in bookstores. And some are pointed out by ALS members. Any member can suggest likely books to review, and we would be happy to consider them. Ed.)*

### Binoculars

...Can you recommend field glasses for a budding 10-year old bird watcher?

Bill Sestek  
St. Augustine, FL

*(For starters, a pair of cheap (under \$40) 7x35 extra wide angle binoculars should do the job. Be sure to take them outdoors for a good check before you buy them; there's nothing worse than a pair of out-of-alignment field glasses. Ed.)*

### Photo Comment

...Just wanted to compliment you on the special effects you've achieved in the cover photograph on the latest issue of the UNDERWATER NATURALIST (Vol.24, No.1). Such soft edges, such grain! And what a wonderful two-dimensional effect, with no depth of field.

It's truly amazing how you've achieved the same results with your Hasselblad (note correct spelling) that so many of us have come to expect with a point and shoot. We've all been vindicated.

Can we expect to see more of your work in future issues? I can hardly wait.

Oleander Ocracoke,  
Newark, NJ.

### Mr. Hatteras Responds:

*Thank you for the fine critique of my photographic endeavors. The soft focus effect you commented on so eloquently was achieved by using a Coken series P colorless diffusion filter. I have worked hard and practiced my craft many years to create that elusive "point and shoot" effect you allude*

*to. Since my retirement a few years ago I have experienced great personal satisfaction through my new hobby, and I am pleased that my work here makes you feel vindicated. Thank you also for pointing out that I misspelled Hasselblad in the credits.*

*In answer to your last question, as a long time reader you should know that through the years my work has periodically appeared in the Society's journal and I look forward to future contributions if the editors will accept them.*

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# Farming Atlantic Salmon in Tasmania

by JAMES DUGGAN

Halfway around the world is the island state of Tasmania. This beautiful land of mountains, crystal clear streams, and lakes is the smallest, southern most state of Australia. Historically, Tasmania is linked to America by the English convicts sent to both places. English convicts and criminals were first sent to America and then to Tasmania, creating the many and infamous convict settlements around the state (i.e. Port Arthur).

Today, this wondrous island boast many historic sites for tourist and local visitors to experience what life was like during the convict era. Another attraction for tourist are Tasmania's beautiful rocky coastlines and inland glacial lakes and rivers. These clean and pristine waters along the coast and in the Central Highlands of the state, were recognized in the 1980's as ideal environments to support aquacultural industries on the island. At present, the Pacific oyster and the Atlantic salmon are among the most successful sea farming endeavours in Tasmania. The crystal clear, unpolluted, and highly oxygenated cold waters from deep in the Southern Ocean are considered ideal conditions for farming the Atlantic salmon (*Salmo salar*). This, combined with a tidal river (Derwent River), that is fed by clear mountain waters, provides a reliable and suitable water current for raising Atlantic salmon at various locations throughout Southern Tasmania.

## Historical Background

Atlantic salmon eggs were originally imported to Australia from Nova Scotia in the early 1960's to a freshwater salmon hatchery in Gaden, New South Wales (NSW). In 1983, it was concluded that a

*The author is a longtime ALS member who now lives in Australia and provides this journal with regular watery notes from down under.*

salmon farming industry could be successfully developed in Tasmania. In 1984, Atlantic salmon eggs were transported from Gaden, NSW, to the marine laboratories at the Department of Sea Fisheries in Tarooma, Hobart, Tasmania. The first sea farm was then established at Dover, Tasmania in the south and a fresh water hatchery was developed at Wayatinah, in the Central Highlands of Tasmania.

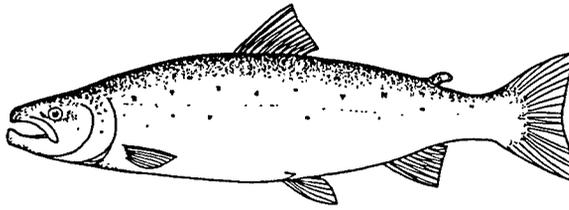
The Tasmanian industry became fully established in 1986, with Tassal Limited in the forefront of salmon farming and production. Tassal Limited is the largest company of its kind in Australia, marketing approximately 65% of the Tasmanian salmon industry's total production. This places Tassal Limited as one of the largest, fully integrated salmon farmers in the world.

Farming of Atlantic salmon is a very interesting and demanding process. The processes may be similar for most aquaculture companies that farm Atlantic salmon. However, this information is specifically related to the Nortas Pty Limited and Tassal Limited companies in Tasmania.

## Stages Farming

Initially, Atlantic salmon eggs are placed in hatchery at Wayatinah on the Derwent River, northwest of Hobart. This hatchery has the ability to produce over 1 million young salmon annually. Mature fish are taken from the river in May to provide eggs and milt for future generations.

This stage in the life cycle of the Atlantic salmon is about 14 - 17 months, from winter to the end of the following winter. Here the eggs give way to yolk sac fry and parr. The young Atlantic salmon or parr must undergo a number of physiologic changes at the hatchery prior to being able to survive in saltwater.



*Atlantic Salmon*

Once these changes occur, they are called smolt. These smolt, in what's termed the nursery stage, are then transferred to brackish water locations on the Huon River, south of Hobart. They remain there for approximately 9 months until they attain a weight of about 1.5kg at which time they are transferred to sea farms, some of which are located at Dover and the Tasman Peninsula. They will remain there for 12 - 18 months, in what's called the grow-out phase, until they reach 3 - 5kg and are ready for harvesting.

At these sea farms, there are numerous routines that must be followed to keep the quality and health of the fish at their peak.

The fish are kept in sea cages or pens while being farmed at sea. A cage consist of a floating structure, usually made of styrofoam-filled polypropylene pipes, connected together to form a circle. Around the circle, nylon nets hang downward from 4 - 10 metres (13 -32 feet) in depth and the circles themselves can have a circumference as large as 80 - 120 metres (260 - 390 feet).

### **Feeding**

Fish are fed with a formulated pellet food each day. The amount of feed given to the fish in each cage is determined on a percentage of the fish's body weight (0.5 - 3%). Normally, due to their higher metabolic rate, the smaller fish are fed a larger percentage of their body weight than the larger fish. Some farms have automatic feeders connected to small computers which control how much and how often the fish are fed. Other farms

accomplish this task manually. At these farms the sea farmer must observe how hungry the fish are, so as not to over or under feed them. An early sign of disease may be indicated by the fish's lack of appetite.

### **Diving**

Divers are an integral part of the sea farm staff. They must be qualified and certified SCUBA divers. However, most divers use a hooker or surface supply line for their air, enabling them to stay underwater longer. This setup provides greater time to inspect and repair cages and their nets, monitor the health of the fish, collect diseased or dead fish, and just perform routine maintenance tasks.

### **Cage Maintenance**

After a period of time the cage nets become clogged with algae and seaweed, and require cleaning. This cleaning is essential. Without the good water flow and oxygenation salmon require, they will die. Salmon are usually transferred to other cages while this maintenance is undertaken.

### **Disease Control**

Juvenile Atlantic salmon are very susceptible to disease during their first summer in saltwater, as they are in a new environment with new disease-causing organisms.

Amoebic Gill Disease is caused by free-living Paramoeba, that effect the smolt in saltwater, usually before Christmas. These organisms colonize the gill filaments and cause irritation. Large amounts of mucous are secreted onto the

gills as a reaction to the organism's presence. This provides a haven for additional bacteria and more food for the Paramoeba. If left untreated, the fish stops feeding, loses weight and dies as a result of poor oxygen uptake. The only effective treatment is to bath the fish in freshwater for 4 hours. This treatment may be required several times throughout the summer (December - March), after which the fish develops resistance to these organisms.

The other major disease encountered when farming Atlantic salmon is a bacterial skin infection caused by a marine flexibacter. This infection can be acquired when damage to the fish's skin occurs through rough handling, collision, or any other mechanical means. The small initial infection can rapidly increase in size, covering more and more of the fish's body. When a salmon becomes infected, seawater slowly enters the blood, via the damaged skin, causing changes in blood composition. The blood becomes more viscous and saline, and intolerable to the fish, finally causing death. The disease can be controlled with antibiotics. Only a licensed veterinarian can administer the antibiotics and the fish will not be deemed suitable for human consumption until the standard withdrawal period for antibiotics has been met. All Atlantic salmon are vaccinated in the hatchery against marine bacteria, which cause the disease, Vibriosis.

### **Grading**

Farmers grade Atlantic salmon once or twice during their residence in sea cages. This enables the number of fish in each pen to be counted and monitored as well as to determine when the salmon may need thinning out, so as not overcrowd them.

Each month, the farmer weighs a small number of salmon in each pen and obtains an average weight. This provides information regarding the size and

growth rates of the fish and an adjustment in the amount of feed can be made if necessary.

The salmon are harvested when they reach a weight between 3kgs and 5kgs. They are scooped out of the pens with large dip nets and placed in iced water with carbon dioxide gas bubbling through it, which helps to anaesthetize the fish prior to being bled. Blood can taint the taste of fish as well as spoil the appearance. An average harvest consist of around 8500 fish or 30 tonnes a day. The salmon are then processed at various sites in Tasmania (i.e. Dover) and prepared for sale.

Tassal Limited uses chartered air freighters, which fly direct into Hobart several times a week, carrying an average load of 20 tonnes of Atlantic salmon. The equivalent of 200 fully laden DC9's are shipped by Tassal out of Tasmania annually.

The product range includes:

- fresh, head on, gilled and gutted whole salmon
- fresh whole skinless boneless fillets
- fresh fillet portions
- smoked whole boneless fillets
- sliced smoked salmon sides
- sliced smoked salmon in a range of sizes
- salmon roe

This industry in Tasmania has thus become a major success story for the Apple Isle and a prime exporter to mainland Australia and overseas to Japan and New Zealand.

There continues to exist pristine, clear waters around the world which may be suitable for farming of shellfish and fish. By managing these natural marine resources, all of us will benefit. Farming and managing these animals through aquaculture also helps to ensure the survival of the species in the wild, with reduced pressure on the fish and shellfish stocks. □

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# Tagging Striped Bass with the NJ Bureau of Marine Fisheries

by PAM CARLSEN



I had been invited to net and tag stripers with the NJ Bureau of Marine Fisheries by Tom Baum, Senior Biologist, from the Nacote Creek Research Station. The purpose of the trip was to investigate the spawning population and to collect data to help determine migration and mortality rates for this specific stock of fish. The NJ Bureau of Marine Fisheries stocked the Navesink River with juvenile stripers from 1984-1989 and continues to monitor the river.

We met at River Plaza Marina just above the Front St. bridge on the Navesink River at 8 a.m. on May 9, 1996. I was instructed to wear foul weather gear, waders (I had oversized hip boots), bring a lunch and have heavy gloves for pulling nets. It was to be a working day. The day was overcast and drizzly, temperature in the 50's. Baum arrived with Heather Corbett, a recent graduate of Stockton State College, who was an

*Pam Carlsen directs the Society's fish tag-and-release program and is an active angler who tags some of her catch and filets the rest. She is pictured above.*

old hand at the whole procedure. Into a 19' Carolina Skiff, we loaded 4 large plastic garbage cans full of gill net, flags, anchor balls, pails, tagging gear, anchors, lunches, and ourselves. The skiff was well chosen for the job to be done, drawing only 6", powered by a 40 H.P. motor, with a large square platform on the bow.

Thus loaded, we left the dock with the tide still running out and proceeded up river as far as we could go. Our first set was at First Bend Beach. We were to set a 300' gill net parallel to the shore. Corbett ran the boat, Baum and I handled the net. I was the lead person handling a small danforth anchor and the weighted side of the net. Baum handled the harder float side of the net and the marking flag. Simultaneously, I let the anchor down and he released the flag, then we each paid out our sides of the net. Corbett steered the boat in reverse parallel to the shore in the middle of the river. At the end of the 300', I set another anchor and Baum released a anchor ball. Our first net was set. The time of each set was recorded and the water temperature noted. It was a very chilly 48 degrees.

Why I wondered did we set the net parallel to the shore rather than across the river? The answer was that the current is too strong to keep the net set properly. Running the net in line with the current kept the hang ups on debris to the minimum. The river has shallow areas where even our boat could not pass without assistance. Here, Corbett was instructed to cut the motor and tip it up, Baum went overboard and pushed us over the area. Back in deeper water, we were ready to set our next net. This set was set at Bicycle Beach, named this because local kids are known to ride down the hill on bikes splashing into the river. This was a very tricky set, as there were many stumps protruding from the water. Corbett followed directions and eased us in and out of the stumps. We laid another 300' net. This done it was time to go back down river and check the first net. We approached the first net quietly and looked for corks that had disappeared below the surface. This would be an indication that a fish was caught in the gill net. Nothing. All was as we left it, so we lifted the net, unfastening the anchor as we deposited the net back into its garbage can. Containing the net kept it from tangling.

Using three 300' nets and one 150' net we hopscotched them up the river all day. Returning to Bicycle Beach, a cork was down. We eased the boat up to the area and Baum used a dip net to retrieve a 26" hybrid striped. We had our first fish. This fish would not be tagged but would be removed from the river. An introduced

species, these supposedly sterile fish are very aggressive and compete with the natural striped bass. Some now think they may be able to reproduce. I was given this fish for my dinner. Upon filleting, we found that it was full of roe. We



*Tom Baum holds a sexually mature striper about to be returned to the river.*

*Note phragmites in background, which grows profusely on the banks of the upstream section*

left this net and proceeded up river to Hockhockson Brook, where we set the smallest net. Almost as soon as we set it we had a hit, but missed the fish. This part of the river is very beautiful and wildlife abounds — green herons, muskrats, osprey, egrets, and Canada Geese, complete with goslings. We set nets, as the tide came in all the way up to the pipeline of the Swimming River Reservoir. When a striped bass was caught, it was brought onboard and placed in

a fish well. Into this large tank, we all bailed river water to revive the fish. Then, the fish was examined for an internal hatchery tag by using an electronic wand. None of the stripers, had a hatchery tag. A scale was removed to help age the fish and the fish was slipped into a long narrow box. On either side of the box were rulers in centimeters to measure the fish. The fish was then turned over and a small incision was made in the belly. Into this incision a USFWS tag was placed. While Baum worked, Corbett recorded all the data. I took pictures. The striper was then released to the river. Twice we tagged fish. Twice we missed fish. At the end of the day, we headed down river lifting the nets as we went, carefully stowing all the nets, anchors, balls, and flags for the next trip. □

# THE TROUBLED HORSESHOE CRAB

*Some 20 years ago, we noticed that local horseshoe crabs were subject to violent human treatment, stabbed with sticks or tossed into the high dunes to die. So we appointed ourselves crab guardians, scheduled regular evening horseshoe crab walks each spring, got some local papers to publish articles defending the crabs' right to exist, and printed up the simple poster reproduced here to display on bay beaches where crabs and people might co-mingle and interact to the crabs' peril. We conducted the crab walks here on Sandy Hook until about five years ago when the numbers of crabs dropped off to a point where we were lucky to see one or two crabs rather than one or two hundred. It isn't clear whether local crab populations have dropped and if so, what caused it—over-harvesting, climate change, loss of habitat, or water quality problems. It is clear that mid-Atlantic crab populations are subject to added pressures for use as bait and in their various scientific and medicine functions.*

*At the same time, horseshoe crabs seldom fail to attract the attention of the curious. On any ALS field trip, a live crab leads to at least a half-hour discussion of its body parts, its history, the animals that encrust it, its uses (and abuses), and its future. Because of its multiple uses, combined with its slow reproductive rate, its future is not bright. To give it its due as an interesting creature in need of care, we present here writings about it and recommend it to you as a creature worth learning more about.*



We have reprinted the original horseshoe crab poster in dark blue on white; you can order up some copies from here. Three for a dollar, or write or phone for a quote in quantities:

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# Of Horseshoe Crabs, Eels, Conch, and Red Knots

By JOSEPH DUTTON

Through an interesting set of circumstances, the futures of four coastal creatures — horseshoe crabs, American eels, conch (whelk), and a shorebird called the red knot — have become entangled; the outlooks of one or more of them depend in part on how the others are handled, harvested, regulated, or protected. Involved are the creatures themselves, their habitats, people who use them, and those charged with their well being. The quandary is the result of an intricate mix of fisheries management, evolutionary biology, politics, ecotourism, and even, to some extent, balance of payments between nations.

The scene of this drama is Delaware Bay, the lower part of the Delaware estuary, downstream from Wilmington and Philadelphia, bordered by tens of thousands of acres of tidal freshwater and saltwater wetlands. Delaware Bay provides spawning habitat for the largest concentration of horseshoe crabs on the east coast. The crabs haul out on the sandy beaches on both sides of the Bay most heavily during the full and new moon periods in May. The larger females dig into the soft, wet sand at the high tide line and release up to 80,000 eggs per season, eggs that are fertilized by one or more smaller males which have ridden ashore hooked to the female's back shell. The eggs hatch in about 30 days.

Red knots, medium sized shorebirds with robin's breast colored chests, migrate north with spring from Brazil to the Arctic with a stop on Delaware Bay beaches in an exquisitely timed ballet: fly 5000 miles non-stop; land on the Delaware Bay beaches in May to eat crab

*The author is a retired school teacher from Pennsylvania. Previously, he has written in UNDERWATER NATURALIST about the Delaware River.*

eggs for two weeks to regain two-thirds of their body weight lost during the flight; and head north on a 2000-mile non-stopper to the Arctic to breed and nest.

Horseshoe crabs, called king crabs by local baymen, have been harvested for at least 100 years. In earlier days, they were taken by the millions, ground up and used as hog food and to fertilize farm fields. Their copper-based blood has been used in science and medicine. And, they happen to be great bait for potting eels and conch, two marine animals that provide livelihoods for commercial fishermen. Thus the rub: both red knots and baymen have grown to count on the availability of horseshoe crabs. Data about the numbers of crabs in the Bay, the numbers of crabs and eggs on the beaches, the area of beach available for horseshoe crab egg-laying, and the numbers and weights of red knots on the Bay beaches are all trending down, though the extent of these downtrends is open to and certainly the subject of debate. Baymen insist that other factors such as sampling techniques and water temperature changes may account for the decreases; biologists say their methodology is more accurate than the anecdotal information from baymen and others.

There is not even agreement on the historic annual harvest of horseshoe crabs for bait, partly because they are harvested with different techniques and brought ashore and stored in many different locations. Some are hand caught by eel fishermen for their own use, others hand caught for sale, still others taken by nets, and frozen for later use. A female crab, the favored bait, is worth about one dollar. The Delaware Bay catch is es-

timated to be about 1.5 million crabs per year.

Biologists and birdwatchers now believe that the Delaware Bay horseshoe crab population has decreased or is decreasing and that the harvesting of crabs should be regulated (read reduced). They argue that while the numbers may not be known exactly, there is enough information to at least err on the side of safety and cut harvest numbers until really good data are produced. In mid-1997, three environmental groups — the American Littoral Society, National Audubon Society, and the New Jersey Audubon Society (not related) — went to court to do just that, and the Governor of New Jersey, Christine Todd Whitman, declared two successive 60-day emergency closings of the horseshoe crab fishery. Subsequently, the state's Marine Fishery Council closed the crab trawl

fishery and limited the remaining fishery to twice-a-week hand harvesting in selected areas to fishermen who could prove three consecutive active years in the fishery. In essence this means that about 14 fishermen can pick up about 1000 crabs per day on the bayshore two days a week for a period of eight weeks when the crabs are on the bay beaches. While this doesn't sound like a lot of crabs it can be: 2 days a week x 8 weeks x 14 crabbers = 280 "crab days" x 1000 = 280,000 crabs. But the crabbers (remember, they get a dollar a crab) want a bigger quota, and the eel and conch fishermen want more crabs because they say they are better baits than suggested substitutes such as crushed clams or mussels, fish scraps or pellets, menhaden, or recently developed artificial baits like freshwater "power baits" and "trout cheese."



*Often the dominant and noisiest bird on a horseshoe crab beach is the laughing gull, shown here in its spring breeding plumage.*

Maybe this is a good place to explain the fisheries of Delaware Bay and southern New Jersey to better understand the place of the horseshoe crab in it.

There are actually a handful of separate but related fisheries involved: first is the horseshoe crab fishery itself, the crabs used as bait in variously designed pots or traps to catch eels, minnows, and some catfish, all in Delaware Bay, and conch mostly in the ocean nearshore. Many of the baymen jump from fishery to fishery seasonally or when one promises to be more profitable than another. The market for eels and conch is good and steady; the minnow fishery is for killifish which are in turn sold as bait for fluke (summer flounder or, in southern New Jersey just called flounder) pretty much during the summer season, June to September. A few freshwater catfish are also harvested with horseshoe crab bait.

Eel fishermen swear by horseshoe crabs for bait. They fish 8-10 eel pots per string. The pots look like big rectangular minnow traps or small lobster pots. Bait is placed in one part of the trap; eels reach the bait through a series of funnels and once in the trap cannot find their way out. Eelers like female horseshoe crabs as bait because they say the eggs from a crab's body trickle out of the pot and drift down current, attracting eels. Eels, famous for the ease with which they are kept alive in captivity in live wells and sometimes simply damp places, are sold as bait primarily for striped bass and as seafood (smoked eels, sushi eels). Conch is sold as scungilli, a dish specially favored by Europeans after much cleaning and pickling.

This eel fishery should not be confused with the recently developed fishery for elvers or glass eels, inch long translucent eels recently arrived from the sea migrating upstream to mature. These are caught by the thousands in tidal creeks throughout the northeast. Glass eelers

can get as much as \$200 a pound for eels which are shipped live to Asia where they are raised in ponds for the fresh eel market. Caught at this one-inch size, elvers can be raised on pelletized food. If they get much larger than an inch in the wild, they will have switched over to other food sources and cannot be reconverted to pellets.

But, back to horseshoe crabs and red knots and baymen and birds and birdwatchers to close. This dilemma is not unlike that of the spotted owl, the timber wolf, or any other species at risk. The horseshoe crab, often called a living fossil, has evolved over more than 100 million years to breed on sandy bay beaches in spring. The red knot developed a life strategy which depends in great part on the presence of horseshoe crabs at a halfway place on their spring migratory route. Delaware Bay fishing families have pursued a number of fisheries over the years, going from one to another as conditions demand. Birdwatching and ecotourism have become big business as people have more leisure time (including senior citizens who not only live longer but tend to be in better shape and more active).

It is no one's goal to put the baymen out of business, kill off the horseshoe population in Delaware Bay or the red knot population worldwide, deprive a person of an eel meal, or prevent people from watching red knots. But it is possible that one or more of these things can happen if a way is not found out of the dilemma. Meanwhile, life on Delaware Bay rolls along. This year, red knots and their cousins the ruddy turnstones were on the Delaware Bay beaches in good numbers, the horseshoe crabs showed up on time, the baymen were busy trapping eels, the price of horseshoe crabs went up some, and the baymen and the birdwatchers continued to meet across the table to try to hammer out an agreement that would satisfy both sides. □

# Living On Limulus

by Dave Grant



The horseshoe crab, or soldier crab as it is sometimes called, is arguably the most interesting creature on our coast. Although most people would not put it high on their list of graceful and beautiful animals, it generally leaves a lasting first impression on those who encounter it.

Spaniards exploring Florida's West Coast were impressed; naming Cockroach Bay after a creature that is neither an insect nor a true crab, but more closely related to spiders and scorpions. Understandably, those who were first to note *Limulus polyphemus* probably had little interest in taxonomy, but were more concerned with the practical value of their discoveries.

The French explorers were also impressed by the "king crab," and it is worth noting that Samuel de Champlain's map

*Dave Grant is the Society's chief naturalist and a contributing editor to this journal. He is on the faculty of Brookdale Community College. The photo above by Don Riepe shows a crab heavily encrusted with slipper shells (Crepidula fornicata).*

from his 1604 voyage to "New France" has on its margin, sketches of a few New World creatures that obviously impressed him. One of those animals is a horseshoe crab with the intriguing, presumably Native American word "Sijuenoc" scratched in next to it. The map was widely distributed in its day and I've seen a copy on display at the Acadia National Park.

Much has been written on the horseshoe crab's remarkable life history. In fact, it has been called the most intensively studied marine invertebrate in the world. However, little mention is made of the great variety of creatures that benefit from the crab or live in association with this common denizen of the shallow waters off our shore.

Over the years I have been compiling an ever-growing list of creatures that somehow rely on horseshoe crabs, and have decided that if I had only one animal to choose as a teaching tool about life in the sea, this venerable arthropod would be on the top of my list. Examining a

mature crab is like perusing a text book on invertebrate zoology, and almost any specimen you might pickup has at least two or three other species in tow.

Most of the myriad creatures that are found clinging or growing attached to the horseshoe crab are probably opportunists, but a few residents of the moving menagerie depend on the crab for survival. Looking over a well inhabited crab, I'm often reminded of Jonathan Swift's jingle:

"Big fleas have little fleas  
Upon their backs to bite 'em  
And little fleas have lesser fleas  
And so, ad infinitum."

In an evolutionary sense, the horse shoe crab is a conservative fellow, changing little since it first left trails between Paleozoic tidepools hundreds of millions of years ago, enduring great changes through the earth's history. (Marine biologist Bill Hall of the University of Delaware likes to say, "When somebody drops The Bomb, two things will survive: cockroaches and horseshoe crabs.")

It is about as close as nature gets to a permanent fixture in this dynamic environment, and like any firm substrate in the sea, its surface is quickly covered by "fouling" organisms that require a safe haven from siltation, as well as access to the water currents that deliver food and oxygen. Because it is large, long-lived and mobile, the horseshoe crab is a magnet for a variety of the invertebrates in the sea as it migrates from the continental shelf to our estuaries to spawn each spring.

A horseshoe crab that has recently shed, especially a rapidly growing youngster, has a smooth and beautiful olive-colored shell that is free of scratches and marine growth. From observations in the aquarium and field, it appears that one way juvenals keep their shells squeaky clean, intentionally or incidentally, is by regularly plowing through the sand and spending extended

periods of time completely buried while at rest.

For the aquarist worried about rotting fish in their tank, this disappearing act, which might last for over a week, makes them unnerving pets; but it's all part of the crabs repertoire in the wild. While diving in rivers in the summer, I've observed them burrowing into the sediments to avoid being pushed around by tidal currents. While treading up clams from the marsh in winter, I've dug up young crabs in the sandy creeks, apparently hibernating. This may be where juvenal horseshoe crabs "mysteriously" disappear to during their first few winters, surviving the cold and keeping free of fouling organisms at the same time.

However, the most important feature of their lives that keeps the shell clean is rapid growth, and they shed most frequently when they are juvenals - up to five times a year. This, more than any other factor, prevents larvae of other creatures that are continuously settling out of the plankton community from becoming permanently established on their shells.

For horseshoe crabs, it is, quite literally, a drag getting old. As a crab ages and its growth rate slows, it sheds less frequently and begins to display a striking variety of hitchhikers. The assortment, size and growth rate of this zoological 5 o'clock shadow, gives us an idea of how recently the crab has shed and becomes a gauge of its growth rate; information that is otherwise difficult to obtain from animals that lose their entire shell, and any markers that are placed on them, as they grow.

A number of these creatures associate with horseshoe crabs because they are a source of food. Others are permanent residents, apparently living intimately with the horseshoe and nowhere else. Others may be attracted to settle on the crab because of the presence of members of their own species. Most of the other hitchhikers may settle out of their

plankton stage randomly, and with luck, end up living on *Limulus*.

Many animals use the horseshoe crab for food, although the adult crab is so large that few things bother it. The shell of an adult crab is often riddled with scars from its few enemies. People are the worst culprits when the crab is inshore, poking and stabbing them, often because they look monstrous in their faunal overcoats. Some specimens have evenly spaced, but healed gashes across the shell, testimony to the crab's great recuperative capabilities. These are often propeller scars, however, I like to embellish things a bit for curious youngsters and add, "Although it could be the bite of a shark or loggerhead turtle!" perhaps the only two creatures that regularly try to tackle an adult crab.

Even before birth and in death, the horseshoe crab is exploited. Shorebirds are noted for their dependence on the crab's eggs, but I've seen many other birds, even ducks, treading the sand for them at the water's edge. At the high tide mark, I've found tiny nematode worms wriggling among the egg clumps in nests, presumably feeding on the eggs. Gulls pounce on overturned crabs and tear them apart to eat the gill and muscle tissue, and flies and sand fleas are soon attracted to the dead crab and utilize what remains of its flesh. The crab exacts some revenge though; it harbors an encysted flatworm in its gut, which matures into a parasite in the gull's intestine.

As on most other submerged surfaces in the sea, there develops a film of bacteria feeding on organic materials adhering to the crab's shell. These pioneers set the stage for the rest of the fouling community of invertebrates, and may ultimately help cause the demise of individual crabs by damaging the shell. On adult crabs in their terminal molt, the microorganisms begin to take a toll, as they do with most things; and as time goes on their shell becomes darker and shows more pock-marking from the presence of bacteria that utilize the

chitin. It's fortunate there's a bacteria to eat just about anything in this world. Otherwise, after millions of generations of crabs, their shed shells would outnumber even old National Geographics, and the world would have long ago been buried in them.

Of all the creatures that utilize the crab, only humans seem to harass it from cradle to coffin. Friends in New York city tell me that in Chinatown in the spring, the gravid female crabs are sold for their eggs. (It seems that, like every unusual oriental dish, they are reputed to be an aphrodisiac.) The tail and leg muscles are also edible and it is said the crabs were eaten by Native Americans.

Even today, around Memorial Day when the crabs are spawning, you can visit Sandy Hook, a popular retreat for recent immigrants living in the N.Y.C. area, and occasionally come across a family filling their car trunk with crabs. You can be certain they're not taking the crabs back to the city to be pets.

Horseshoe crabs are also used as bait. Fishermen freeze the females, saw them in half, and insert them into eel traps. The crabs are famous for the fertilizer and farm feed industry they once supported along Delaware Bay, but even up on Raritan Bay, "old-timers" tell me that as late as 1950, farmers from Freehold gathered them by the wagonload to plant with melon seeds.

Even the crabs' remains benefit people. The chitin has been used medicinally, and the complete shell is a popular curio at shell shops outside of the crab's range. I've even come across a design for a Victorian-era lady's purse made from the crab's shell.

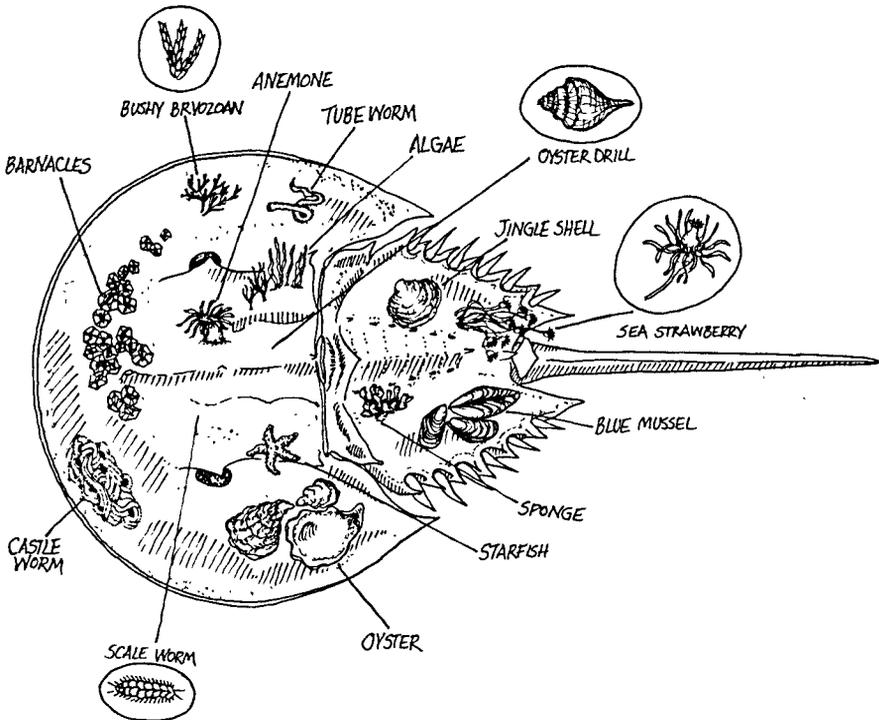
The shells can be used for more than whimsical folk art though. Like Native Americans, I've used an empty shell to bail out my canoe and if I ever had the need to fashion a fish spear, my first experiment would be with a horseshoe crab tail.

So much for butchering crabs or using their remains to exploit them. What I

really find interesting are those creatures that are dwelling with crabs. The most unique confederate of the crab is the *Limulus leech*, an inconspicuous, but regular "ectocommensal" found on the underside of the crab. The "leech" is a flatworm, one of the Platyhelminthes; an interesting phylum because most of its members are parasitic - like tapeworms in humans; or commensal - apparently harmless or even beneficial to their host. The *Limulus leech* is not a true "blood-

long time. For those of us who are squeamish about wiggly things in our hands, they are often present in disconcerting abundance, and are said to be toxic if eaten - just in case you're the adventurous type.

We tend to button hole animals as being either aquatic or terrestrial, overlooking the third lifestyle that is so important and prevalent, that of the distant cousin who appears at the door looking for a place to live. Symbiotic relation-



sucking" parasite in its behavior or classification, although you'd think so, judging from the name - bdelloura - that taxonomist borrowed from the Greeks. (A hint to the word's pronunciation and origins is the bdellometer - pronounced "delometer" - a 19th century medical gadget developed as a substitute for leeches.)

Bdelloura is found around the book gills and leg joints of crabs, especially on older females that have not shed for a

ships can benefit only one partner (Commensal), both (Mutualism), or be detrimental to one (Parasitism). The *Limulus leech* exhibits features of all three "-isms", at least in the literature, and biologist don't all seem to agree on its exact relationship to the crab.

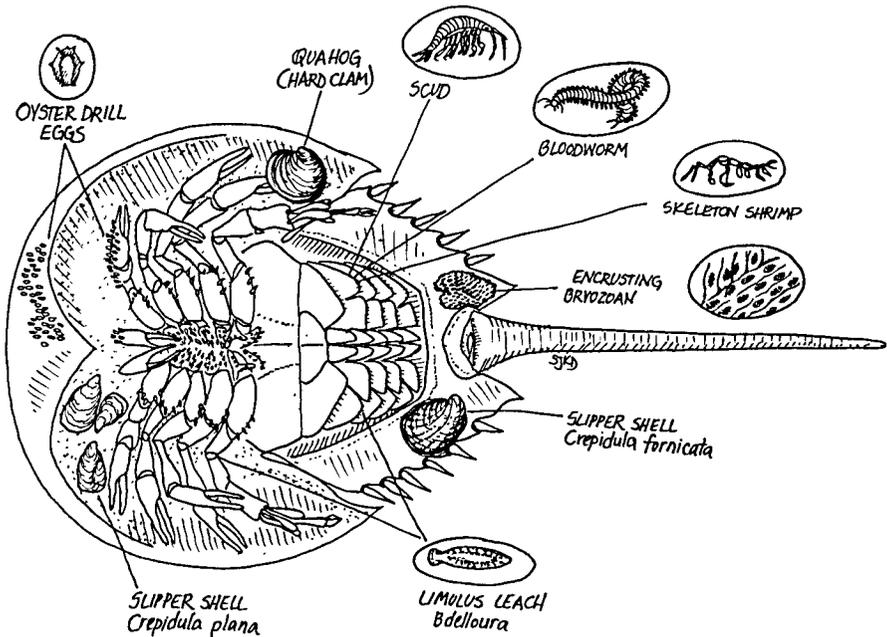
Traditionally the feeling was that the leech was not a parasite and didn't harm the crab, but merely took advantage of the minute bits of organic material that drifted around while the crab was eating

or perhaps grazed the film of fouling growth on the shell surface. More recently biologists have started to reconsider *Bdelloura* as a parasite that may weaken the crab enough to contribute to its eventual demise.

The leech lays its eggs in the "pages" of the crab's book gills and these are visible as little dark spots. It may also use the cuticle of the gills as a substrate for chemical activity. In time, these actions weaken the gill surface and allow

though the flatworms seem to be more abundant on females, all you need to do is flip over any large horseshoe crab to find a few.

The flatworms appear as small, pale pieces of fleshy tissue that move when you touch them. Under the magnifying glass they are fascinating to watch as they glide across your finger, no doubt trying to escape this hot, alien world onto which they have suddenly been transplanted. How they manage to stay



leakage of seawater and bacteria into the crab's body. This may account for the crab's hypersensitivity to bacteria in its blood, which makes it of interest to the medical field. Eventually the crab begins to suffer from the onslaught.

The largest of the three *Bdelloura* species is easily seen and measures up to a half inch in length. Like its two smaller and less conspicuous cousins it is known only from the horseshoe crab, but is easy to find if you know where to look. Al-

with the crab during the molting process is a bit of a mystery. I've never found them on young crabs and suspect it takes a considerable amount of time or good luck for a community of them to get established. Do they spread between crabs during mating? With the death of their host, how do they deal with such a disaster in their otherwise secure existence?

There are many other more conspicuous residents found on horseshoe

crabs. Poring over the Phylogenetic tree that forms my ever-growing list, I see nine major phyla of invertebrates regularly represented. Some are probably no better off on a crab than they would be on a rock, but others seem to thrive as hitchhikers and consistently can be found attached at specific spots on the horseshoe crab.

Sponges are filter feeders and are usually restricted to locations where there is enough water movement to bring plankton to them and to prevent burial by siltation. Brightly colored red beard sponges and other fouling Porifera occasionally become established on the posterior of horseshoe crabs; probably when the water is cool and the crab is half buried in a dormant stage. They never seem to get a chance to grow very large; at least I've never seen any more than an inch or so long. These slow growers are better suited for cosmopolitan lives on an immovable rock in a current-swept channel where they won't be buried.

Coelenterates are some of the pioneering animals of the fouling community in our waters and are represented on horseshoe crabs by anemones and hydroids. The ghost anemone, a common, non-descript intertidal species, and the colorful striped anemone, an immigrant from Japanese waters, can sometimes be found if the crab's dorsal side is closely inspected. They can only fully be appreciated underwater since they close up when the crab is lifted out of the water. Like the lovely pink sea strawberries, hydroids that are also found on *Limulus*, they must be observed underwater to be fully appreciated. Their exquisite shape is lost when they are not supported by the water.

Snail fur, a stout, bristly cousin of sea strawberries, is more durable out of the water, but is not as attractive or easy to see without a magnifying glass. However, it is easy to feel and a colony's velcro-like texture contrasts greatly with the smooth glistening shell of the horseshoe crab.

Although the flatworms are well represented by *Bdelloura*, other worms are less common on horseshoe crabs. The Annelids or segmented worms are present, but never in such great numbers. Free-living annelids like the scale worm (*Lepidonotus*), sand and blood worms (*Nereis* and *Glycera*), may be temporary residents, as they would be on a rock or among seaweeds. They may also be potential food items that the crab has dug out of the sediments. It is difficult to decide which, but it is not unusual to pull a crab out of a net and find a worm or two gliding among its fouling growth community or trapped by the surface tension of the film of water on the crab's shell.

Tube-building worms are common on the backs of horseshoe crabs. Older crabs oftentimes have a filigree of tunnels intertwined on the highest portion of the shell where it is rarely buried. Some worm species, like *Sabellaria*, glue sand grains together to form a protective tube. Obviously the crab must have spent time on the sandy bottom for the sand castle worm to collect construction materials, so this helps us trace its movements.

Other worms extract calcium from the water to make their home, and the bottom type where the crab lives is not a factor. The loosely-coiled *Hydroides* is fairly common on our crabs in the Middle-Atlantic, and I've been told the tightly-coiled *Spirorbis* worm is found on crabs in the cool waters at the crabs northern limit in Frenchman's Bay, Maine, where Champlain may have encountered them.

Another ancient group, the *Echinoderms*, is sometimes represented on horseshoe crabs by the starfish. I've never found more than one or two tiny ones on a heavily encrusted crab, so they are probably only temporary residents and fall or move off in a short time. It's hard to imagine they could be any threat to the crab since their prey is bivalves, however, in captivity, aquarists have reported adult starfish and urchins grazing on the eyes of resting horseshoe crabs. Perhaps there is also some hazard



in the wild for dormant crabs. Of the horseshoe crabs that arrive earliest in the spring at Sandy Hook, a surprising percentage have damaged eyes. Most seem disoriented and make landfall on the wrong side of their destination, ending up stranded by the rough surf on the ocean side and becoming food for gulls.

Several crustaceans are regular companions of the horseshoe crab. Mud crabs and sand shrimp are usually with the horseshoe crabs that we drag up with nets. The shrimp are no doubt incidentals in the catch and temporarily caught up with the crabs legs, although while diving and watching horseshoe crabs, I have seen shrimp and mud crabs hiding on, under, and around their shells as though the resting horseshoe crabs were algae-covered rocks. Tiny juvenal spider and rock crabs also find a secure, prefabricated home in the crevices inside *Limulus* molts.

Give a crab a good shake in a bucket

of clean water and after you remove it you'll be surprised at what's swimming around. Scuds and marine sowbugs are likely to be found with horseshoe crabs, especially if they are heavily covered with growth. Both animals are quite common where the crabs pass through seaweed beds, and although they are strong and graceful swimmers, they are also good fish food so it is certainly to their advantage to stick close to seaweed, rocks, or horseshoe crabs that look like seaweed-covered rocks.

Some years the bottom of the bay is carpeted with skeleton shrimp, and they too can be found on the fouling growth of the crab. The inch-worm-like movements of these tiny crustaceans is often overlooked, especially when the substrate they are on is out of the water, but they are easy to spot if the crab is submerged.

There is no mistaking barnacles, and they regularly settle and attach per-

manently to the backs of horseshoe crabs. In fact they are the crustacean you are most likely to find on *Limulus*. The crown they form on the cephalothorax is a mark of how deep the crab burrows into the substrate when it is at rest for long periods. Usually the circular scars of detached barnacles are also present, evidence that the crab has not shed for some time and burrowed deep enough at some point to smother the previous generation of barnacles.

The Mollusks are better represented on the horseshoe than any other phylum. Several species of bivalves become attached to the crabs, and a number of snails are also regularly found gliding around on them.

Oyster spat need to settle on a firm, silt-free substrate, and crab backs occasionally fit the bill, especially in Delaware Bay farther south. Like barnacles, if they die after being smothered in the mud by the crab's burrowing habits, they leave behind scars on the lower shell.

Mussels also like to call the crab home and usually attach themselves near the hinge where water is circulated to the gills by the resting crab. Less frequently, they can be found on the underside of the crab around the legs and gills, and I've freed quite a few old souls whose movements were greatly impeded by clumps of sizable mussels.

The water of the Delaware Bay is sometimes too warm in the summer for edible blue mussels to thrive and grow large, but traditionally, residents in Fortescue (NJ) are said to have collected suitable mussels from crabs that move into the bay after wintering offshore. Up in Raritan Bay, we also find horse mussels on crabs in the spring as they arrive to spawn and small ribbed mussels on them after they've been up in the marshes during the summer.

Turn over a horseshoe crab in the shallows and you are likely to discover young soft and hard clams, and tiny gem shells

hung up in the bristles surrounding its mouth. These are prey items of the crab, the dominant predator of the bay's benthic community and the reason why in the unenlightened and not too distant past, Massachusetts had a bounty on *Limulus*.

Sometimes you'll find the prey exacting a penalty too. As the crab treads the bottom for seed clams, it may inadvertently stick a claw into the open shell of a hard clam that is filtering water. A large clam can clamp down so tightly neither creature can free itself. If the waters were cleaner here on Sandy Hook Bay, on a lunchtime stroll in May I could easily collect enough quahogs from those crabs that are dragging around a living ball-and-chain, to make myself a nice chowder. And without even getting wet above the ankles.

Asking around in New England, I've heard of one more bivalve that's been reported attached to *Limulus*, the jingle shell. The delicate and colorful jingle shell secures itself with byssal threads that pass through its lower shell. It then grows along the contours of the shell or rock it calls home. With a geographical range that extends south to the Yucatan, there are probably many other bivalves that take up residence on them and hopefully, I'll eventually hear about them from readers.

Another mollusk that is form fitted to its substrate is the slipper shell. Three species - the common, convex and flat - are regularly found attached to the underside of the crab. They are so abundant and such a regular fixture on *Limulus*, people often mistake them for part of the crab's shell. To insure that there are males and females living in clusters, slipper shells are said to use pheromones to attract larva out of the plankton to settle on their own kind. The crab is such a good home to slippers that several generations are usually present in one stack.

Snails are well represented on horseshoe crabs. I've found periwinkles, basket and mud snails and that old nemesis

of the oyster, the drill. The periwinkles graze algae - common on crabs that spend time in shallow water. Basket and mud snails are scavengers and swarm to dead crabs for food. Snails also lay eggs on the back of the crab, and in the spring we find specimens that are literally carpeted from head to tail with drill and mud snail egg capsules.

Algal growth on the shell is a clue to where the crab has been for the last few weeks. Green seaweeds like sea lettuce and *Enteromorpha*, and brown weeds like popweed (*Fucus*), thrive best in shallow waters where the light is intense. They also endure dissiccation, so we find them getting established on the crab's back in the warmer weather when spawning and feeding in shallow waters. The more delicate red seaweeds, *Agardhiella* and *Gracilaria*, are more likely to be found on crabs in the fall when they are dredged up from the cooler water in the bay.

Bryozoans, the colonial "moss animals", are a difficult group to recognize, but they are often the most abundant hitchhikers on horseshoe crabs, sometimes forming a coating over most of the crab's shell, even on parts of its underside. The most noticeable bryozoan, *Bugula*, is a bushy, golden seaweed-like creature. It is probably the most attractive ornament found on a horseshoe crab. Harvested elsewhere, dried and dyed green, it is familiar to us as the "plant" sold by a florist as "everlasting" Irish sea ferns.

Other bryozoans include calcified types that form a delicate lacy pattern on the top of some shells. A third type, the spongy bryozoans, often spread across most of the upper shell of crabs, even covering their eyes.

No one is quite sure how long horseshoe crabs live (although they might live well into a second decade) or on which birthday they reach maturity (although it probably takes about ten years). How-

ever, it is suspected that they stop growing at that point, and the spreading growth of the bryozoan colony, especially on adult males, seems to confirm that they indeed stop molting at maturity.

One of the things I look forward to the most each spring is the crabs moving inshore to spawn, because they always bring along something new and interesting to show me. Over the years, I have noticed that the most sluggish are likely to have most of the shell and eyes covered with fouling growth.

Such a thorough covering across the surface of the crab may cause it more than a little inconvenience, by interfering with light detection. The thick coating of hitchhikers seems to presage the final demise of the crab. This and their sluggishness are clues that they are suffering and probably won't survive another season.

I pity them and always peel off the growth from the eyes of heavily infested crabs, but it probably doesn't help them for long, since they undoubtedly grow right back. In spite of it all, the crabs struggle on, ambling off into deeper water, disappearing beneath a thickening blanket of bryozoans, barnacles, and whatever else issues from Triton's wreathed horn.

Perhaps, like their terrestrial counterparts, old soldier crabs never die, they just fade away. □

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# Mass Stranding of Horseshoe Crabs

By ROBERT REID

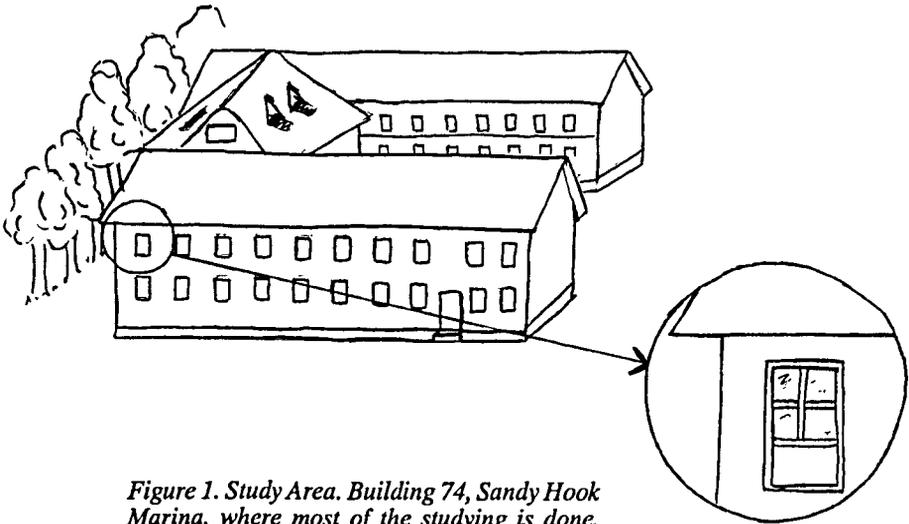


Figure 1. Study Area. Building 74, Sandy Hook Marina, where most of the studying is done. Inset: My office.

The common horseshoe crab, *Limulus polyphemus*, is among the oldest and most curious crustaceans extant.<sup>1</sup> Despite this, horseshoe crabs have until now been poorly studied.<sup>2-439</sup> The species represents an evolutionary cul-de-sac, having remained virtually unchanged since at least World War II. *Limulus* is of considerable commercial importance; its blood is the chief ingredient in horseshoe crab pudding (which is, unfortunately, inedible), and the shells are commonly used to decorate Middle Atlantic beaches. Where abundant, horseshoe crabs are also considered to be of major ecological significance. In foraging through soft estuarine sediments like miniature Corps of Engineers bulldozers, they are thought to help keep

*Bob Reid is an ecologist with the National Marine Fisheries Service, Howard Lab, Sandy Hook, NJ. No horseshoe crabs were harmed in the course of this study.*

in check populations of juvenile soft and hard clams, oysters, blue crabs, and similar pests.

Like certain cetaceans (to whom they are distantly related), horseshoe crabs have sometimes been observed to strand themselves en masse on the shores surrounding their customary habitats. Limulologists have yet to reach agreement on the cause(s) of this puzzling behavior. In an attempt to shed some light on the subject, I here report a mass stranding of horseshoe crabs at Sandy Hook, NJ.

## STUDY AREA AND METHODS

Sandy Hook is a sandy hook of land bounded by the Raritan Bay on the west and Raritan Bay Surface Water to the east; the crystalline Atlantic is reputed to lie just offshore. The fauna is dominated by seabirds, shore birds, sea-shore birds, gobies, bennies, pine, and brine pigs. The specific study location is shown above in Figure 1.



*Figure 2. Typical stranding behavior of *Limulus*. Stranding crabs leave water and plow through sand, often for tens of meters, until immobilized. If not soon immersed by rising tides or wave action, crabs in this state will quickly succumb of desiccation or boredom. In short, he's in trouble.*

For the stranding observations, I used my eyes, supplemented by my ears. The photographs were taken with a camera. Temperatures and salinities were determined with a toad fish.

## STRANDING OBSERVATIONS

The strandings were observed on June 12, 1959, approximately 1 km (3.3 nautical miles) north of Sandy Hook Coast Guard dock. At least one, and possibly as many as two, animals were involved. I concentrated on a strapping male which had worked its way approximately 10 m up the beach (Figure 2).

The crab was returned to the water but, after "frolicking" for a shot time (Figure 3), soon beached itself again (Figure 4).

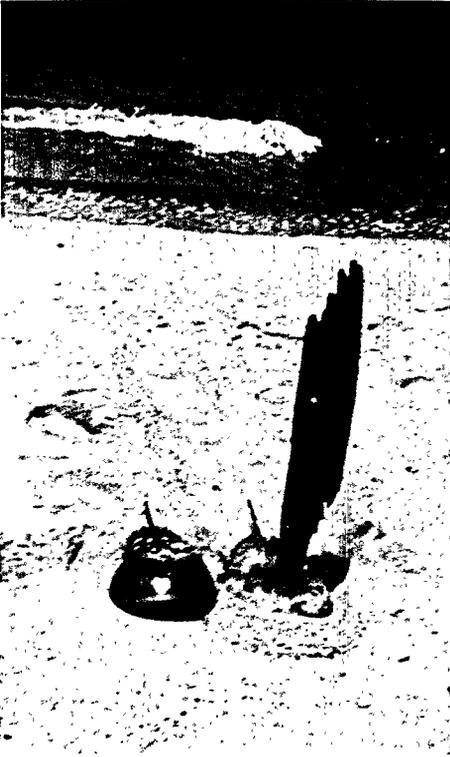
I repeated this sequence, with similar results most of the time, until it began to rain. I then went back to my office (still Figure 1) and toweled off.

## YOUR OBLIGATORY STATISTICAL ANALYSIS (OSA)

A three-way OSA was run on the pooled data (which had been transformed by natural logarithms and slight-of-hand) after discarding outliers, anomalies, and other disagreeable values. This was followed by the Stanford-Binet Multiple Vocational Preference Test, on which the mean horseshoe crab score was just above the national average for high school juniors. A qualitative cluster analysis indicated



*Figure 3. The crab is returned to water, where it briefly exhibits the "frolicking" behavior characteristic of the species. Healthy crabs are often seen floating on their backs during periods of feeding, play, and rest. Indians reported observing large schools of crabs in this posture, using rocks to break open sea otters and feeding on the soft parts. This proclivity may be responsible for the present scarcity of sea otters along the Middle Atlantic coast. Crabs also frequently assume this position to use favorable winds in making extensive migrations.*



*Figure 4. As is often the case, the crab that was returned to the water soon strands itself again. Here the experimental subject has been immobilized, and a second crab has been added for scale.*

the little critters do indeed tend to hang around in groups. Ordination revealed over 98% of the variation to be accounted for on Axis II (experimental error). Interpolation of eigenvectors yielded an F value of 2.4, demonstrating that statistics is at best a minor branch of science.

#### **DISCUSSIONS AND CONCLUSIONS**

*Limulus* strandings along this area of Sandy Hook have apparently been on the increase over the past few years (Commercial Fish Strandings, 1977). Chief Bo's'un's Mate (j.g.) Ernest "Bufflehead" Scoter of the Coast Guard recalled having seen similar events "Oh, \$%&# half a dozen @#%\$&\*\$ times" during the preceding summer. He felt it was "no wonder those crazy crabs run aground...coming around here in pitch

black or peasoup fogs, with no electronic navigation whatsoever, strictly seat of the pants." "%\$&\*+@##," he continued, "you think this is bad, you should see the 4th of July and Labor Day. I'll tell you what I think it is...I think the whole \$#@%\$\* Bay's finally turned euphoric."

Thanks, Chief. In fact, *L. polyphemus* has remarkable navigational ability, although the mechanism remains obscure. After the millions of eggs hatch along the Sandy Hook littoral in the spring, the tiny megalopolii begin their arduous two-mile journey across Sandy Hook Bay to the Naval Ammunition Dump at Earle Naval Weapons Station. Upon maturing, they return to Sandy Hook to spawn. Despite the similarity of physical environments along their route, and the multitude of chemical cues to sort through in Raritan Bay, they almost invariably return to spawn at a location different from where they were hatched. (One theory holds that this navigation is by echolocation, which *Limulus* may also utilize in searching for batfish, another of its preferred prey items.) The migratory feats of some individuals are legendary; one large female tagged by the author off Sandy Hook in 1956 has still not been heard from.

The biology of *Limulus* is in fact chock full of interesting little tidbits. Adults grow to a maximum of about 100 cm total length, but a larva 65 cm long was recently dredged up from Newark Bay. Extrapolating from normal growth rates, this specimen would have reached at least 102 cm at maturity. If a crab that size were on you, you'd know it was big. Also, scientists have recently determined that from every two parents, an average of only two offspring must survive to reproduction in order to maintain a stable population. Well my eight year old kid could have told you that.

Any rate, in light of the extraordinary navigational ability of *L. polyphemus*, it becomes even more of a mystery why strandings of these marine lemmings

occur so frequently. The major theories attempting to explain this behavior have been summarized by Warden (1976), Jones (unpublished), Branch (personal communication), Rabinowicz (draft letter), Seagran (offhand remark), and a whole host of others. These theories are

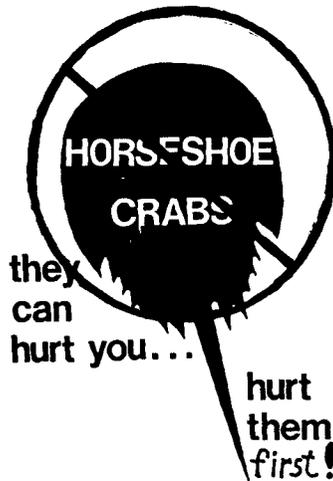
summarized in Figure 5. My own observations contribute nothing to the debate, and I haven't the faintest idea what's going on here. Obviously, no further studies are needed in this field...the crab is dead, after all, and there's plenty more where he came from. □



*Figure 5. (To be read with a heavy French accent). Why do these ancient and fascinating creatures leave the hospitable confines of Raritan Bay for almost certain death on the shores of Sandy Hook? Scientists remain puzzled over this apparently non-adaptive behavior. Perhaps the crabs' navigational ability has been impaired by disease, or by parasites. Some even theorize that *Limulus* has a far greater intelligence than is generally recognized, and is trying to communicate with other life forms, including man. But what is their message? We may never know.*

#### ACKNOWLEDGEMENTS

*I'd like to thank Konrad Lorenz and Larry Flynt for stimulating my early interest in aberrant behavior; two gutless anonymous reviewers for making picky little comments on the manuscript; the typing pool for not trying to type it on a Monday or Friday; and my patient wife Bunny for being patient. I'd like to thank these people but I can't - I did it all myself.*



FOR INFORMATION: LITTORAL SOCIETY, BIRCHLAKE, N.J. 07122, 2011.291.0034

# Horseshoe Crabs: Ancient Wonders of New York City

by DON RIEPE



Each spring, between mid-May and mid-June, thousands of fierce-looking sea creatures crawl from the sea to mate and lay eggs along the sandy shorelines and mudflats of New York City. These harmless animals called horseshoe crabs are not really crabs at all, but more closely related to arachnids (spiders and scorpions). A living fossil, the horseshoe crab evolved long before the dinosaurs with an ancestral heritage dating back to the Triassic Period two hundred million years ago. Currently, four species exist worldwide. One species populates the Atlantic coast from Maine to Mexico with the largest concentrations found in Delaware Bay. Named *Limulus polyphemus* after the one-eyed giant of Greek mythology, this horseshoe crab

*The author directs the Society's Northeast Chapter. His photo above shows two horseshoe crabs with tags which will last until the crabs molt.*

actually has nine eyes: one large compound eye on each side of its shell, two small ones in the front center and five light-receptive organs underneath. The other three species of horseshoe crabs are found in the Indian and Pacific Oceans. During high tides, especially at new and full moons, these "crabs" emerge from the water to spawn. The larger females are usually accompanied by one or more smaller males that attach themselves to her back by specially adapted clasper claws. At the high tide line, the female will dig a nest in the wet sand and lay tiny greenish eggs. The attached male fertilizes the eggs as they are laid and then both move back to deeper waters to feed on benthic animals such as marine worms, crustaceans, and mollusks.

About a month later the eggs hatch out, each one containing a tiny, though tail-less replica of the adult crab. The little crabs will molt their shells several times

yearly during the first few years of life and then once yearly thereafter. They reach adult size in about 10-13 years and may live another 7-10 years. Before molting takes place, a new skin forms under the existing shell. The old shell splits open along the front and the crab walks out. The crab then takes in water and digs into the sand. This new skin is stretched larger and hardens around the crab to form a new shell. The molted shells can be found along beaches at any time of year and make nice coffee table or shelf decorations.

The eggs provide a bonanza for migrating shorebirds arriving in New York City from their winter homes in Central and South American. Some birds such as black-bellied plovers and red knots may have travelled several thousand miles across the ocean, making their first landfall in the estuaries of New York and New Jersey. Peak shorebird migration coincides with the peak horseshoe crab egg-laying period. The horseshoe crab eggs provide critical nourishment for many shorebird species as they head to their Arctic breeding grounds. At the Jamaica Bay Wildlife Refuge in Broad Channel, Queens, I have observed these mating rituals and feeding frenzies for many years and still am amazed by the abundance and diversity of participants. Besides red knots, sanderlings, ruddy turnstones, and about 20 other species of shorebirds, the egg feast attracts many laughing gulls, glossy ibis and even Canada geese, whose goslings feed on animal matter as well as vegetation.

Snowy egrets join in, not to feed on eggs, but on the mummichogs, silversides, and other small fish that are taking part in the bountiful melee. Larger predators, such as herring and black-backed gulls, will frequently take advantage of overturned horseshoe crabs and peck out their gills, leaving a beachfront strewn with dead and dying crabs. Despite this heavy onslaught, the crabs keep coming ashore, determined to

carry out the reproductive urge as they have done for millions of years, long before the advent of *Homo sapiens*.

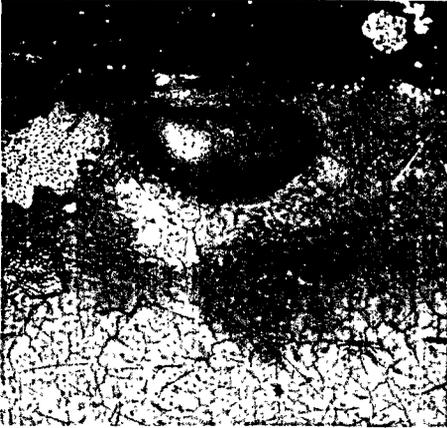
It is man, however, that poses the greatest threat. In earlier times, native Americans used the horseshoe crab for food and the shell for bailing water out of their canoes. They also used the long pointed tail, or telson, for spearing fish. None of these uses threatened the crab's existence. Today, however, using more efficient trawling techniques, fishermen harvest great numbers of horseshoe crabs for bait and many biologists are seriously concerned for their future.

Shoreline development is another problem. As sea level rises and people continue their migration to live in coastal areas, available shoreline habitats are becoming changed by bulkheading and dredging. Even though most coastal states have laws protecting these wetland areas, there is a continued "nibbling away" of shoreline habitat from use of legal "loopholes" and "variances" as well as degradation of habitat from other disturbances including offshore dredging and water pollution from increased boating. Sewage outflows and untreated runoff further exacerbate the situation. As our coastal population swells, there will be increased pressure to build groins, seawalls, and other shoreline stabilizing methods used to protect coastal property - all of which impact natural shoreline habitats.

Another human-related problem is the tide of floatable debris littering many shorelines, thus impeding the crab's access or entangling the animal with monofilament or other plastic.

Fortunately, there is a growing public awareness about this issue. Many volunteer groups routinely clean beaches in all coastal states and cities are seeking ways to keep trash from entering waterways. In New York City, the Department of Environmental Protection has purchased several skimmer boats that remove debris from the surface.

Often overlooked in the equation is



*Closeup of the compound eye  
of a horseshoe crab.*

that the horseshoe crab has great medical value to humans. The large compound eye and accessible optic nerve have been used in scientific research for over 50 years. The *Limulus* lateral eye is one of the most thoroughly understood of all sensory receptor systems today. The copper-based blood contains a clotting factor that can detect minute amounts of pathogens. At Woods Hole and other re-

search centers, crabs are routinely bled and then released unharmed back into the water. Unlike the red color of human blood, horseshoe crab blood turns bluish when exposed to air. This color comes from hemocyanin, a copper-based molecule that carries oxygen through the circulatory system. An extract of blood cells from the horseshoe crab is used to detect the presence of endotoxins in human blood serum. Chitin, the substance that makes up the horseshoe crab's shell, is used in surgical sutures and bandages that promote healing. One can only imagine what other beneficial secrets are yet to be discovered from studying this living fossil.

There is still much to be done through education as these crabs still suffer from a maligned superstition passed down through generations. Horseshoe crab programs are becoming more popular and each spring both Urban and National Park Rangers as well as school groups visit NYC shorelines to tell the fascinating story of this prehistoric wonder, the ageless horseshoe crab. □

### 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.

**ARTWORK:** 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.

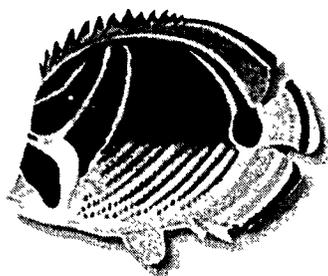
□ We do not pay for articles or illustrations, but we do send five authors' copies when published. Thank you for your interest. We look forward to receiving your submission.

# CORAL REEF FISHES

Caribbean, Indian Ocean, and Pacific Oceans  
Including the Red Sea



Ewald Lieske and Robert Myers



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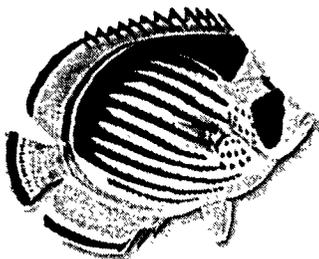
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## Field Trip Notes

# Red Knots

By DENNIS REYNOLDS



This year marked the tenth anniversary of my participation in the Littoral Society's annual spring visit to Reeds Beach on the shore of the southern Delaware Bay in Cape May County, New Jersey, to watch red knots eat horseshoe crab eggs. Where the evolution of two species comes together to create an opportunity for me to have fun.

During the height of the horseshoe crab breeding season large flocks of red knots can be seen feeding on the beach alongside laughing gulls in full breeding plumage, ruddy turnstones, and opportunistic starlings and boat tailed grackles. From a distance, looking down the beach it sometimes appears that the sand is red and moving; through binoculars it becomes apparent that what you are seeing is group of red knots feeding. The spectacle of thousands of horseshoe crabs on

*Reynolds is a longtime ALS member, now on the staff of both the Society and its Baykeeper project. He took the pictures for this article; above is Reeds Beach, Cape May County, NJ, with crabs.*

the wet sand of the beach is equally impressive.

But this trip gives you the opportunity to see more than just birds. The opportunity to spend time on the bayshore side of Cape May County is worth the price of admission all on its own. Under constant development pressure, this area has somehow managed to hold on to many of its farm communities, its watermen, and its rural nature.

Repeating this excursion year after year allows you see a gradual change. Ten years ago Route 47 presented far fewer chances to stop along the way and throw away your money. Back then we would meet at Captain Tate's, a bait and seafood store, to buy smoked whiting for lunch and pick from two kinds of soda (Captain Tate's is still there, new and improved). Now Wawas provide the chance to spend a half-hour while you choose from a selection of 63 different soft drinks and a variety of shrink-wrapped sandwiches. The few antique stores you could find were old stores, not

stores that sell antiques. One year at one such store attached to a gas station we pulled in to spend minimal money and use the restrooms. The restrooms were out of order so the owner of the store led us around the corner to his home where he invited twenty plus strangers to trample through his house and use his bathroom.

Not all residents of the area have always been as welcoming. Over the years the community seems to have come to welcome the ecotourists drawn to the spectacle of rare birds and the horseshoe crab mating scene. At one time homeowners in the small shorefront communities would do their best to make parking as difficult as possible. One year there was a gentleman who would wait for a busload of birders (BOBs) to pull up, unload themselves and all their gear and then open his front door and release his dog who would run gleefully down the beach scaring all the birds into flight.

Over the years the landscape itself has changed. For the most part when people contemplate the effects of beach erosion and sea level rise it's ocean beaches they picture, but erosion is equally obvious on the bayshore. For years we would finish the trip a little north in Cumberland County at a collection of 20 or so vacation homes and fishing shacks called

Moores Beach. Each year the buildings got wetter and wetter as the beach in front of them gradually disappeared. Today those buildings are gone, bought out by the state. The road that once led to them, passable only by truck and partially underwater at high tide, now ends at the bay.

The culinary aspects of this trip are not to be ignored. ALS provides the group with raw clams, crackers, a choice of two cheeses, tortilla chips and America's new favorite condiment, salsa. For my part, I do my best to continue a tradition started by Hannah "Words" Johnson by doling out brownies just like mother used to bake from a box mix.

In recent years a visit to the Brigantine National Wildlife Refuge has been added to the day's activities. This year we spotted black skimmers, oystercatchers, black-bellied plovers, semipalmated sandpipers, dunlin, sora rail, great blue herons, great egrets, snowy egrets, teal, black duck, gadwall, scaup, peregrine falcons, and two mature bald eagles sitting on a sand bar. A nice ending to the day.

The ALS trip is usually a weekday toward the end of May. You can also go on your own, of course. On Route 47 in Cape May County; turn west at the sign to Reeds Beach. Weekends may be crowded. □



*Moores Beach, Cumberland County, NJ, with crabs. This picture was taken in 1987. Since then, the town and the beach have washed away.*



# TAGGING REPORT

compiled by PAM CARLSEN

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Our tagging program experienced another banner year with 25,307 fish tagged. Striped bass was the number one species tagged: 19,599; fluke (summer flounder) was second with 2,443; and bluefish number three with 1,192. A total of 1,790 recaptures were processed. Twenty-seven of these were "out" five years or more and five were "out" nearly seven years. The five seven year, fish were all striped bass. Tom Rinaldi caught his 26" bass 11/7/90 at Montauk, NY. It was returned 6/21/97 from Westbrook, CT, 38", 20 lbs. Steve Kellner also caught his bass at Montauk, NY, 11/15/90, 24". It was returned 8/26/97 from Ellis Is., NY, 30", 11 lbs. Steve White caught his 18" bass 10/19/90 at Long Branch, NJ. It was returned from Sandy Hook, NJ, 11/23/97, 26". Ray Lewis caught a 26" bass at Island Beach State Park, NJ, on 11/28/90. It was returned from Montauk, NY 11/28/97 at 25 lbs. John Reiches caught a 27" bass at Davids Island, NY, on 8/26/90. It was returned 6/19/97 from Mamaroneck, NY.

Two taggers, who also happen to be dentists from Virginia, had nice returns of their Chesapeake Bay "rockfish" up north. Jim Wright tagged a 27" fish on 11/14/96 and a 31" fish on 12/10/96. The first fish was returned from Gloucester, MA, on 9/3/97, 28", the second from Orient Pt., NY, early in July of 1997. Robert Allen tagged a bass on 12/28/96 at 25" and another on 3/8/97 at 27". Both were returned from Newport, RI, in June, 1997.

The state of Maine, produced some nice striper returns for A.L.S. taggers. Dorothy Obropta tagged a 22" fish in Cliffwood Beach, NJ, on 4/14/96. It was returned from the Kennebec R., 7/25/97,

25". Rodger Leeds tagged his at Ocean City, NJ, 10/29/96, 20". It was returned from the Saco River, 7/10/97, 21". Phil Lowcher tagged a 13" fish at Rumson, NJ on 4/28/97. It was returned from the Saco R. on 6/17/97. Quite a trip for a small fish. Terry Marburger tagged a 19" fish on 5/12/96 and a 20" fish on 5/10/97. Both of these fish were returned from the Kennebec R. in August, 1997.

Fluke also had some nice returns. Charlie Kennedy tagged a 12" fluke at Cape May Inlet, NJ, on 9/30/96. It was returned on 6/15/97 from Great South Bay, L.I., NY. Stuart Fries tagged a 13" fluke at Rockaway Inlet, NY, on 8/10/96. It was returned from Lucas shoals, between Elizabeth Islands and Martha's Vineyard, 6/23/97 at 16". Brian Skirka tagged a 13" fluke on Flynn's Knoll, Raritan Bay, NJ, on 7/20/96. It was returned from Newport, RI, on 7/21/97 at 15".

George Dulka's, 26" bluefish tagged 25 Mi. E of Rudee Inlet, VA, on 4/27/97 was returned from the "Mudhole", offshore Sandy Hook, NJ on 7/15/97, proving once again that bluefish are great ocean travelers.

When we examine these returns and see how far these various fish have travelled, we realize that we truly have a coastal fishery, that knows no state boundaries or rules. One that is effected by whatever we choose to do to it, whether it is pollution of the waters, destruction of the habitat or overfishing or one that can be safe guarded by caring people working on these issues. A New Jersey fish is a Maine fish. A Chesapeake Bay fish is a Massachusetts fish. And a tagged fish is a scientific messenger.

# TAGGING RETURNS

## Species

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
<b>Atlantic Cod</b>							
18	B Jones	Offsh., Coxes Ledge, RI	02/07/97	M Poirier	Offsh., Cox's Ledge, RI	18	04/06/97
<b>Bluefish</b>							
24	A Anderson	Montauk Pt., NY	10/24/96	J Corr	West Bank Lt., NY	27	06/12/97
25	M O'Connell	NY Harbor	05/30/97	J Robertson	Governor's Is., NY	25	06/18/97
25	M Barrett	Tottenville, NY	06/09/96	P Mareno	Staten Is., NY		06/27/97
23	A Anderson	Montauk Pt., NY	06/06/97	J Schulz	Race Pt., Fishers Is., NY		06/30/97
33	A Anderson	12 mi. S Block Is., RI	06/14/97	W Fisher	Provincetown, MA		07/05/97
22	A Anderson	Montauk Pt., NY	06/24/97	S Semlear	Peconic Bay, NY		07/13/97
20	D Stratton	Groton, CT	06/08/97	C Perez	Gales Ferry, CT	23	07/13/97
26	G Dulka	Offsh. Rudee Inlet, VA	04/27/97	R Scrammarilla Jr.	Offsh., Mudhole, NJ		07/15/97
<b>Fluke</b>							
13	D Haines	Delaware Bay, NJ	07/06/96	M Menna	Fortescue, NJ	14	09/16/96
12	B Quick	Loveladies, NJ	07/08/96	K McCarthy	Massapequa Cove, NY	15	05/26/97
13	L Gordon Jr.	Lynnhaven Inlet, VA	05/11/97	M Evans	Chesapeake Bay, VA		06/11/97
12	C Kennedy	Cape May Inlet, NJ	09/30/96	E Weccera	Great South Bay, NY	12	06/15/97
11	F Haines	Freeport, NY	06/29/96	S Nelson	Shinnecock Canal, NY	15	06/18/97
6	R Romanow	Reynold's Chan., NY	06/15/97	P Grunner	Freeport, NY		06/22/97
13	F Spall	Sandy Hook, NJ	07/25/95	H Adler	Atlantic Bch Brdg., NY	16	06/23/97
13	S Fries	Rockaway Inlet, NY	08/10/96	J Lucarelli	Lucas Shoals, MA	16	06/23/97
11	J Gibbons	E. Rockaway Inlet, NY	06/14/97	A Berman	Atlantic Beach Brdg., NY	06/23/97	
11	E Zmara	Robert Moses Brdg., NY	06/05/97	R Vincent	Robert Moses Brdg., NY	12	06/24/97
14	J Gibbons	Atlantic Beach, NY	06/08/97	A Berman	Atlantic Beach, NY	14	06/25/97
12	J Hickey Jr.	Long Branch, NJ	07/28/96	Unkn Fisherman	Spring Lake, NJ	13	06/26/97
12	A D'Amato	Lower DE Bay	07/18/96	M Habel	Staten Island, NY	13	06/29/97
14	C Kennedy	Wildwood, NJ	07/10/96	L Mastroddi	Wildwood, NJ	15	07/04/97
13	A Gano	Fire Is., NY	06/12/97	J Lederman	Fire Is. Inlet, NY	14	07/05/97
13	S Fries	Rockaway Inlet, NY	08/10/96	T Ippolito	E. Quogue, NY	14	07/06/97
14	R Anderson Jr.	Fire Is. Inlet, NY	05/31/97	M Catania	Fire Is. Inlet, NY	14	07/06/97
12	J Gibbons	E. Rockaway Inlet, NY	06/14/97	S Moses	Jones Inlet, NY	14	07/06/97
13	A Schweithelm	Montauk, NY	07/11/96	W Silverstein	Montauk Pt., NY	15	07/07/97
11	J Gibbons	Atlantic Beach, NY	06/21/97	F Weber	Atlantic Beach, NY	11	07/08/97
13	B Shillingford	Ludlam Bay, NJ	07/01/97	F Merola	Ludlam Bay, NJ		07/08/97
13	E Timmermann	Southold Bay, NY	06/28/97	J Mulholland	Southold Bay, NY	13	07/08/97
14	D Harris	Massapequa, NY	08/11/97	C Fioccola	Massapequa, NY	15	07/12/97
14	T Ritchie	No. Wildwood, NJ	06/09/97	L Mastroddi	Wildwood, NJ	15	07/12/97
13	S Fries	Rockaway Inlet, NY	07/05/97	J Gorman	Hoffmann Is., NY	13	07/13/97
13	J Calamia	Democrat Pt., NY	06/26/97	V Riggio	Democrat Pt., NY	13	07/14/97
13	B Balmer	Tip of Sandy Hook, NJ	07/13/96	C Toth	Leonardo, NJ	15	07/14/97
13	J Lutz	Avalon, NJ	07/09/96	S Behr	Fire Is., NY		07/15/97
11	J Buhl	Sandy Hook, NJ	05/28/97	S Lewis	Sandy Hook, NJ	11	07/15/97
13	W Filce	Mantoloking, NJ	07/28/96	F Ciampa Jr.	Long Branch, NJ	14	07/15/97
<b>Nurse Shark</b>							
48	J Wright	Venice, FL	06/19/97	J Wright	Venice, FL	48	06/21/97
<b>Pollack</b>							
15	W Anderson	Provincetown, MA	06/01/94	F/V Elaine Marie	Offsh., Nova Scotia, CDA	06/03/97	
<b>Striped Bass</b>							
26	B Voytasck	Flynn's Knoll, NJ	07/15/97	M Yoshida	Battery Park, NYC		
20	J Faulhaber	Atlantic Beach Brdg., NY	05/22/95	J Jariz	Saco R., ME		07/15/95
26	K Sprankle	Outer Banks, NC	02/04/92	W Lippmann	Cheasapeake Beach, MD	27	10/15/95
16	H Sweet	Warren R., RI	09/24/95	G Penza	Norwich, CT		02/07/96
18	J Karolides	Danvers, MA	08/25/93	G Penza	Norwich, CT		02/07/96
16	GR Gray	Charlestown, RI	06/03/95	G Penza	Norwich, CT		02/07/96
23	W Dracsel	Barnegat Inlet, NJ	09/02/92	J DiFabio	Barnegat Bay, NJ		06/15/96
25	R Grobarz	Seaside Park, NJ	07/05/95	J DiFabio	Barnegat Inlet, NJ		06/15/96
33	F Heal	Staten Island, NY	11/02/95	V McClancy Jr.	Jones Beach, NY	37	07/05/96
20	A Schweithelm	Fort Salonga, NY	04/10/95	D Brunski	Watch Hill, RI	25	07/15/96
31	F Stunkel	Stamford, CT	07/12/95	J Caron	Block Is., RI		07/15/96
21	J Karolides	Danvers, MA	06/04/95	B Bowers	Marshfield, MA	31	07/17/96
20	R Nystrom	Devon, CT	02/13/95	M Patil	Gloucester, MA		08/15/96
28	A Dangelo	Montauk, NY	06/21/95	J Benedict	Montauk, NY		09/15/96

**Species**

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
<b>Striped Bass (cont.)</b>							
23	F Stunkel	Stamford, CT	10/21/87	R Alberti	Co-op City, Bronx, NY		09/23/96
20	T Lynch	Greenwich, CT	09/19/92	M Gates	Montauk Pt., NY	32	10/11/96
33	G Ruest	Quick's Hole, MA	07/25/96	M Melito	Montauk, NY		10/15/96
20	D Kelly	Sag Harbor, NY	06/09/92	J Benedict	Montauk, NY		10/20/96
29	S Fries	Montauk, NY	07/30/96	C DiGiacomo	Montauk Pt., NY	29	11/01/96
29	A Anderson	Montauk Pt., NY	10/24/96	J Hurd	Townsend Inlet, NJ	32	11/02/96
18	R Grobarz	Long Branch, NJ	06/30/96	B Garrison	Delaware Bay, NJ		12/16/96
28	A Dangelo	Montauk, NY	10/30/95	B Garrison	Cape May, NJ		01/27/97
24	D Kelly	Sag Harbor, NY	05/23/95	R Arnold	James R., VA		03/15/97
24	R Kalenka	Glen Cove, NY	10/06/96	B Arnold	James R., VA		03/15/97
18	G Ottavio	Cape May, NJ	09/16/96	C Howell	Fort Elfsborg, NJ		03/28/97
22	JC Wright	Ches. Bay Brdg. Tun., VA	07/16/95	A Jones	Leedstown, VA		04/01/97
32	A Anderson	Block Is., RI	09/21/96	A Jones	Dahlgren, VA		04/01/97
22	R Leeds	Ocean City, NJ	03/20/97	H Acord	Mays Landing, NJ	22	04/06/97
28	G Ker Khan	Sandy Hook, NJ	10/09/96	T Coulson	Navesink R., NJ	28	04/09/97
18	A Schweithelm	Crab Meadow Beach, NY	05/18/95	C Riley	Assawoman Inlet, VA	25	04/10/97
22	R Wellman	Horton's Pt., NY	10/15/93	NYS D.E.C.	Hudson R., NY	28	04/15/97
27	R Stroz	Shrewsbury R., NJ	05/18/96	NJ Div. F.G. & W.	Sea Bright, NJ	28	04/16/97
26	B McElroy	Montauk Pt., NY	05/21/94	NJ Div. F.G. & W.	Elberon, NJ	30	04/17/97
23	R Grobarz	Sea Bright, NJ	09/25/95	D Partusch	Shrewsbury R., NJ	29	04/19/97
20	K Hollins	Isl. Bch. St. Pk., NJ	09/16/96	T Eggie	Graveling Pt., NJ	21	04/19/97
16	D Kelly	Sag Harbor, NY	07/31/96	W Soto	Stony Pt., NY	16	04/22/97
15	A Bettencourt	Barrington, RI	07/07/96	J Jersey	Hudson R., NY	15	04/23/97
29	O Van Helmond	Fire Is., NY	09/13/95	J Zaffuto	Democrat Pt., NY		04/26/97
16	A Anderson	Jerusalem, RI	05/22/97	J Dotsey	Rockaway, NY	17	04/28/97
22	D Stratton	Norwich, CT	04/16/97	W Forbes	Norwich, CT		05/01/97
15	T McCandless	N. Kingstown, RI	10/01/96	D Reitz	Wakefield, RI		05/04/97
28	F Ryan	Darien, CT	07/24/96	S Tardella	Newark, CT		05/06/97
21	R Nystrom	Bridgeport, CT	10/06/96	H Pianka	New London, CT		05/07/97
19	H Sweet	Barrington, RI	10/25/96	R Meehan Jr.	Newport, RI	19	05/09/97
17	J Gibbons	Sandy Hook, NJ	04/22/97	R Pearson Jr.	Croton Bay, NY	18	05/09/97
15	G Blank	West New York, NJ	03/23/97	F Weise	Beacon, NY	16	05/14/97
24	D Stratton	Norwich, CT	05/12/97	E Crosby	Norwich, CT	24	05/14/97
28	A Anderson	Block Island, RI	11/17/96	B Basque	Martha's Vineyard, MA		05/14/97
18	K Hollins	Island Beach St. Pk., NJ	04/28/97	A Porini	Brooklyn, NY	18	05/15/97
16	T Marburger	Northport, NY	02/27/96	E Brady Jr.	L. Chesapeake Bay, VA		05/15/97
15	D Kelly	Sag Harbor, NY	06/02/93	J Augustine	Kingston, NY		05/15/97
17	D Stratton	Niantic, CT	09/08/96	W Goglin	Mt. Hope Bay, RI		05/15/97
22	J Sullivan	Sandy Hook, NJ	09/10/92	M Smith	Kingston, NY	28	05/15/97
24	D Stratton	Norwich, CT	04/12/97	R Morgan	Shetucket R., CT	24	05/15/97
24	G Ciriello	Sandy Hook, NJ	09/30/95	E Mack	Germantown, NY	30	05/15/97
25	G Ciriello	Sandy Hook, NJ	10/13/95	T Rhinesmith	Kingston, NY		05/15/97
27	A Dangelo	Montauk, NY	10/02/96	K Rice	1 mi. E Montauk Lt., NY	28	05/16/97
25	D Taft	Martha's Vineyard, MA	07/09/93	H Smith	Martha's Vineyard, MA	36	05/18/97
15	M LeBlanc	Swansea, MA	01/01/96	J Nelson	Wickford, RI		05/22/97
23	R Nystrom	Bridgeport Harbor, CT	06/07/96	P Manville	Derby, CT		05/23/97
23	C Husta	Mullica R., NJ	04/22/97	P Haertel	Barnegat Inlet, NJ	23	05/23/97
24	J Mettler	Fishers Is., NY	08/29/96	W Beeman	Milford, CT	27	05/24/97
16	J Drew	Providence R., RI	05/20/97	T Lavallee	Pawtucket, RI		05/24/97
24	PS Warny	Manhasset Bay, NY	10/06/96	J Lemmo	Cold Spring Harbor, NY		05/25/97
29	R Conklin	Moriches Inlet, NY	10/06/96	D Rera	Moriches Inlet, NY	30	05/25/97
18	F Casey	Boston, MA	09/24/96	S Pietruska	Marian, MA	19	05/27/97
22	D Haines	Cape May Pt., NJ	10/06/96	B Peterson	Cape May Inlet, NJ	24	05/27/97
25	E Petronio Sr.	Pt. Judith, RI	07/28/96	J LaPorte	Charlestown, RI	28	05/27/97
27	A Anderson	Montauk, NY	06/15/96	J Lapinski	Suffield, CT	29	05/29/97
17	D Bettencourt	Barrington, RI	06/15/96	D Cameron	Providence R., RI		05/30/97
15	H Sweet	Warren, RI	09/06/95	D Alves	Warren R., RI	22	05/30/97
20	M LeBlanc	E. Providence, RI	05/31/97	P Palmesciano	Pawtucket, RI	22	05/31/97
25	T Shaheen	Raritan Bay, NJ	05/26/96	P Westcott	10 Mi. S Ilyannis, MA	27	06/01/97
20	P Grippo	Jones Inlet, NJ	11/16/96	L Merly	Watch Hill, RI	20	06/01/97
20	R Grobarz	S. Mantoloking, NJ	11/11/96	K Daniels	Sag Harbor, NY	24	06/01/97
19	H Sweet	Bristol, RI	08/15/96	C Christen	Palmer & Warren R., RI	23	06/02/97
20	G Ottavio	Cape May, NJ	09/08/96	C Sao	Delaware R., NJ	22	06/03/97
33	D Brodeur	Niantic, CT	06/01/96	E Forlenza	The Race, L.I. Sound	37	06/03/97

## Species

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
<b>Striped Bass (cont.)</b>							
27	A Lo Cascio	Manhasset Bay, NY	04/29/95	P Plachy	Suffield, CT	33	06/04/97
22	D Alves	Barrington, RI	05/31/97	D Trottier	Barrington, RI	23	06/04/97
26	G Nigro	Romer Shoal, NJ	05/19/96	R Lynch	Rockaway Beach, NY	33	06/05/97
20	H Sweet	Bristol, RI	08/05/96	P Auclair	Narragansett Bay, RI	26	06/05/97
28	J Karolides	Beverly, MA	06/07/96	M Picanco	Salem Harbor, MA	32	06/06/97
23	D Hoxsie	Charlestown Pond, RI	05/10/97	B Szarek	Narragansett, RI	26	06/06/97
29	S Kellner	Mattituck, NY	10/31/95	R Altman	Hempstead, NY	32	06/06/97
28	A Anderson	Block Is., RI	09/22/96	F Kochan III	Martha's Vineyard, MA	32	06/07/97
19	D Kelly	Sag Harbor, NY	06/14/93	A Daniels	Sag Harbor, NY	31	06/07/97
26	R Grobarz	Montauk Pt., NY	08/07/96	R Butler	Montauk Pt., NY	28	06/07/97
24	F Tellefsen	West Bank Lt., NY	11/11/96	P Colding	Matunuck, RI	26	06/07/97
33	R Locke	Provincetown, MA	07/18/96	W Peterson	Buzzards Bay, MA	34	06/07/97
23	W Sharpe	Navesink River, NJ	05/08/93	D Perkins Jr.	Wareham, MA	32	06/10/97
22	T Marburger	Northport, NY	12/18/95	G Tribou	Wareham R., MA	25	06/10/97
23	G Ciriello	Sandy Hook, NJ	06/24/96	T Bigelow	Belmar, NJ	26	06/10/97
10	A Anderson	Jersalem, RI	05/19/97	K Beaucage	Providence, RI	13	06/10/97
34	L Spano	Raritan Bay, NY	06/09/97	D McKillop	Sandy Hook, NJ	35	06/10/97
22	D Alves	Barrington, RI	05/21/97	D Trottier	Barrington, RI	24	06/10/97
18	D Wright	Ches. Bay Brdg., VA	12/12/96	R Powers	Buoy 62, Ches. Bay, VA	22	06/10/97
18	G Horvath	Spring Lake, NJ	07/31/96	W Ridgway Sr.	Barneget Inlet, NJ	26	06/11/97
11	R Kyker	Norwalk, CT	08/20/95	M Martinez	Far Rockaway, NY	26	06/11/97
22	S Kellner	Mattituck, NY	07/15/92	L Molnar	Shinnecock Inlet, NY	31	06/11/97
35	A LoCascio	Manhasset Bay, NY	05/03/97	C Constant	Manhasset Bay, NY	36	06/11/97
30	T Dixon	Stamford, CT	06/22/96	M Sganga	Rye, NY	31	06/11/97
28	A LoCascio	Manhasset Bay, NY	05/03/97	R Naylor	Stratford, CT	30	06/11/97
25	T Shaheen	Raritan Bay, NJ	07/06/96	R Rosa	Flynn's Knoll, NJ	28	06/12/97
18	T Marburger	Northport, NY	03/16/97	D Huer	Scituate, MA	18	06/12/97
18	H Sweet	Warren R., RI	09/21/95	S Covitz	Warren, RI	20	06/12/97
18	T Marburger	Northport, NY	04/14/97	C Leonard	Marshfield, MA	18	06/12/97
16	J Karolides	Beverly, MA	06/22/92	S Franklin	Danversport Y.C., MA	31	06/13/97
16	GS Gray	Charlestown, RI	06/13/97	B Gray	Charlestown, RI	16	06/13/97
20	M Simmons	Barneget Lt., NJ	11/17/96	T Kester	Great South Bay, NY	26	06/13/97
20	B Radice	Long Branch, NJ	11/21/95	R Pearson Jr.	Breezy Pt., NY	21	06/13/97
22	J Mulkerin	Sandy Hook, NJ	06/13/97	L Alessi	Sandy Hook, NJ	26	06/13/97
33	A Schweithelm	Montauk, NY	07/12/95	K Yu	Montauk, NY	41	06/14/97
32	L Yanick	S. Mantoloking, NJ	07/03/95	G Broome Jr.	Barneget Inlet, NJ	36	06/14/97
32	D Kelly	Orient Pt., NY	09/20/96	G Nilsen	Smithtown Bay, NY	34	06/14/97
31	J McAfee	Quick's Hole, MA	07/23/96	A Malgieri	Quick's Hole, MA	32	06/14/97
25	L Yanick	S. Mantoloking, NJ	05/25/96	J DiFabio	Barneget Inlet, NJ	26	06/14/97
27	A Anderson	Montauk Pt., NY	10/17/96	B Harding	Cape Cod Canal, MA	26	06/14/97
22	M Simmons	Barneget Light, NJ	06/07/97	T Warhol	Island Beach St. Pk., NJ	24	06/14/97
30	H Fisher	Susquehanna Flats, MD	05/15/95	D Reed	Tilghman's Is., MD	32	06/14/97
20	D Kelly	Orient Pt., NY	08/20/96	L Montanez	Bridgeport, CT	23	06/14/97
12	A Drew	Charlestown, RI	06/09/93	J Buccelli	Westerly, RI	22	06/14/97
27	F Urban	Flynn's Knoll, NJ	07/24/95	R Tancredi	Sandy Hook, NJ	29	06/14/97
17	R Kyker	Norwalk, CT	05/26/96	A Sgoutas	Norwalk, CT	17	06/14/97
22	A Anderson	Block Is., RI	07/19/95	J Slamiak	Old Orchard Lt., NY	24	06/14/97
21	J Samyn	Execution Lt., NY	11/18/96	W Langworthy	New Rochelle, NY	22	06/14/97
24	P Johnson Sr.	Block Island, RI	08/24/96	R Wilkins	Rockaway, NY	26	06/14/97
32	R Conklin	Moriches Inlet, NY	08/37/95	S White	Moriches Inlet, NY	34	06/14/97
23	J Foti	Ft. Wadsworth, NY	06/29/96	B Glynn	Verrazano Brdg., NY	25	06/15/97
28	A Anderson	Block Is., RI	09/19/96	G Nilsen	Smithtown Bay, NY	28	06/15/97
30	A D'Amato	Offshr., Cape May, NJ	12/08/96	S Bogue	Nantucket Is., MA	26	06/15/97
20	R Conklin	Moriches Inlet, NY	09/20/95	J Jariz	Saco R., ME	20	06/15/97
30	A Anderson	Montauk Pt., NY	06/22/96	T Farthing	Chesapeake Bay, VA	36	06/15/97
23	B Waas	Brewster, NY	10/08/96	A Penny	Brewster, MA	26	06/15/97
25	R Kyker	Norwalk, CT	11/05/96	R Bauer	Bourne, MA	26	06/15/97
20	D Obropta	Sandy Hook Bay, NJ	10/18/96	C Johansen	Cape Cod Canal, MA	26	06/15/97
27	L Richards	Allantic Beach, NY	06/23/96	P Krueger	Atlantic Beach Brdg., NY	26	06/15/97
26	A Dangelo	Block Is., RI	08/09/96	C Blane	Block Is., RI	30	06/15/97
27	A Anderson	Block Island, RI	06/11/95	B Cherms	Block Is., RI	26	06/15/97
24	M Berger	Atlantic Bch. Brdg., NY	05/15/97	P Krueger	Atlantic Bch Brdg., NY	24	06/15/97
27	A Locascio	Hart Island, NY	07/17/97	H Dismake	Throgs Neck Brdg., NY	26	06/15/97
24	A LoCascio	Throgs Neck Brdg., NY	09/29/96	H Dismake	Throgs Neck Brdg., NY	25	06/15/97

**Species**

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
<b>Striped Bass (cont.)</b>							
22	D Kelly	Sag Harbor, NY	05/10/97	J Swobodzinski	Sag Harbor, NY	22	06/15/97
15	A Bettencourt	Barrington, RI	08/11/96	W Barbeau	Providence, RI		06/15/97
24	P Malamed	Moriches Inlet, NY	06/15/96	V Caldwell	Moriches Inlet, NY	26	06/15/97
29	D Kelly	Orient Pt., NY	07/28/96	Unkn Fisherman	Plum Gut, NY	32	06/15/97
27	J Wachter	Robert Moses Brdg., NY	06/12/97	H Bowman III	Fire Is. Inlet, NY		06/15/97
24	G Ciriello	Offshr., Sandy Hook, NJ	11/03/96	D Ayotte	Green Is., NY		06/15/97
27	L Gonnello	Sandy Hook, NJ	07/01/96	J Cousins	Highlands Brdg., NJ	28	06/15/97
28	A Moore	Newburgh, NY	05/20/96	R Whipple	Watch Hill, RI	28	06/15/97
21	D Obropta	Sandy Hook, NJ	04/17/97	R Bauer	Bourne, MA	22	06/15/97
30	A Anderson	Montauk Pt., NY	10/07/96	E Woodward	Wellfleet, MA		06/15/97
26	R Conklin	Moriches Inlet, NY	09/29/96	M Kleban	Moriches Bay, NY	27	06/16/97
16	T Marburger	Northport, NY	04/13/97	D Pepe	Weymouth, MA	17	06/16/97
21	M Habel	Perth Amboy, NJ	09/05/91	M Cutrona	Sandy Hook, NJ	31	06/16/97
23	G Nigro	Sandy Hook, NJ	11/23/96	J Capuano	Shinnecock, NY	23	06/16/97
26	A Anderson	Montauk Pt., NY	10/11/96	W Galvin	Plymouth, MA	26	06/16/97
24	A Evangelista	Robins Reef, NY	06/07/97	E Wilkowski	Lower NY Bay		06/16/97
29	J Karolides	Danvers, MA	10/18/96	P Khounnasenh	Dover Pt., NH	32	06/16/97
34	F Coronato	Flynn's Knoll, NJ	07/16/96	A Dangelo	Montauk, NY	34	06/16/97
27	JC Wright	Ches. Bay Brdg. Tun., VA	10/24/96	S Vierkorn	Thomas Pt. Lt., MD	27	06/16/97
28	C Kollett	Prudence Is., RI	06/19/95	J Cordeiro	Prudence Is., RI	32	06/16/97
32	R Nystrom	Bridgeport, CT	07/28/96	A Dangelo	Montauk, NY	32	06/16/97
20	R Conklin	Moriches Inlet, NY	11/22/95	E Weymouth	Augusta, ME	24	06/17/97
17	J O'Keefe	Housatonic R., CT	05/08/97	L Hathaway	Martha's Vineyard, MA		06/17/97
20	A Anderson	Montauk Pt., NY	05/21/97	C Flynn	Montauk, NY	22	06/17/97
30	G Drago	Montauk Pt., NY	10/21/96	C Dakin	Execution Rocks, NY	34	06/17/97
18	P Grippo	Jones Inlet, NJ	11/16/96	C Bergeron	Martha's Vineyard, MA	18	06/17/97
24	D Kelly	Orient Pt., NY	06/26/93	A Fogal	Orient Pt., NY	30	06/17/97
19	R Pearson Jr.	Croton Bay, NY	05/10/97	R Lichtenwalner	Chatham, MA		06/17/97
20	R Lejar	Bridgeport, CT	07/08/95	J Cummings	Derby, CT	26	06/17/97
13	P Lowcher	Rumson, NJ	04/28/97	B Welch	Biddeford, ME		06/17/97
30	J Sullivan	Newburyport, MA	06/19/96	H Fortin	Merrimack R., MA	30	06/17/97
30	A Anderson	Block Is., RI	06/26/96	W Johnson	Stamford, CT	30	06/17/97
28	G Ruest	Quick's Hole, MA	07/25/96	G Ruest	Quick's Hole, MA	29	06/18/97
20	T Marburger	Northport, NY	01/07/97	R Piazza	Smithtown, NY	24	06/18/97
26	D Kelly	Orient Pt., NY	10/27/96	D Woodland	Cape Cod Bay, MA	28	06/18/97
30	C Messina	Montauk Pt., NY	10/07/95	C Hlewliitt	Mt. Sinai, NY		06/18/97
29	G Ministeri	Wellfleet, MA	05/26/95	K Dutra	Provincetown, MA	34	06/18/97
20	G Kerkhan	Deal, NJ	10/20/96	M Martinez	Far Rockaway, NY		06/18/97
17	P Grippo	Wantagh Brdg., NY	06/07/97	P Grippo	Wantagh Brdg., NY	17	06/18/97
22	GS Gray	Charlestown, RI	05/14/93	J Tatro	Pt. Judith, RI		06/18/97
19	A Anderson	Jerusalem, RI	04/30/97	B White	Wakefield, RI	19	06/19/97
27	R Allen	Ches. Bay Brdg. Tun., VA	03/08/97	D Zambrotta	Newport, RI	28	06/19/97
25	F Stunkel	Stamford, CT	10/11/95	W Klatt	The Race, L.I. Sound	27	06/19/97
27	J Reiches	Davids Island, NY	08/26/90	P Barbis	Mamaroneck, NY		06/19/97
26	S Fries	Rockaway Inlet, NY	11/17/96	W Yackel	Stony Brook, NY	27	06/19/97
24	D Dibblee	Esopus, NY	05/13/97	M Tepes	Shinnecock Canal, NY	28	06/19/97
34	A Schweithelm	Montauk, NY	10/27/95	J Truskoski	Niantic, CT	40	06/19/97
32	P Bombino	Sandy Hook, NJ	07/17/96	G Buono	West Bank Lt., NY	32	06/19/97
23	B Quick	Loveladies, NJ	11/02/96	C Vining	Revere, MA		06/19/97
25	M Bolton	Middletown, RI	08/22/96	C Silva	Middletown, RI	25	06/19/97
17	B Chanley	Pt. Pleasant, NJ	11/22/96	J Sasserson	Scituate, MA	18	06/19/97
35	T Marburger	Shinnecock Inlet, NY	08/27/95	L Molnar	Shinnecock Inlet, NY		06/20/97
27	B Firth	Wood's Hole, MA	08/03/96	L Guethner	Quick's Hole, MA	30	06/20/97
18	T McCandless	N. Kingstown, RI	10/07/96	A White	E. Greenwich Bay, RI	19	06/20/97
22	R Kyker	Norwalk, CT	09/30/96	G Wetmore	Norwalk, CT	24	06/20/97
26	J McAfee	Quick's Hole, MA	08/02/96	L Guethner	Quick's Hole, MA	30	06/20/97
27	H Andersen	Barnstable, MA	09/16/95	B Lewis	Barnstable, MA	27	06/20/97
19	L Richards	Atlantic Beach, NY	05/11/96	G Allbright	Atlantic Bch Brdg., NY	23	06/20/97
26	G Ruest	Quick's Hole, MA	06/18/97	L Guethner	Quick's Hole, MA	30	06/20/97
30	A LoCascio	Execution Lt., NY	06/11/97	J Meyer Jr.	Hempstead, NY	31	06/20/97
16	H Sweet	Warren, RI	09/12/96	Unkn Fisherman	Warren R., RI	17	06/20/97
25	F Heal	Staten Is., NY	10/23/96	D Welder	Romer Shoal, NJ	27	06/20/97
27	A Dangelo	Block Island, RI	06/05/96	R Drinkwater	Freeport, NY	29	06/20/97
36	A Schweithelm	Montauk, NY	10/27/95	F Puza	Provincetown, MA	42	06/20/97

## Species

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
<b>Striped Bass (cont.)</b>							
21	B Shillingford	Corson's Inlet, NJ	10/04/96	R Cecora	Wantagh Brdg., NY	23	06/20/97
23	J Mettler	Fishers Is., NY	10/23/95	P Westcott	1/2 mi. S Charlestown, RI	27	06/20/97
25	A Anderson	Montauk Pt., NY	10/11/96	G Banfield	Martha's Vineyard, MA		06/20/97
18	A LoCascio	Manhasset Bay, NY	08/13/92	J Calamia	Manhasset Bay, NJ	25	06/20/97
26	T Rinaldi	Montauk, NY	11/07/90	B Oertel	Westbrook, CT	38	06/21/97
26	J Gibbons	Kingston, NY	05/13/95	R Zimmermann	Fire Is. Inlet, NY	30	06/21/97
34	B White	Great Kills, NY	05/26/97	J Perette	Provincetown, MA		06/21/97
25	G Husta	Little Egg Inlet, NJ	05/14/97	T Warhol	Island Beach St. Pk., NJ	27	06/21/97
34	M Murphy	Barkers Pt., NY	06/11/95	M Christ	Manhasset Bay, NY		06/21/97
25	D Gamble	Shrewsbury Rocks, NJ	11/29/96	J Nunez	CT River, CT	28	06/21/97
17	J O'Keeffe	Stratford, CT	05/01/97	C Partridge	Waterford, CT	20	06/21/97
25	J Sullivan Jr.	Hampton, NH	08/10/95	R Lavallee	York, ME	33	06/21/97
15	T Marburger	Northport, NY	03/11/97	M Vatousion	Holyoke, MA	15	06/21/97
23	B Wilkins	Newburyport, MA	06/18/95	G Ryan	Rockaway Pt., NY	29	06/21/97
32	J Herchenroder	Sandy Hook, NJ	11/04/95	E Jarabek Jr.	Little Compton, RI	35	06/21/97
25	R Grobarz	Sandy Hook, NJ	11/10/96	W Matuszak	Montauk Pt., NY	25	06/21/97
21	R Leja	Bridgeport, CT	11/13/95	D Pattie	Bristol, RI	26	06/21/97
16	T McCandless	Jamestown, RI	11/02/96	S Gaeckle	3 Mi. Harbor, NY	16	06/21/97
21	T Marburger	Shinnecock Inlet, NY	09/08/96	D Kaye	Shinnecock Bay, NY	22	06/21/97
17	E Petronio Jr.	Pt. Judith, RI	07/02/96	F Maciel	Prudence Is., RI		06/22/97
25	R Allen	Ches. Lt. Tower, VA	12/28/96	M Treeman	Brenton Reef, RI	27	06/22/97
26	A Anderson	Block Is., RI	09/27/96	L Firmino	Hampton Bays, NY	30	06/22/97
32	R Canfield	Westport, CT	06/29/95	R Michelin	Norwalk, CT	34	06/22/97
23	R Conklin	Moriches Inlet, NY	06/17/97	S Smith	Moriches Bay, NY	24	06/22/97
23	C Lienau	Montauk Pt., NY	08/03/96	A Hendrick	3 Mi. Harbor, NY		06/22/97
27	T Rinaldi	Hortons Point, NY	08/26/91	R Cordeiro	Branford, CT	38	06/22/97
28	C Carroll Jr.	Keyport, NJ	04/06/97	J Squalli	Smithtown Bay, NY	29	06/22/97
30	S Fries	Rockaway Inlet, NY	10/09/95	A Koytoykas	Jamaica Bay, NY	32	06/22/97
28	G White	Piscataqua R., NH	07/30/95	M Amaral	Newburyport, MA		06/23/97
20	T Marburger	Northport, NY	04/13/97	L Hahaway	Martha's Vineyard, MA		06/23/97
20	H Sweet	Warren, RI	09/06/96	V DeLisi	Barrington, RI	20	06/23/97
32	D Hoxsie	Stonington, CT	09/27/96	M Zahornacy	Block Is., RI	35	06/23/97
32	F Coronato	West Bank Lt., NY	06/08/96	R Newalls Jr.	Flynn's Knoll, NJ		06/23/97
18	E Petronio Jr.	Pt. Judith, RI	05/22/97	J Johnson	Pt. Judith, RI	18	06/23/97
16	T McCandless	Jamestown, RI	10/31/96	E Bardinelli	Milford, CT	20	06/23/97
18	E Petronio Jr.	Pt. Judith, RI	08/25/96	J Johnson	Pt. Judith, RI	18	06/23/97
22	A LoCascio	Throgs Neck Brdg., NY	09/29/96	D Tudor	LaGuardia Airport, NY	24	06/23/97
28	F Coronato	West Bank Lt., NY	08/08/96	F Vanderhoef	Raritan Bay, NJ		06/24/97
25	A Anderson	Block Is., RI	06/19/97	T Ziobo	Block Is., RI	26	06/24/97
26	L Gonnello	Sandy Hook, NJ	07/08/96	F Vanderhoef	Raritan Bay, NJ		06/24/97
25	R Conklin	Moriches Inlet, NY	06/09/96	C Koloski	Moriches Bay, NY	29	06/24/97
29	A Anderson	Montauk Pt., NY	10/23/96	R Stone	Provincetown, MA	29	06/24/97
22	J Gibbons	Sandy Hook, NJ	09/20/96	K Tolan	J.F.K. Airport, NY	24	06/24/97
34	T Marburger	Shinnecock Inlet, NY	08/11/96	T White	Shinnecock Inlet, NY	38	06/24/97
20	A LoCascio	Manhasset Bay, NY	11/04/96	A Martin	Matunuck, RI	21	06/25/97
29	A LoCascio	Throgs Neck Brdg., NY	09/21/96	W Denning	Throgs Neck Brdg., NY	29	06/25/97
19	M Simmons	Barneget Lt., NJ	11/12/96	E Flanagan	Boston, MA		06/25/97
29	T Marburger	Shinnecock Inlet, NY	06/18/96	G Grosselfinger	Shinnecock Inlet, NY	33	06/25/97
26	A Dangelo	Charlestown, RI	10/31/95	P Westcott	1/2 mi. S Charlestown, RI	28	06/25/97
22	L Richards	Atlantic Beach, NY	06/20/97	M Berger	Atlantic Bch Brdg., NY	22	06/25/97
34	A LoCascio	Manhasset Bay, NY	07/06/96	R Tenreiro	Manhasset Bay, NY	34	06/25/97
29	A Anderson	Montauk Pt., NY	09/30/96	W Sang	Westbrook, CT	30	06/25/97
21	M Simmons	Barneget Lt., NJ	10/17/96	M Simmons	Barneget Lt., NJ	25	06/25/97
9	G Horvath	Trenton, NJ	06/10/97	D Mankin	Bristol, PA	10	06/25/97
20	R Leja	Bridgeport, CT	09/11/95	R Katz	Bridgeport, CT	22	06/25/97
23	G Ciriello	Sandy Hook, NJ	06/14/96	J Brewer	Damariscotta, ME	25	06/26/97
27	G Ottavio	Cape May, NJ	11/23/96	P Wegener	Dennis, MA	30	06/26/97
29	A Anderson	Block Island, RI	11/14/96	S Wiggins	Narragansett, RI		06/26/97
20	W Perlman	Atlantic Beach, NY	06/22/97	A Landau	Atlantic Beach, NY	20	06/27/97
22	M Bolton	Middletown, RI	08/12/96	R Gouveia	Sachuest Pt., RI	27	06/27/97
20	C Wilcox III	Moriches Inlet, NY	06/03/97	M Alfieri	Shinnecock Inlet, NY	20	06/27/97
23	T Shaheen	Raritan Bay, NJ	09/11/96	S Andrews	Little Neck Bay, NY		06/27/97
24	R Leja	Bridgeport, CT	05/30/95	C Grimes	Bridgeport, CT	34	06/27/97
30	P Grippo	Jones Inlet, NY	10/02/95	E Lein	Jones Beach, NY	30	06/27/97

**Species**

<b>Lgth</b>	<b>Tagger</b>	<b>Place Tagged</b>	<b>Date</b>	<b>Recapturer</b>	<b>Location</b>	<b>Lgth</b>	<b>Date</b>
<b>Striped Bass (cont.)</b>							
15	M Simmons	Barnegat Lt., NJ	11/27/96	J Hardy	Newport, RI	22	06/27/97
24	L Richards	Atlantic Beach, NY	06/22/97	J McMurray	1 mi S Rockaway, NY		06/27/97
31	E Albright	Kingston, NY	05/16/97	M Walsh	Nashon Is., MA		06/27/97
22	J Karolides	Beverly, MA	09/19/96	D Marchant	Gloucester, MA		06/27/97
17	A LoCascio	Manhasset Bay, NY	10/24/95	R Lazar	Kings Pt., NY	20	06/27/97
18	S Giaccone	Whitestone Bridge, NY	04/18/93	R Gaglione	City Is., NY	26	06/27/97
24	P Hierholzer	Sea Isle City, NJ	11/16/96	R Benson	Chatham, MA		06/28/97
20	P Lowcher	Gloucester, MA	05/24/97	N Harris	Ipswich, MA		06/28/97
21	J Della Porta	Swampscott, MA	06/17/97	C Tranos	Rockport, MA		06/28/97
11	A Anderson	Thames R., CT	05/06/97	J Martinez	Norwich, CT		06/28/97
25	R Kyker	Norwalk, CT	06/01/97	G Zografidis	Norwalk, CT	28	06/28/97
19	W Anderson	Provincetown, MA	06/09/97	J Cromme	Race Pt., MA	20	06/28/97
30	R Conklin	Moriches Inlet, NY	11/11/95	D Smith	Moriches Inlet, NY	32	06/28/97
23	W Perlman	Atlantic Beach, NY	06/22/97	W Perlman	Atlantic Beach, NY	23	06/28/97
22	W Woodroffe Sr.	Riis Park, NY	09/06/95	R Pagano	Breezy Pt. Jetty, NY	27	06/28/97
20	T Shaheen	Sandy Hook, NJ	08/31/96	I Ramirez	Seaside, NJ	25	06/28/97
22	D Dibblee	Esopus, NY	05/09/97	J Foti	Staten Is., NY	24	06/29/97
24	B White	Princess Bay, NY	05/06/96	E Adams	Long Branch, NJ	24	06/29/97
22	M Berger	Atlantic Beach Bldg., NY	05/26/97	D Simon	Freeport, NY	22	06/29/97
20	J Foti	The Narrows, NY	07/04/96	J Foti	Staten Is., NY	24	06/29/97
32	M Favale	Boston, MA	09/15/96	J Barker	Boston, MA	34	06/29/97
32	F Coronato	Staten Island, NY	10/26/95	B Cookson	Hogg Is., MA	36	06/29/97
23	J Mulkerin	Union Beach, NJ	03/28/97	D Marini	Chatham, MA		06/29/97
17	J O'Keefe	Stratford, CT	05/08/97	J Brown	Stratford, CT	19	06/29/97
15	R Kyker	Norwalk, CT	11/10/95	G Zografidis	Norwalk, CT	17	06/30/97
22	G Ciriello	Sandy Hook, NJ	10/11/96	B Frey	Flynn's Knoll, NJ	25	06/30/97
18	G Ottavio	Cape May, NJ	09/15/96	B Hippel	Cape May, NJ		06/30/97
26	N Bobetsky	Quonochontaug, RI	06/12/95	A Vernucci	Milford, CT	29	06/30/97
20	A LoCascio	Manhasset Bay, NY	09/15/96	S LaPera	Port Washington, NY	24	06/30/97
35	R Canfield	Westport, CT	07/15/95	D Mooney	Westport, CT		06/30/97
42	A Anderson	Montauk Pt., NY	10/26/96	K Fuller	Newburyport, MA		06/30/97
28	D Crann	Montauk Pt., NY	10/08/95	S Farmer	Hartford, CT	28	06/30/97
18	R Grobarz	Sandy Hook, NJ	12/06/95	M Matula	Mansquan R.R. Bldg., NJ	22	07/01/97
20	D Obropta	Sandy Hook NJ	09/29/96	A Perednia	Delancy St., East R., NY	20	07/01/97
24	G Ciriello	Offsh., Sandy Hook, NJ	10/25/96	J Desalvio	Merrick, NY	25	07/01/97
17	F Jessup	Moriches Inlet, NY	07/11/96	P Grippo	Haunts Creek, NY	18	07/01/97
27	G Kerkhan	Truro, MA	06/19/97	C Maynard	Cape Cod Bay, MA	27	07/01/97
24	G Nigro	Sandy Hook, NJ	05/23/97	W Blas	Lower NY Bay		07/01/97
15	R Kyker	Norwalk, CT	09/25/95	G Zografidis	Norwalk, CT		07/01/97
29	A Anderson	Block Is., RI	09/15/96	R Hackbarth	Guilford, CT	29	07/01/97
15	GS Gray	Charlestown, RI	05/27/97	J Pardee Sr.	Swansea, MA	15	07/02/97
32	D Kelly	Sag Harbor, NY	06/17/97	S Dinizio	The Brickyard	36	07/02/97
28	J McAfee	Quick's Hole, MA	07/23/96	A Malgieri	Quick's Hole, MA	29	07/02/97
21	J Dotsey	Long Beach, NY	09/12/93	V Minafo	Sandy Hook, NJ	25	07/02/97
18	H Sweet	Warren, RI	08/16/96	M Langlois	Barrington R., RI		07/02/97
30	S Wisniewski	Cuttyhunk Is., MA	06/23/97	A Malgieri	Quick's Hole, MA	30	07/02/97
25	W Perlman	Atlantic Beach, NY	05/08/97	V Minafo	Sandy Hook, NJ		07/02/97
35	D Kelly	Orient Pt., NY	10/27/96	R Murphy	Salisbury, MA	37	07/02/97
18	B Suer	Manasquan Bch., NJ	11/13/96	C Vangile	Newburyport, MA	18	07/02/97
28	D Kelly	Orient Pt., NY	10/13/95	S Smith	The Race, L.I. Sound	30	07/02/97
29	J Treat	Cuttyhunk, MA	10/01/96	D Charest	Cuttyhunk, MA	29	07/02/97
18	A Soiefer	Manhasset Bay, NY	10/27/96	J Schwenn	Port Washington, NY		07/02/97
18	E Petronio Jr.	Pt. Judith, RI	06/15/97	T Hughes	Galilee, RI	22	07/03/97
17	E Petronio Jr.	Pt. Judith, RI	06/04/97	T Noons	Galilee, RI		07/03/97
26	B Finke	Norwalk, CT	07/01/96	D Biddle	Norwalk, CT		07/03/97
17	J Gibbons	Sea Bright, NJ	09/20/95	S Saniewski	Spring Lake, NJ	19	07/03/97
21	A Anderson	Charlestown, RI	10/26/95	W Pupecki Jr.	Bourne, MA	22	07/03/97
36	A LoCascio	Manhasset Bay, NY	11/10/96	T Violissi	Clinton, CT		07/03/97
29	R Leja	Bridgeport, CT	07/08/95	F Mazovec	Eatons Neck, NY	32	07/03/97
22	R Testa	Saco R., ME	05/25/95	L Gonnello	Raritan Bay, NJ	24	07/03/97
22	T Marburger	Northport, NY	04/30/96	H Gruner	Fishers Is., NY		07/03/97
16	R Kyker	Norwalk, CT	04/29/95	R McDaniel	Popham Beach, ME	26	07/03/97
27	A Dangelo	Montauk, NY	08/14/96	D Frank	Stepping Stone Lt., NY		07/03/97
30	A Anderson	Block Island, RI	06/13/95	A DaSilva	Barnstable, MA	33	07/03/97

**Species**

<b>Lgth</b>	<b>Tagger</b>	<b>Place Tagged</b>	<b>Date</b>	<b>Recapturer</b>	<b>Location</b>	<b>Lgth</b>	<b>Date</b>
<b>Striped Bass (cont.)</b>							
32	T Marburger	Shinnecock Inlet, NY	08/22/95	M Bandiera	Shinnecock Inlet, NY	36	07/03/97
21	C Wilcox III	Moriches Inlet, NY	10/06/96	J Kearns	Moriches Bay, NY	24	07/04/97
20	T Marburger	Northport, NY	02/23/97	J Poratti	Wells Beach, ME	24	07/04/97
26	T Marburger	Shinnecock Inlet, NY	06/16/96	R Boll	Shinnecock Inlet, NY	30	07/04/97
31	M Favale	Boston Harbor, MA	06/26/97	B Gillis	Boston Harbor, MA	27	07/04/97
23	G Ruest	Robinson's Hole, MA	09/19/96	R DuPonte	Robinson's Hole, MA	23	07/05/97
24	D Dibblee	Esopus, NY	05/06/97	P Pagan	Pea Is., NY	25	07/05/97
31	T Shaheen	Ambrose Chan., NJ	10/22/95	C Zablocki	Democrat Pt., NY	32	07/05/97
33	A Anderson	Block Is., RI	09/27/96	J Amaral	Newport, RI	33	07/05/97
20	R Leja	Bridgeport, CT	10/20/95	D Larzik	Romer Shoal Lt., NJ	25	07/05/97
21	K Kyker	Northport, NY	04/02/95	G Claveau	Salem Pwr. Plt., MA	26	07/05/97
18	J Della Porta	Nahant, MA	06/11/97	M Whittemore	Salisbury, MA	18	07/05/97
18	S North	Island Bch. St. Pk., NJ	11/23/96	R Swartz	Sandwich, MA	18	07/05/97
31	JC Wright	Rudee Inlet, VA	12/10/96	S Hurnitz	Orient Pt., NY	27	07/05/97
28	G Nigro	Sandy Hook, NJ	06/24/97	V Mayer	Flynn's Knoll, NJ	28	07/05/97
34	W Kobel Jr.	Eatons Neck, NY	10/10/96	J Wells	Stratford Shoal, CT	35	07/05/97
20	H Sweet	Warren, RI	06/03/95	C Berry	Damariscotta R., ME	28	07/05/97
28	R Conklin	Moriches Inlet, NY	10/10/95	G Navratil	Moriches Inlet, NY	29	07/05/97
29	S Jakubowski	Hoffman Is., NY	10/30/95	J Ready Jr.	Cape Elizabeth, ME	31	07/05/97
26	A Schweithelm	Montauk, NY	06/06/97	V Arcos	Montauk, NY	27	07/05/97
29	R Leja	Bridgeport, CT	09/09/95	L Vazquez	Bridgeport, CT	32	07/05/97
22	J Foti	Staten Is., NY	06/21/97	J Foti	Staten Is., NY	22	07/05/97
33	B Cotiaux	Gardiners Is., NY	09/16/96	D Hagenow	Fishers Is., NY	34	07/05/97
21	W Perlman	Atlantic Beach, NY	06/05/93	S Perri	Long Beach, NY	29	07/05/97
38	F Noto	Flynns Knoll, NJ	07/22/96	J Pace	Flynn's Knoll, NJ	38	07/06/97
26	A Moore	Newburgh, NY	04/29/97	J Flowers	Montauk Pt., NY	27	07/06/97
34	C Wilcox III	Moriches Inlet, NY	11/04/96	R Kerjean	Moriches Inlet, NY	34	07/06/97
21	R Grobarz	Sea Bright, NJ	09/06/92	K Hollins	Island Beach St. Pk., NJ	32	07/06/97
19	R Conklin	Moriches Inlet, NY	08/20/95	N Popka	Provincetown, MA	28	07/06/97
24	R Conklin	Moriches Inlet, NY	11/16/95	D Poirier	Cape Cod Canal, MA	24	07/06/97
34	G Buono	Old Orchard Lt, NY	05/20/97	G Osmond	Fire Is. Inlet, NY	35	07/06/97
34	G White	Piscataqua R., NH	06/26/97	F/V Harvester	Rye, NH	34	07/06/97
17	G Blank	Jersey City, NJ	03/02/97	S Nigro	Old Saybrook, CT	17	07/06/97
23	F Heal	Flynn's Knoll, NJ	07/16/96	E Bannon	Flynn's Knoll, NJ	23	07/06/97
30	A LoCascio	Hempstead, NY	06/24/97	V Weiler	Manhasset Bay, NY	30	07/07/97
20	P Grippo	Wantagh, NY	06/20/97	C Donohoe	Wantagh Bldg., NY	21	07/07/97
35	F Casey	Boston, MA	09/09/95	D Beetz	York Harbor, ME	36	07/07/97
27	F Coronato	Flynn's Knoll, NJ	07/16/96	D Lerch	Flynn's Knoll, NJ	29	07/07/97
31	B White	Great Kills, NY	05/26/97	W Meyer	Ambrse Chan., S.H., NJ	35	07/07/97
26	J Caputo	Manhasset Bay, NY	09/28/96	A Marino	Manhasset Bay, NY	27	07/07/97
30	A Anderson	Green Hill, RI	09/30/95	W Little	Pemaquid Pt., ME	33	07/07/97
24	G Kerkhan	Sea Bright, NJ	09/20/92	L Shute	Island Beach St. Pk., NJ	32	07/07/97
32	G Ruest	Quick's Hole, MA	07/19/95	J Donahue	Quick's Hole, MA	34	07/08/97
29	D Kelly	Sag Harbor, NY	06/11/97	M Feder	Orient Pt., NY	29	07/08/97
27	J McAfee	Quick's Hole, MA	07/01/97	W DeMello	Elizabeth Is., MA	28	07/08/97
23	G Horvath	Barnegat Inlet, NJ	11/05/96	J Pinder	Merrimack R., MA	23	07/08/97
29	A Dangelo	Montauk, NY	07/04/95	B McCombe	Block Is., RI	33	07/08/97
21	D Pardy	Windsor, CT	05/09/97	T Williams	Harwich, MA	21	07/08/97
26	M Berger	Atlantic Beach Bldg., NY	06/09/97	S Pugach	Fire Is. Inlet, NY	26	07/08/97
24	F Tenore	Sandy Hook, NJ	05/19/96	H Lynch Jr.	Newburyport, MA	27	07/08/97
26	P Grippo	Jones Inlet, NY	10/18/95	R Kessinger	Jones Inlet, NY	27	07/08/97
28	A Schweithelm	Ft. Salonga, NY	06/15/96	S Driscoll	Northport, NY	32	07/08/97
28	A Dangelo	Montauk, NY	06/02/96	T Currier	The Race, L.I. Sound	32	07/08/97
25	L Gonnello	Sandy Hook, NJ	07/09/96	B Voytasek	Flynn's Knoll, NJ	26	07/08/97
33	G Ministeri	Wellfleet, MA	07/27/95	D Machado	Provincetown, MA	35	07/09/97
23	T Shaheen	Raritan Bay, NJ	07/06/96	J Mineo	Old Orchard Lt., NY	23	07/09/97
31	JC Wright	Rudee Inlet, VA	12/10/96	J Kiernan	Moriches Inlet, NY	32	07/09/97
21	G D'Amato	Stratford, CT	11/09/95	F Kaufmann	Provincetown, MA	29	07/09/97
32	S Penta	Boston, MA	09/20/95	B O'Brien	Boston, MA	38	07/09/97
18	E Petronio Jr.	Pt. Judith, RI	06/15/97	T McVey	Pt. Judith, RI	19	07/09/97
26	G Nigro	Sandy Hook, NJ	09/26/96	E Green	Moriches Inlet, NY	27	07/09/97
26	A Walker	Deal, NJ	05/29/97	E DiCocco	Orient Pt., NY	30	07/09/97
31	S Jakubowski	Hoffman Is., NY	11/30/96	A Lee	Norwalk, CT	33	07/10/97
16	T Lake	Bay Ridge Flats, NY	11/24/95	N Kritikos	69th St., Bklyn, NY	22	07/10/97

**Species**

Lgth	Tagger	Place Tagged	Date	Recapturer	Location	Lgth	Date
<b>Striped Bass (cont.)</b>							
32	D Kelly	Orient Pt., NY	09/20/96	S Nockler	Plum Gut, NY	35	07/10/97
20	R Leeds	Ocean City, NJ	10/29/96	S Fancy	Saco, ME	21	07/10/97
22	G Nigro	Sandy Hook, NJ	06/24/97	T Licknack	Raritan Bay, NJ	22	07/10/97
25	A Dangelo	Montauk, NY	06/09/96	M Cebulski	Wantagh, NY	28	07/10/97
36	J Karolides	Beverly, MA	06/26/95	D Wright	Manchester, MA	41	07/10/97
21	M Berger	Atlantic Beach, NY	06/09/97	C Diaz	Jones Beach, NY	25	07/10/97
17	G Nigro	Sandy Hook, NJ	05/17/97	D Pallaria	Block Is., RI	18	07/10/97
27	G White	Piscataqua R., NH	06/29/97	K Ransom	Portsmouth, NH		07/11/97
21	T Shaheen	Raritan Bay, NJ	05/25/96	N Kalish	Zach's Bay, NY	24	07/11/97
33	F Coronato	West Bank Lt., NY	05/24/97	C DeNisco	Tuckernut Is., MA		07/11/97
25	R Pearson Jr.	Croton Bay, NY	05/02/97	E Shoniecki	Salem, MA	25	07/11/97
22	G Nigro	Sandy Hook, NJ	08/29/96	D McMillan	Rockaway Pt., NY	23	07/11/97
26	L Newsky	Piscataqua R., NH	06/23/96	G LaCombe	Merrimack R., MA	26	07/11/97
29	S Giaccone	Montauk Pt., NY	09/06/96	W Nye	Old Lyme, CT	30	07/11/97
25	G Nigro	Sandy Hook, NJ	06/24/97	F Preto	Sandy Hook, NJ	26	07/11/97
17	P Blanchard	Salisbury, MA	02/05/97	Unkn fisherman	Salisbury, MA	00	07/11/97
31	F Casey	Boston, MA	07/02/97	G Ohanian	Boston, MA	33	07/11/97
25	G Ciriello	Sandy Hook, NJ	11/20/95	W Hoffman	Salem Harbor, MA	28	07/11/97
41	A Anderson	Block Is., RI	10/30/96	D Granger	Fishers Is., NY		07/12/97
25	J Posh	Watch Hill, RI	05/13/97	J Sibley	Searsport, ME	26	07/12/97
29	J McAfee	Quick's Hole, MA	06/18/97	D Sardinha	Martha's Vineyard, MA	32	07/12/97
26	T Marburger	Shinnecock Inlet, NY	07/28/96	M Pistilio	Moriches Inlet, NY	30	07/12/97
20	M Simmons	Barneget Lt., NJ	11/12/96	F DeMenezes	Cuttyhunk, MA	23	07/12/97
30	R Ries	Cold Spring Harbor, NY	09/04/95	B Brick	Merrimack R., MA		07/12/97
26	A Anderson	Block Island, RI	06/20/97	D Wood	Little Compton, RI		07/12/97
20	J Della Porta	Swampscott, MA	07/07/97	M Grigway Jr.	Swampscott, MA		07/12/97
28	A Anderson	Montauk Pt., NY	07/02/97	J Benedict	Montauk, NY		07/12/97
26	L Gonnello	Flynn's Knoll, NJ	07/07/97	E Bannon	Flynn's Knoll, NJ		07/12/97
23	A Anderson	Montauk Pt., NY	05/30/97	J Prenda	Vineyard Sound, MA		07/12/97
28	R Gariepy	Newburyport, MA	07/23/96	B Morin Jr.	Merrimack R., MA	31	07/12/97
23	G Ciriello	Ambrose Chan., NY	11/16/96	R Carbonaro	Norton's Pt., NY	25	07/13/97
23	A Landau	Atlantic Beach, NY	06/27/97	W Perlman	Atlantic Beach, NY	24	07/13/97
29	A Anderson	Block Is., RI	06/15/97	L Napoletano	Montauk Pt., NY	30	07/13/97
16	P Blanchard	Salisbury, MA	07/07/97	K Fish	Salisbury, MA		07/13/97
27	P Grippo	Wantagh, NY	06/17/97	J Andretta	Wantagh, NY	27	07/13/97
26	R Grobarz	Sea Bright, NJ	07/04/96	S Kerr	Shrewsbury Rocks, NJ	28	07/13/97
27	M Russo	Old Field Pt., NY	07/01/95	H Bowman III	Fire Is. Inlet, NY		07/13/97
16	R Ferraro	Narragansett, RI	04/27/97	A D'Agostino	Narragansett, RI		07/13/97
31	F Casey	Boston, MA	07/05/95	W Bartkus	Boston, MA	36	07/14/97
33	D Kelly	Orient Pt., NY	09/28/95	K Salisbury	Lyme, CT	36	07/14/97
28	D Stratton	Norwich, CT	04/12/97	R Burcham	Boston, MA	28	07/14/97
18	H Sweet	Barrington, RI	05/24/96	G Medeiros	Hope Is., RI	20	07/14/97
21	A Piszczatowski	Glen Cove, NY	10/01/96	H Smith	W.L.I. Sound	23	07/14/97
20	M Simmons	Barneget Lt., NJ	11/07/96	D Roselli	Rockaway, NY		07/15/97
25	C Silva	Middletown, RI	07/01/96	M Bolton	Middletown, RI	25	07/15/97

**Tautog**

14	G Ruest	Nyatt Pt., RI	09/25/96	P Bettencourt	Barrington, RI	14	06/17/97
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**Triggerfish**

12	T Carlsen	Hereford Inlet, NJ	07/08/97	J Reichert	N. Wildwood, NJ		07/12/97
14	S Carlsen	Hereford, NJ	07/08/97	M Palmer	Hereford Inlet, NJ		07/15/97

**Weakfish**

20	C Kennedy	Cape May Inlet, NJ	06/01/97	P Newsome Jr.	N. Fortescue, NJ	21	06/15/97
20	G Ottavio	Cape May Pt., NJ	06/16/97	R Law	Cape May Pt., NJ	21	06/18/97
24	G Ottavio	Cape May Pt., NJ	06/21/97	P Degliomini	Cape May Pt., NJ		06/22/97
20	G Ottavio	Cape May Pt., NJ	06/12/97	C Smith	Wildwood, NJ	21	06/26/97
16	C Kennedy	Cape May Inlet, NJ	06/20/97	C Blough	Avalon, NJ	16	07/06/97

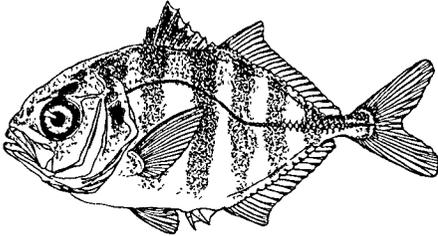
**THE FIRST YEAR IN THE LIFE OF ESTUARINE FISHES IN THE MIDDLE ATLANTIC BIGHT**

by Kenneth W. Able and Michael P. Fahay

Rutgers University Press, New Brunswick, NJ. 400p. \$67.00 (cloth).

The Littoral Society and others have been broadcasting a drumbeat for several decades about the importance of estuaries and shallow inshore waters in the life cycles of fishes, evidenced in part by the 1967 ALS publication, "FISH AND MAN, Conflict in Atlantic Estuaries."

Crevalle Jack

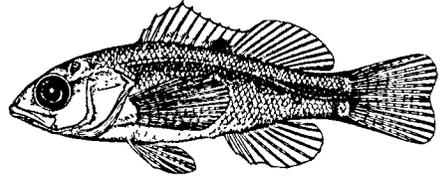


This new volume presents well documented, scientific evidence that further confirms our need to learn more about the key roll played by coastal waters during the first year in the lives of 70 fish species out of the 300+ species whose young are found nearshore from Cape Cod to Cape Hatteras.

The book is especially important because it addresses the lives of juvenile fishes and the not-well understood time they spend between their larval and adult stages. It reports when they reach estuaries, what they eat, how fast they grow, and when they leave. For example, summer flounder or fluke enter estuaries in the winter months at postage stamp size, eat small stuff till they have put on enough weight and grown big enough teeth to go after serious protein, and then grow up to an inch every two weeks chomping on shrimp, adult forage

species, and juveniles, leaving estuaries to winter offshore as foot-long fluke, growing much faster than previously thought.

Black Sea Bass

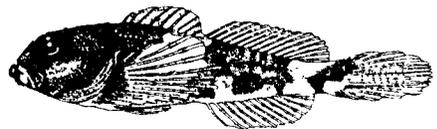


The authors trace similar fish life histories, adding greatly to ichthyologic knowledge of fishes like hakes, killies, silversides, perch and their relatives (including striped bass and weakfish), blennies, herring, eels, bluefish, flatfishes, and anchovies.

Each species gets about three pages of text and detailed (and quite spellbinding) pen and ink illustrations by Susan Kaiser and Nancy Arthur.

The volume should serve as a model (and goad) for fisheries biologists to address the first year life histories of other fishes in other coastal water bodies. And the illustrations and descriptions will help generations of taxonomists and amateur fish chasers (including ALS members) identify young fishes. Cheers to the authors and illustrators for their years of work and to Rutgers University Press for seeing to it that this volume is added to the literature of fishes. We look forward to similar works for the Gulf of Maine, the South Atlantic, the Gulf of Mexico, and the West Coast.

Grubby





## FIELDS OF SUN AND GRASS

by John R. Quinn

Rutgers University Press, New Brunswick, NJ  
330 p. \$22.50 (paper).

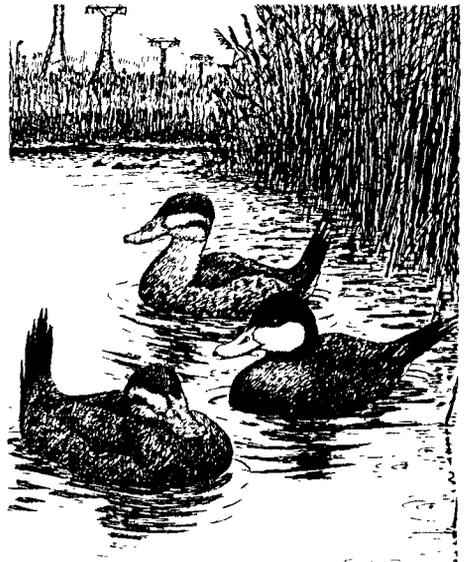
This is an artist's journal of the New Jersey Meadowlands — not an original thought, it is the subtitle of Quinn's wonderful book about the Hackensack Meadowlands. Those who have read some of his earlier work, including "One Square Mile on the Atlantic Coast," will recognize the design — a tidy mix of writing and drawing to describe a special kind of habitat. In this case, the habitat is the last big piece of open space in the NJ/NY metropolitan region.

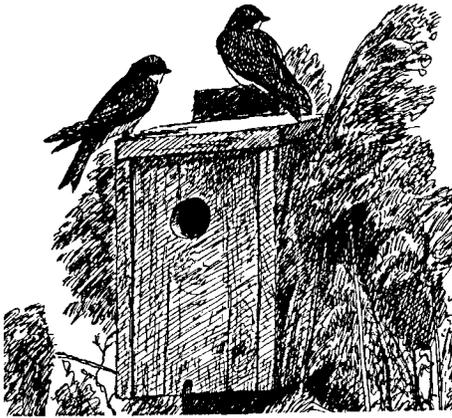
The Hackensack has wetlands, uplands, rivers and ponds, snakes, turtles, nesting waterfowl, muskrats, teal, carp, weakfish, fiddler crabs, and rough-legged hawks. It has dirt bike trails, landfills and leachate, superfund sites, phragmites, saltmarsh grasses, lots of four-lane asphalt, and the Vince Lombardi rest stop. It has some of the biggest blue crabs in New Jersey, a burgeoning population of striped bass, nesting marsh hawks, and rookeries of wading birds. Kearny Marsh is a major nesting area for

waders and waterfowl; Snake Hill is that plug of rock near the NJ Turnpike where the Greek fraternity symbols are painted. Berry's Creek is polluted with mercury; the sediments in the bed of the Passaic River feature dioxin.

It is a fascinating, under-rated place, and Quinn is just the right person to do the book. He knows his wildlife, he draws so very well, and he grew up in Ridgefield Park at the northern end of the Meadows, so he approaches his subject honestly.

This book comes at a critical and useful time, because the Littoral Society's Baykeeper project is right now locked in mortal combat with the powers that govern Meadowlands land usage. Having despoiled, filled, and misused about 18,000 of the Meadowlands' original 26,000 acres, developers are now back to slice off another prime chunk of the remaining unoccupied land, the so called Empire Tract where Mills Corporation wants to build (hold onto your hats), an outlet shopping mall peddling such necessities as towels, loafers, and jeans on 200 acres of wetlands. It's difficult to see how such a plan fits into the professed NJ and US goal of not only not filling wetlands but actually trying to





regain, replenish, or restore millions of acres of previously filled wetlands. Nor do we know whether Quinn is willing to add sketches of the mall to the next printing of this fine book.



## THE MEADOWLANDS

by Robert Sullivan  
Scribner, New York  
206 p. \$23.00 (cloth)

This is not like Quinn's guide to the natural history of the Meadowlands, but it does cover the same geographic area. It is a more casual collection of funny, poignant, or fanciful vignettes that mirror the paradoxes that make up the Hackensack meadows. After all, the area is the locale of contrasts — former pig farms, maybe Jimmie Hoffa's final resting place, a model plane flying club with its perfectly groomed landing strips hid-

den among the phragmites, and a roosting place for long-eared owls in winter.

The Meadowlands' Bergen County landfill was one of the truly disgusting places on planet Earth, with rats the size of Jack Russell terriers (but fiercer) and fetid, belching mounds of solid waste, fluids, and ert and inert gases. At one time, the meadows were getting 10,000 tons of garbage a day. The landfill hills are visible today, but getting lower as the underlying garbage decomposes.

The author has a lot of fun with the different stories the meadows can tell. One of the blurbs on the back jacket aptly compares his approach to that of Joseph Mitchell whose collection of New York stories, "The Bottom of the Harbor," has a similar mix of oddball facts and startling conclusions. Sullivan's book is funnier and sadder than Quinn's, whose fine work will last longer and be more useful.

## IMAGINING ATLANTIS

By Richard Ellis

Alfred A. Knopf, New York, NY  
322p. \$27.50 (cloth).

Books about Atlantis, the (mythical) island that once existed somewhere in the Atlantic Ocean then disappeared, must number in the thousands. I think that a half-hour after Plato first told the tale, someone was writing a book about it. Many people's first reaction when seeing a new book on the subject may be, why would anyone want to write another book about Atlantis, let alone read one. In fact, in the introduction to this, his latest book, Ellis ponders the same question.

The first clue to why this book is worth reading comes from title, *Imagining Atlantis*. This is not so much a book about Atlantis as it is a book about what people think about or how they envision Atlantis, and how, for centuries, they have chosen to express those visions. There is no way that a study of all the works about Atlantis could be done in one book and the author doesn't claim to have written an all-encompassing study. What Ellis

all-encompassing study. What Ellis has done is come up with a very interesting, and at times, eclectic selection of Atlantis works. An entertaining approach.

From comic books to the classics, from mythology to archeology, from science to mysticism, Ellis has taken an interesting cross-section of the ways people have tried to tell their own stories of Atlantis. He writes about historical events that may have been the basis for Plato's tale of utopia destroyed. He also dedicates a chapter of the book the depiction of Atlantis in television and the movies. Imagining Atlantis is fun to read.



## MOBY DICK

Retold by Geraldine McCaughrean

Illustrated by Victor G. Ambrus

Oxford University Press, Oxford/New York.  
102 p. \$19.00 (cloth).

"There is a whale in the sea, as white as a ghost, and it haunts me." The name of the whale? Moby Dick, of course. The teller of this tale? "Call me Ishmael. It might be my name. There again it might not be... Sometimes when I'm afloat in sleep, like a drowned sailor, he swims towards me — a nightmare all in white, jaws gaping, and I wake up

screaming and salt-water wet with sweat. Somewhere out there in the bottomless oceans lives Moby Dick, a great white winter of a whale, and I shiver still at the thought of him. Even in summer."

And we are off on one of the great stories in western literature. This is Moby Dick recast for youngsters. It works very well as rewritten, and the illustrations are striking. A child reading or being read this book will be mildly frightened, but that's not the worst way to prepare for a good night's sleep. Anything that gets a person to read Moby Dick is good, so this is a good book. The watercolors make it even better.



## SONG FOR THE BLUE OCEAN

by Carl Safina

Henry Holt and Co., New York  
440 p. \$30.00 (cloth).

This book could have been one long whine about the death of the fishes of the sea because of overfishing, followed by a short summary of half a dozen ways of saving sea creatures. Instead, the author goes to several years of trouble talking to the people who catch fish to make money or for fun, to biologists who study fish lives and try to measure their abundance, and to fisheries managers whose job it is to allocate a limited resource of wild fish to people with a seemingly insatiable desire to catch every last one.

The result is this thorough discussion of fish, best when it speaks objectively about life histories and behaviors and about the art and science of commercial fishing as the fishermen tell it. If we are to believe what's here (no need not to), commercials and recreational care about fish and want them to survive. They just want to catch their share. And here's where the going gets rough — how to decide who gets what. Commercial fishermen argue that they help feed the world, that the fish they want to catch are more numerous than biologists think, and that government efforts to regulate fishing are unfair, ineffective, and contradictory — after all, they say, the passage of the 200-mile limit, followed by federal guarantees for cheap boat loans, was a signal for U.S. fishermen to get to work catching all those fish the foreign fleets missed.

Recreational fishermen argue that they spend much more money pursuing their prey than the same fish will produce if caught by commercial fishermen. And environmentalists and fish biologists say that current fishing practices have thrown the world's population of fishes and invertebrates out of balance, threatening some species with commercial extinction, or knocking them down so low it will take decades to restore populations and then only through

draconian measures. (Old joke: What's the difference between a recreational and a commercial fisherman? A recreational fisherman takes a picture of his fish before he sells it.)

Safina probably wisely focuses on a few fish species to make his points: tunas, salmon, and reef fishes. (The table of contents indicates only one reference to bluefish and two to striped bass.) His coverage is worldwide because the problem he addresses is worldwide. His solution? Nothing clear cut or easy. He asks us to develop a sea ethic, to back off until fish populations recover, and then harvest them conservatively enough to make sure their numbers never again fall to today's lows. He also calls for an understanding that fisheries cannot be managed species by species; rather, the mix of marine life needs to be addressed at once. The outlook? Gloomy; it probably means eating lower on the food chain (soybeans instead of sushi), more aquaculture, less freedom of choice for fishermen (quotas, limited entry, no fishing sanctuaries), and compromise. Those are tall orders.

## THE AEROSOL SOLUTION

by Lee Del Mar

A'a Press  
7960-B Soquel Drive #125  
Aptos, CA 95003.  
320p. \$12.00 (paper)

The world is over populated; the directors of a pharmaceutical foundation want to find a solution. Using a large monetary prize offered to graduate schools of microbiology they hope someone will come up with population control agent. Someone does; a doctoral student comes across a virus that causes sterility in human males and we're off to the races.

In this novel, a thriller, set in the near future, the author seems to think of every peril, pitfall, conflict, and intrigue that this scenario can conjure up. With characters that are well developed we wind our way through the academic world, corporate crime, religion, politics, civil disobedience, terrorism, the internet, the

paramilitary culture, and more. Lee Del Mar seems to have done a dizzying amount of research and has managed to put it all together in a nicely readable book. By way of introduction the author states, "This story is fictional. But all parts are possible." It's fast, fun, and more than a little disturbing.

## **ALASKA:**

### **A Photographic Journey Through the Last Wilderness**

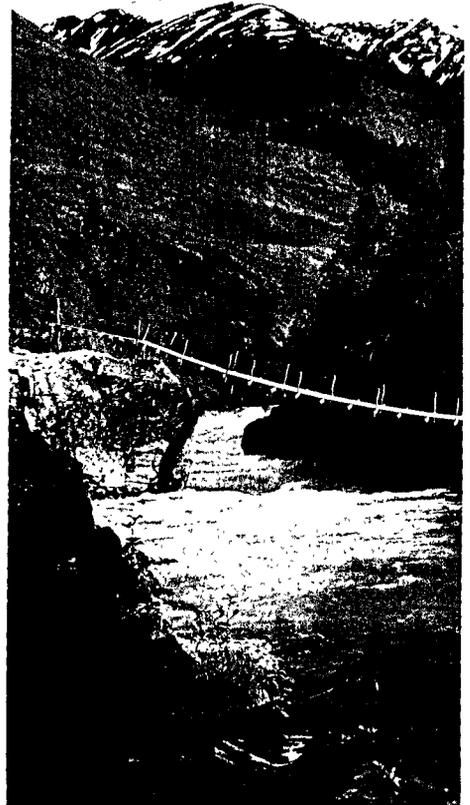
By John Pezzenti, Jr.

The Penguin Group, New York.  
223p. \$50.00 (cloth).

Seemingly, all people who write about Alaska fall into one of two categories. Either they visit, fall in love with it, and stay or, without ever having been there, they fall in love with the idea of Alaska, and then move there. Mr. Pezzenti falls into the later group. At sixteen, while camping in the Blue Ridge Mountains, he

meets and bonds with an old timer who tells him of Alaska and his plans to move to the last frontier. Mr. Pezzenti's fate is sealed. Two years later he leaves his home in Connecticut for Alaska, his plan to photograph the wilderness lent new urgency by the announced plans for the TransAlaskan Pipeline. Some 25 years later he's still there.

In 25 pages of well-written notes, Mr. Pezzenti relates his Alaskan experience: people he's met, places he's been, the wildlife he's seen. But the most important element of any coffee table book is the illustrations or photographs, in this case photographs. Mr. Pezzenti does not disappoint. We are presented with over 170 exciting, well-crafted photographs in a nicely laid out book. No one trip can show you all of Alaska, and neither can just one book, but the photographic tour given by the author here, is well rounded, thoughtful — an impressive book.





## FACES OF FISHING

by Bradford Matsen

Monterey Bay Aquarium Foundation,  
886 Cannery Row, Monterey, CA 93940.

117 p. \$19.95 (cloth).

This is a collection of terrific writing and magnificent photography about people and the fish they catch, worldwide, by hand, with nets, hook and line, even with trained cormorants. The ocean's bounty is beautiful, and the fishermen, young and old, go about their business seriously, chasing protein for a growing human population.

It seems that a major goal of the book — its author and its photographers — is to record what the world's fisheries looked like at the middle and toward the end of the 20th century, because the times are changing and the era of unlimited and unmanaged growth of the fisheries is ending.



## The Last Page

### OUR LISTS OUR BETTER THAN THEIR LISTS

1998 has been the year of lists — 100 best movies and 100 best books. And supermarket tabloid headlines feature “25 Most Eligible Bachelors” or “Most Fascinating Women of the Decade.” Not to be outdone, we asked Society members to send in lists of their favorite littoral things.. Here are some of their responses:

My five favorite fish dishes (from member Fletcher Selkirk):

1. Lutefisk
2. Carp on a Stick (with tartar sauce)
3. Baked really small swordfish on a bed of rice
4. Porpoise on rye toast points
5. Prime rib o' right whale.

Best Movie Actor: George Seagull, Marlin Brando (tie)

Best Movie Actress: Lauren Bergall, Marlin Monroe (tie)

Best Movie: A Fish Named Wanda, Jaws (tie)

Best Bands: Phish, Hootie and the Blowfish, The Beach Boys (three-way tie)

Best Record: (Golden Oldie Dept.): Sedimental Journey

Best Classic Composer: Baithoven

Best Exotic Dancer (female): Candy Striper

Best Exotic Dancer (male): Buster Crab

Favorite Summer Vacation Spot: Cape Cod

My five favorite books (from member Letitia Everett Thorndike):

1. The Redfish and the Blackfish, by Stendhal
2. Huckleberry Fin, by Mark Fathom
3. The Catfish in the Hat, by Dr. Seuss
4. Look Homeward Angelfish, by Thomas Wolfe
5. Peyton Plaice, by Grace Metalious

Favorite two-line saltwater joke:

Q: What's the difference between a piano and a fish?

A: You can tune a piano but you can't tunafish (7.3 on the laffometer).

Runner-up two-liner:

Q: What's the difference between caviar and crabmeat?

A: About \$180 a pound (3.6).

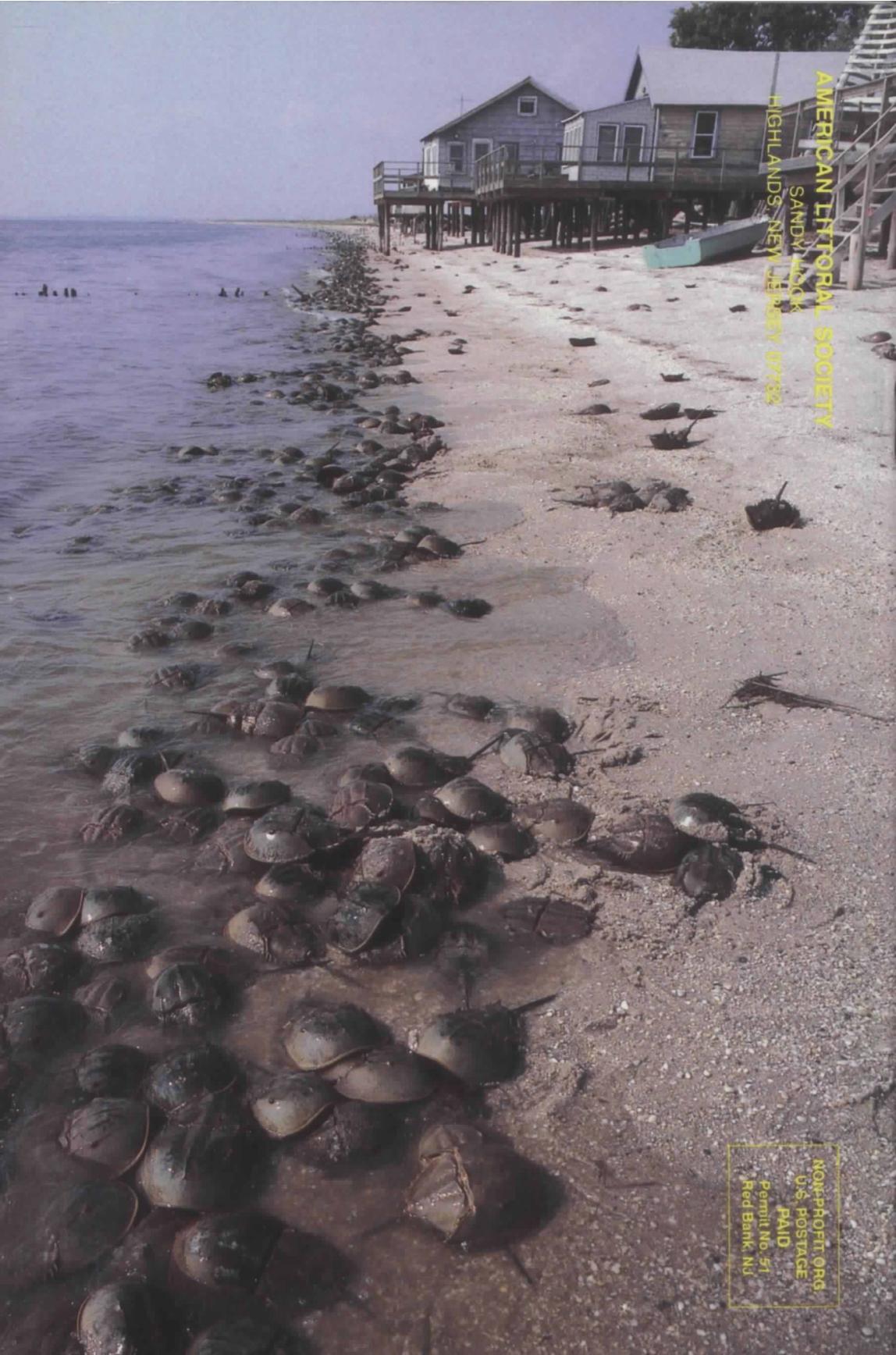
Favorite get up for a night on the town: Sharkskin suit, blue striped shirt with pearl buttons, red snappers (suspenders), bass weejuns, tortoise-shelled glasses, Rolex oyster watch, and a splash of my favorite cologne — eau de low tide. (Sent in by Wesley Snipefish.)

Best Fish Puzzle Quickies: (1) Take a letter out of this fish and it turns into a doctor. (2) Add two letters to the end of this 20th century US president's last name and it becomes a yellow wildflower seen on the ALS Maine Coast weekend field trip. (3) Take the first letter out of this old dance step and it becomes a long, squirmy fish, put another letter back on the beginning of the word and it becomes a misspelled waterfowl, and then put the original letter back on, add a letter in the front and it becomes a basket to hold fish (especially trout). Answers upside down below; don't cheat.

ANSWERS: (1) Sturgeon becomes surgeon. (2) Clintonia. (3) (Virginia) reel becomes eel, which becomes teal (sp), which becomes creel. Get all three and you win 10 pounds of ling!

D. W. Bennett





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