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Two Littoral Giants Retire from the Board

The American Littoral Society has been fortunate to have had many long-serving employees, volunteers and trustees. Among those are Bill Feinberg and Frank Steimle, both of whom recently retired from the board of trustees. Both Frank and Bill have been active with the society since its humble beginnings in the 1960s.

Bill Feinberg

Bill Feinberg joined the American Littoral Society in 1962 after reading about the society in area newspapers. Prior to joining the Littoral Society he had been active in marine environmental issues as a member of the Asbury Park Fishing Club.

In the American Littoral Society's early years Bill used his experience as a practicing attorney to assist in the writing of the society's by-laws. Later, when the society led the fight for public beach access, he frequently met with Russ Cookingham who was then the Director of the NJDEP's Division of Fish and Wildlife to further the society's goals. Bill also assisted in the creation of what would become Clean Ocean Action and Raritan Bay Keeper by reviewing and modifying drafts of agreements between the society and those organizations.

Bill has been a contributor to the Underwater Naturalist and a longtime member of the Finance Committee.

As a trustee, Bill described himself as a "watchdog," especially in regard to finances. That sentiment was echoed by fellow trustee George Kowallis, who said Bill was famous for wanting "every last penny accounted for."

Bill "was quite serious about what the society should be and always made his position unmistakably clear," George said. "I would not want to tangle with him in a Board meeting and, once again, am grateful to him for pointing out what was reality over the years."

Frank Steimle

Frank is a benthic scientist who worked in the NOAA lab at Sandy Hook until 2007. Before joining NOAA he was a lobsterman and diver who also owned a tropical fish store. He is a past president of the American Littoral Society and has worked tirelessly for the society, frequently with his wife Claire by his side.

Frank read about the society in newspapers and was intrigued by the organization's mission, which was to provide support for the Sandy Hook Marine Laboratory. So he became a member in 1965 and soon after took a job with the lab as a field tech working on artificial reefs and bottom surveys.

During those early years at the lab he also struck up a friendship with Dery Bennett, long-time director of the society. Dery convinced him to become more active in environmental and educational activities.

Over the years Frank has contributed many articles to the Underwater Naturalist and served a stint as editor of the society's scientific magazine.

Among other activities Frank led many overnight Pine Barrens trips, acted as educator for local field trips, and served as a naturalist at many annual meetings. Current Education Director Stevie Thorsen calls Frank "a wonderful educator, one of the best ever."

Frank was also part of the society's original clamming group, which included Dery Bennett and current board members Cindy Zipf and Don Abrams. He still maintains leadership of that group and continues to alert members of the group to the clamming season and its activities. Frank was also the longtime umpire for the Hutz Cup softball game and is also known as "Frank the Squid Magician" for his skill with a fillet knife at the annual Squid & Spaghetti dinner.

Luckily for the society Frank says he will continue to be involved with society activities as a participant, volunteer and expert.

Remarkably, between the two of them, Frank and Bill provided more than a century of service to the Littoral Society. We thank them for their years of hard work and many contributions.

Cover photo: Elizabeth Stoehr, assistant director of the American Littoral Society's Northeast Chapter, carries a tray of marsh grasses to a restoration site in Jamaica Bay. For more information about the American Littoral Society's numerous restoration projects, read Executive Director Tim Dillingham's article on page 21. Photo by Don Riepe.

Underwater Naturalist is the bulletin of the American Littoral Society, 18 Hartshorne Dr., Ste. 1, Highlands, NJ, 07732. It is a benefit of membership which costs $40 for individuals and $50 for clubs and schools.

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The American Littoral Society promotes the study and conservation of marine life and habitat, protects the coast from harm, and empowers others to do the same. Caring for the coast since 1961.

From the Executive Director

The marine world is full of wonders. Underlying the truly amazing multitude of forms and behaviors of marine life are the subtle, yet complex interactions of life with its habitats and the physical and chemical processes driving those. It is the diversity of the ocean and coastal environment which is its hallmark.

In this issue of the Underwater Naturalist, we explore life across a number of creatures: fish, birds, and reptiles. Our contributing authors provide us with insights into their natural history, as well as exploring the important role they play in the ecology of the sea.

The American Littoral Society has long been fascinated by the complexity of the marine web of life. The contributions of our members, well established scientists and amateur naturalists alike have filled the pages of the UN with amazing stories for many years, promoting their study and, hopefully, conservation. Like the diversity of marine life itself, its conservation is built upon a complex web of tradition, science, policy and law. The Littoral Society advocates to have this human overlay onto the ocean's life reflect and respect its ecological structures and demands as closely as possible. This has led us to seek an ecosystem based approach to the protection, use and management of the coast. We are seeking to promote ocean planning and a strong national ocean policy as well, anticipating what is necessary to insure healthy, productive oceans and coastlines, and making conscious decisions to insure those outcomes – often through the use of new approaches and tools. In addition to policy initiatives, we are restoring critical habitats along the shore to both replace lost ecological values, to serve as models for others, and to bolster the policy advocacy. Our work currently includes restoring horseshoe crab spawning and migratory shorebird stopover beaches on Delaware Bay, oyster reefs in Barnegat Bay and tidal marshes in Jamaica Bay.

At the foundation of all our work is our goal of protecting the coast, and the life found there. Our starting point is the belief that better understanding of marine life will lead to better stewardship.

Tim Dillingham

Silent Seashores

By Deborah Cramer

As the spring days lengthen, shorebirds have begun their hemispheric migrations from South America to nesting grounds in Canada's northern spruce and pine forests and the icy Arctic.

They are among Earth's longest long-distance fliers, traveling thousands of miles back and forth every year. I have watched them at various stops along their routes: calico-patterned ruddy turnstones flipping tiny rocks and seaweed to find periwinkles or mussels; a solitary whimbrel standing in the marsh grass, its long, curved beak poised to snatch a crab; a golden plover pausing on a mud flat, its plumage glowing in the afternoon sun.

I used to think that sandpipers flocking at the sea edge, scurrying before the waves, were an immutable part of the beach. No longer. This year, as the birds come north, one of them, the red knot — Calidris canutus rufa — will have acquired a new status. It is now listed as threatened under the federal Endangered Species Act. It joins four other shorebirds on the government's list of threatened and endangered species.

Sadly, it is unlikely to be the last.

As these birds make their long journeys, they face a host of threats. Whimbrels navigating through tropical storms finally make landfall in the Caribbean, only to be shot by hunters. Wilson's plovers lose their beach nesting sites to development, and their eggs and chicks to raccoons, dogs and cats, whose numbers swell as more people build along the shore. The tidal flats and inlets where knots, turnstones and other shorebirds feed are disappearing as storm surges and a rising sea eat away at the coastline.

Already the loss of shorebirds has been staggering. In the continental United States, more than half were listed on the 2014 State of the Birds Watch List, compiled by the North American Bird Conservation Initiative. Their inclusion means that their small or declining numbers put them in urgent need of additional protection. The number of North American long-distance migrating shorebirds that scientists have tracked has dropped by more than half since 1974, an alarming loss of 12 million birds.

"The number of North American long-distance migrating shorebirds that scientists have tracked has dropped by more than half since 1974"

Sightings of ruddy turnstones, for instance, are down by 75 percent. Semipalmated sandpipers are down by 80 percent in their winter home in northern South America. And in Churchill, Manitoba, the nesting season for Hudsonian godwits has been abysmal.

These sturdy birds travel thousands of miles from the Strait of Magellan to reach the west shore of the Hudson Bay in Canada. But they are now threatened by the changing climate, which, according to 2014 research led by Tufts University, presents an increased risk of extinction to nearly 90 percent of North American shorebirds. As the planet is warming, insect populations are peaking up to two weeks before the godwits' eggs hatch. As a result, many chicks end up starving.

Over the last three years, I have logged over 40,000 miles following shorebirds. Day after day I trudged across the snowy Arctic tundra, looking for ruddy turnstones that hadn't shown up to nest, and through miles of meadow where semipalmated sandpipers used to lay their eggs. On a quiet island off the coast of Georgia, I followed the delicate tracks of Wilson's plovers, whose range is contracting and whose numbers are down 78 percent. In South Carolina in 1831, John James Audubon, watching long-billed curlews flying in to roost at sunset, saw several thousand birds. I saw one, in a wildlife refuge starved of sand and disappearing into a rising sea.

About 10,000 species of birds are living today. Scientists estimate that before humans accelerated the rate of extinctions, a bird extinction might happen every 1,000 years. In my own life, at least 19 bird species have become extinct. One shorebird — the Eskimo curlew — may shortly disappear, if it hasn't already. Hundreds of thousands once flew from the South American pampas up through the Great Plains, and then back through Labrador, gorging on blueberries. The last sighting, confirmed by physical evidence, was in 1963, when I was a young girl.

We have also seen aggressive, dedicated conservation return birds from the brink. The bald eagle, peregrine falcon and brown pelican were all rescued from the ravages of DDT after the pesticide was banned, though their recoveries took 30 to 40 years. Scarcely 20 California condors were alive in the wild before a captive breeding program began in the early 1980s; it now has pushed the bird's numbers in the wild to more than 200.

It is not easy to address the complex and myriad threats that these migrating shorebirds face along a flyway that spans two continents, but many people are trying. This work involves curbing development along a congested coast; minimizing human disturbance; curtailing hunting in South America and the Caribbean; protecting habitat that is being lost to dredging, redesigning inlets and stabilizing the sea edge; conserving additional land; and finally, carrying out research to understand how a rapidly changing Arctic affects nesting.

I hope I never walk beaches empty of sandpipers and plovers. But it is possible that may happen. In the case of some shorebirds, it is increasingly likely. This is why we must commit the money and muscle needed to give these birds safe harbor. If we do, we just might keep our shores teeming with shorebirds.

Deborah Cramer, a visiting scholar at M.I.T., is the author of "The Narrow Edge: A Tiny Bird, an Ancient Crab, and an Epic Journey." The American Littoral Society led an effort to restore horseshoe habitat on New Jersey's Delaware bayshore following Hurricane Sandy. Those efforts were apparently rewarded this year with some of the best Red Knot population numbers in nearly 20 years. **Article first appeared May, 1, 2015 in The New York Times. Reprinted with permission.**

Previous page: A Red Knot in flight on Delaware Bay. Photo by Jan van der Kam from *Life on the Delaware Bay.*

Menhaden and the Need for Ecosystem Management

by H. Bruce Franklin

Menhaden are the living keystone of the marine ecology of the Atlantic and Gulf coasts. But a single corporation is now grinding that keystone into profits for a few individuals, thus tearing down the structure of marine life as we know it.

Menhaden have always been an integral part of America's history. This was the fish that Native Americans taught the Pilgrims to plant with their corn. This was the fish that made larger scale agriculture viable in the 18th and early 19th century for those farming the rocky soils of New England and Long Island. As the industrial revolution transformed the nation, this was the fish whose oil literally greased the wheels of manufacturing, supplanting whale oil as a principal industrial lubricant and additive by the 1870s. By then the menhaden reduction fishery had actually become one of America's largest industries. Overall, from the 1860s to the present, catching menhaden has been far and away the nation's largest fishery. In fact, since the end of the Civil War, more menhaden have been caught—not just by numbers but also by weight—than the combined Atlantic and Gulf commercial catch of all other finned fish put together.[1]

All these roles menhaden have played in America's national history are just minor parts of a much larger story, indeed an epic story, of menhaden in America's natural history. For menhaden play dual roles in marine ecology, one that is perhaps unmatched anywhere on the planet. And this is why menhaden are the most important fish in North America.

Menhaden are crucial to the diet of most of the predatory fish on the Atlantic and Gulf coasts, including tuna, bluefish, weakfish, striped bass, swordfish, summer flounder, redfish, and king mackerel. The great 19th-century ichthyologist G. Brown Goode exaggerated only slightly when he declared that people who dine on Atlantic saltwater fish are eating "nothing but menhaden." Menhaden are also an important part of the diet of many marine birds, including ospreys, gannets, and pelicans, and mammals, such as porpoises and whales. Right off Sandy Hook in Lower New York Harbor in the summer of 2013, I watched a humpback whale day after day filling its huge mouth with pods of menhaden. Recreational anglers and commercial fishermen know that menhaden are by far the best bait for almost all our marine carnivores. Menhaden scent is such a powerful attractant that it is sold to be sprayed on artificial lures. Bluefish, porpoises, and other predators attack in such a frenzy that they sometimes drive whole schools onto beaches. In his monumental volume *A History of Menhaden*, published in 1880, Goode expressed his wonderment at menhaden's role in the natural world: "It is not hard to surmise the menhaden's place in nature; swarming our waters in countless myriads, swimming in closely-packed, unwieldy masses, helpless as flocks of sheep, . . . at the mercy of any enemy, destitute of means of defense or offense, their mission is unmistakably to be eaten.

Eons before humans arrived in North America, menhaden evolved along the low-lying Atlantic and Gulf coasts

[2]But Goode was only half right. What he did not fathom was menhaden's other, equally stupendous mission, in marine ecology.

Where did this enormous biomass of menhaden, so crucial to the food web above it, come from? And why do all those marine carnivores go berserk in their mad lust for menhaden?

Just as all those saltwater fish are composed largely of menhaden, those menhaden are composed largely of phytoplankton, tiny particles of vegetable matter, mainly algae. For menhaden, eating is just as crucial an ecological mission as being eaten.

Eons before humans arrived in North America, menhaden evolved along the low-lying Atlantic and Gulf coasts, where nutrients flood into estuaries, bays, and wetlands, stimulating potentially overwhelming growth of algae. From this superabundance of algae emerged the superabundance of these fish—and the fish that eat these fish. Menhaden are filter feeders which depend on consuming tiny plants and other suspended matter, much of it indigestible or toxic for most other aquatic animals. Dense schools of menhaden, once numbering in the millions, used to pour through these waters, toothless mouths agape, slurping up plankton, cellulose, and just plain detritus like a colossal submarine vacuum cleaner as wide as a city block and as deep as a subway tunnel. Each adult fish can filter an astonishing four gallons of water a minute.[3] To appreciate this feat, turn on your faucet full blast and see if you can get four gallons in a minute. You won't.

These amazing creatures actually digest the cellulose they imbibe, a rare ability for fish and something nobody else can do. Terrestrial animals that digest cellulose usually have some special mechanism or modality (cows have four stomachs and chew their cud; rabbits and rats eat their own poop, thus passing the cellulose through their guts twice).

Menhadens' filter feeding clarifies the water, allowing sunlight to penetrate. This encourages the growth of aquatic plants that release dissolved oxygen while also harboring a host of fish and shellfish.

Even more important, menhaden's filter feeding may also possibly prevent or limit algal blooms. Excess nutrients can make algae grow out of control, and that's what happens when overwhelming quantities of nitrogen and phosphorus flood into our inshore waters from runoff fed by paved surfaces, roofs, detergent-laden wastewater, over-fertilized golf courses and suburban lawns, the vast cornfields of the Mississippi basin, and industrial poultry and pig farms. These devastating blooms of algae, including red tide and brown tide, cause massive fish kills, then sink in thick carpets to the bottom, where they smother plants and shellfish, suck dissolved oxygen from the water, and leave vast dead zones that expand year by year. One of these dead zones is destroying the Chesapeake Bay. The monster seasonal dead zone in the Gulf is now larger than the states of Connecticut and Rhode Island combined.

Marine biologist Sara Gottlieb compares menhaden's role with the human liver's: "Just as your body needs its liver to filter out toxins, ecosystems also need those natural filters."

"Just as your body needs its liver to filter out toxins, ecosystems also need those natural filters."
- Sara Gottlieb

Overfishing menhaden, she says, "is just like removing your liver."[4] If a healthy person needs a fully functioning liver, consider someone whose body is subjected to unusual amounts of toxins—just like our Atlantic and Gulf coasts. If menhaden are the liver of these waters, should we continue to allow huge chunks to be cut out each year, cooked into industrial oils, and ground up to be fed to chickens, pigs, and pets?

Menhadens' two great missions - eating and being eaten - are tightly interwoven in the great web of marine ecology. Why do all these marine fish and birds and mammals go berserk in their obsessive appetite to gorge on menhaden? Just like us, all those marine carnivores have to have Omega-3 fatty acids. These are essential nutrients. And

Previous page: An Osprey shows its 5-foot wingspan as it carries its menhaden prey. Photo by Don Riepe.

just like us, all those marine carnivores are incapable of synthesizing their own Omega-3. We can get Omega-3 by eating certain grains, nuts, and, best of all, oily ocean fish. Where can ocean fish get their Omega-3? Only by eating other fish that somewhere along the food web had eaten vegetable matter, mainly algae, the best source of Omega-3. Menhaden, the champion consumers of algae, are therefore their most direct and efficient source of Omega-3. To us, menhaden are unappetizing because they stink with the oils derived partly from algae. This stench is precisely what attracts all those marine carnivores, whose bodies tell them that bite for bite they are going to get more of those precious lipids from menhaden than from anything else they can possibly eat.

Both of the crucial ecological functions of menhaden are now threatened by the ravages of the reduction industry, so called because it "reduces" billions of menhaden into industrial commodities. This industry sprang up in the wake of the Civil War. By the 1870s, in Maine alone there were 20 menhaden reduction factories doing nothing but processing menhaden strip mined from Maine's waters. Rhode Island's Narragansett Bay was ringed by 13 menhaden factories. Historical records reveal that when menhaden migrated south from Maine, the vanguard would reach Cape Cod while the rear guard had not yet left Maine. Sometimes the stream was forty miles wide, with fish almost solid from the surface to the ocean floor. Although northern New England had once been the scene of the largest menhaden fishery, today it is rare to see any schools of adult menhaden north of Cape Cod. They are long gone from Maine, and lobstermen and recreational anglers have almost come to blows squabbling over the few schools that still sometimes migrate into Narragansett Bay. The present menhaden population is nothing more than a tiny fragment of the historical and natural population.

Way back in the 1870s, the destruction wreaked by the reduction industry initiated the struggle going on today on both the Atlantic and Gulf coasts. It was commercial fishermen who led this struggle, because the reduction industry was destroying their livelihood. The commercial fishermen rioted and burned down at least one, and maybe two, of these factories. Finally in 1879 they forced the Maine legislature to pass a law banning the reduction industry. But it was too late. The fish were gone.

The story repeated down the coast as state after state saw their marine ecology wrecked and, too late, banned the reduction industry from their waters. Imagine how much damage the industry had to inflict to create the political will to pass these laws and regulations. Back in 1882, the New Jersey legislature passed a law outlawing the reduction industry from state waters, but it was vetoed by the governor. It was not until 2001 that New Jersey passed such legislation, almost identical to that bill vetoed by the governor 119 years earlier. By then all the gigantic oceanic schools were long gone, converted by the reduction industry into feed for pigs, chickens, dogs, and cats, fertilizer, industrial oils and other commodities.

Those last great schools were destroyed after World War II when the reduction industry acquired surplus World War II ships, outfitted them with modern electronics, and used airplanes to spot the schools as far out as 50 miles offshore. I was fortunate enough to find and interview Hal Watters, the menhaden industry's first spotter pilot. Watters, who had been a youthful fighter pilot during the Second World War, began that job in 1946 and continued until 1980, pioneering many of the techniques still used in the fishery.

Locating the schools no longer depended upon the sharp vision of a lookout in the crow's-nest of a ship wallowing amid the ocean's waves. A spotter plane, canvassing huge areas at relatively high speeds, could quickly spy schools that ships would not have encountered. For the first time, menhaden's oceanic spawning was seriously endangered.

In the early postwar years menhaden sometimes still filled the seas. Watters vividly remembered as late as 1960 a spectacular example of the wholesale slaughter. He spotted a school about "five city blocks in diameter" and "dragging mud in 125 feet of water," that is, solid all the way from the surface down to the seabed 125 feet below. "I couldn't believe they could destroy a school that size," he said, but boats managed to surround and annihilate the entire school. After 1960, he observed that the schools kept getting smaller and smaller.

The peak year for the Atlantic menhaden industry was actually 1956. By 1967, the catch was already just half what it had been merely nine years earlier. When I interviewed Watters in 2000, he summed up the tragic story: "The industry overfished their own fishery and they destroyed it themselves. And they're still at it." Referring to himself and the other spotter pilots, he said, "We're the worst culprits," because the airplane meant that "the menhaden had no place to hide."

By the end of the 20th century, the population and range of Atlantic menhaden had virtually collapsed. The estimated numbers of sexually mature adult fish had crashed to less than 13 percent of what it had been just four decades earlier.[5] For a picture of the crash, see the graph derived from the official 2009 stock assessment. As the population of menhaden plummets, the industry continues to fish itself virtually out of existence. In the Atlantic over a hundred companies have been reduced to a single company - Omega Protein - with a total coast wide monopoly. In the Gulf, Omega has just two small competitors. Menhaden managed to survive centuries of relentless natural and human predation. But now there are ominous signs that we may have pushed our most important fish to the brink of an ecological catastrophe.

By the end of the 20th century, the population and range of Atlantic menhaden had virtually collapsed.

Until 2013, the only protection for menhaden came from individual states. On the Atlantic, every state

Facing page: A large school of menhaden feeds along the surface waters off Rockaway Beach, New York City. Photo by Don Riepe.

but Virginia now bans the fishery in its state's waters. In the Gulf, Florida bans the fishery. In Texas, the late John Parker, a wonderful gentleman on the Texas Parks and Wildlife Commission, handed out copies of *The Most Important Fish in the Sea* to his fellow commissioners and in 2008 got the Commission to restrict the industry in Texas waters. But in Louisiana, Alabama, and Mississippi the slaughter goes on with no restriction whatsoever. The Gulf States Marine Fisheries Commission, which should be regulating the fishery, instead behaves like a whore for the industry. In fact the GSMFC's website reads like an advertisement for the reduction industry.

Its counterpart on the East coast, the Atlantic States Marine Fisheries Commission was for seven decades also under the control of the industry.[6] Finally in 2013, the ASMFC for the very first time established a very feeble and timid coast-wide quota on menhaden landings.

As for the federal government, it has never done anything whatsoever to protect menhaden. The waters of every state except Texas extend out only three miles from shore. Beyond that, out to 200 miles, is the EEZ - the Exclusive Economic Zone - under federal jurisdiction. In the Atlantic, that is where the surviving schools of adult spawners are being scooped up by Omega Protein. With a stroke of a pen - or rather a few clicks of a keyboard - NOAA (the National Oceanic and Atmospheric Administration) could put a stop to this carnage.

But all federal agencies charged with fishery management, including NOAA, have always been part of the Department of Commerce. So despite a lot of recent lip service to ecosystem management, the goal has always been profits, not a healthy marine environment. The holy grail of modern, supposedly enlightened, fishery management is "Maximum Sustainable Yield" (MSY) for each species. And each species is "managed" as though it were all alone in a gigantic tank with all the food it needs and with no interrelationships with any other species.

Because most people have so little knowledge of the marine environment, I tried for a long time to imagine a terrestrial analogue for what Omega Protein is doing. Suppose there were a single company that had developed a pheromone that was attracting all our bees and was then grinding them up and turning them into an industrial commodity—say an aphrodisiac. Terrestrial harvests and horticulture would be failing. Would we allow this to continue or would we outlaw the industry?

So then why are we continuing to allow the menhaden reduction industry to turn the most important fish into industrial commodities, thus devastating our marine environment?

H. Bruce Frankiln is the John Cotton Dana Professor of English and American Studies at Rutgers University-Newark. He has authored or edited eighteen books as well as written articles for many magazines and journals including Science, The Atlantic Monthly, Discover and The New York Times.

Terrapin Shell Game

By Russell L. Burke

If you're a northeasterner fond of reptiles and you spend time near the ocean, the only object of your affection you're likely to see is a diamondback terrapin. Other reptiles are out there to be sure, but nothing else is nearly as common. I grew up in the Midwest and moved to New York. Terrapins drew me to the ocean in 1998, and I've been returning for terrapins every summer since.

Terrapins have always been popular turtles; their populations were nearly decimated range-wide in the 1700-1800s when they were harvested in huge numbers, particularly for turtle soup. Terrapin populations started recovering after the collapse of the soup industry, until large-scale coastal urban development caused massive habitat losses in the 20th century. Despite some recovery, terrapin numbers are still declining throughout their range because of mortality as by-catch in commercial crab traps, ongoing habitat loss, road crossing mortality, and nest predation. As a result, they are protected to some extent in most of the states they inhabit.

Terrapins are medium-sized turtles (females 7-9 inches long, males 4-6 inches long). Unlike their freshwater relatives, terrapins live in the narrow brackish water strip along the ocean coast, from Massachusetts to Texas. They can only be found where either Spartina marshes or mangrove marshes occur. Terrapins have a number of adaptations to salt water, but they are not as tolerant of salt water as true sea turtles. Unlike sea turtles, terrapins rarely go into the open ocean, and they don't make long migrations like sea turtles; instead, terrapins spend their whole lives fairly close to where they hatch. They spend a lot of their time in Spartina or mangrove marshes, because that's where they feed (snails, crabs, clams), bask, and overwinter.

As with many species, one of the main issues regarding the conservation of terrapins is reliable estimates of population sizes and trends. We can't know if they're doing okay unless we know how many there are. Most of what we know about their populations comes from long-term mark-recapture studies, including one my team conducts at Ruler's Bar (an island in New York's Jamaica Bay). The work is just like it sounds - we catch terrapins, we give them permanent marks, then let them go unharmed. Each time we catch them again, it tells us something about their survivorship and movements. Even catching unmarked individuals from the same population is helpful. Data are analyzed using mathematical models, and they produce an estimate of the total population size of marked and unmarked animals. The longer the project runs, the better our population estimates become.

There are about 25 other similar teams counting terrapins elsewhere in the range (nine here in the northeast). But it's a lot of work each year capturing enough terrapins at each of these sites to be able to determine whether populations are increasing or decreasing. It's a truly daunting task to repeat mark-recapture efforts over the 3500 miles of terrapin habitat. For example, I work with an ever-changing crew of 30-50 volunteers who are mostly college students. Every summer during June and July, we patrol a one mile stretch of beach every 15-60 minutes. We look for nesting female terrapins from dawn to dusk. Females are allowed to finish nesting, then are captured, marked, measured and released. As a result of that effort we have a pretty good idea about the population of terrapins that nest on the west side of that one island.

Other terrapin researchers go boating to catch terrapins. They sometimes set fyke nets at the mouths of marsh channels, or they drag nets through the channels, or they use baited traps. Traps and nets capture both females and males. But none of these mark-recapture approaches allow us to say with much confidence what's happening with terrapins elsewhere across the range, just in those few well-studied locations where we sample intensively. These projects have allowed us to determine that in some places, like Jamaica Bay, populations are fairly stable. Other places in the northeast have been collecting population data, but have not yet analyzed it. As a result, we don't know what's happening with their terrapin populations. However,

Facing page: Terrapin are basking on an algea pad. Photo by Russell Burke

where crab trapping is common, such as in southeastern states, terrapin populations are crashing because terrapins drown as by-catch in crab pots. These findings have been valuable because they help build the case that terrapin excluder devices are needed on crab pots to keep the terrapins out. So, regular censuses of terrapin populations can give us very useful information, which is important to their conservation.

In the last several years, two new terrapin censusing techniques have started to become popular. These might make counting terrapins much easier. One of the methods uses the existence of the small parasitic trematode Pleurogonius malaclemys (it doesn't have a common name). As an adult, this little trematode only infects terrapins. The parasite's juvenile stages, however, infect a common terrapin prey, the eastern mudsnail. One of the juvenile stages is a pinhead-sized cyst that lives on the outside of the snail, waiting for the snail to be eaten by a terrapin. Mudsnails are easily collected along the beach in low tide. The abundance of these cysts varies with the size of the local terrapin population, which makes it possible to arrive at a good estimate of the number of terrapins nearby by counting cysts on easily collected mudsnails. This census costs almost nothing and is very quick, making it ideal for anyone to use.

A diamondback terrapin makes its way through a tidal estuary. Photo courtesy the Davidson College Herpetology Lab.

However, many questions remain:

How far do the trematodes disperse from the terrapins?

How big is the range of the trematodes and do they occur as far north as the terrapins?

How well do the cyst counts really match the local terrapin populations?

We've been exploring these and related questions here in New York since 2011. This year my colleagues and I started a pilot program to get other citizen scientists (the youngest is only 12!) to try out this new technique on beaches all over the northeast. We can envision terrapin censuses through cyst counts being done annually by middle school and high school classes over much of the terrapin range. Such counts result in high quality data on terrapin numbers in many areas, which at the same time engages many more young people in marine science.

The other "new" terrapin censusing technique uses the fact that turtles love to bask in the sun, especially in the spring. Most people don't see terrapins basking because terrapins usually sun themselves in the Spartina marshes where they live, and it's not easy to see them unless you're in the marsh. Kayakers and canoeists can get into the network of channels that flood and drain marshes with each tide and they can often see terrapins basking and swimming. Several researchers have used standardized kayak routes, counting terrapins seen along the way, and compared the counts to the number of terrapins known to be in the area using more traditional techniques. They have found that visual surveys do a good job of estimating the number of terrapins, at a fraction of the time and cost of mark-recapture studies. Given the popularity of ocean kayaking and canoeing, I can envision organizing citizen scientist teams to make regular visits to marshes all over the terrapin range, following standardized routes, and counting terrapins.

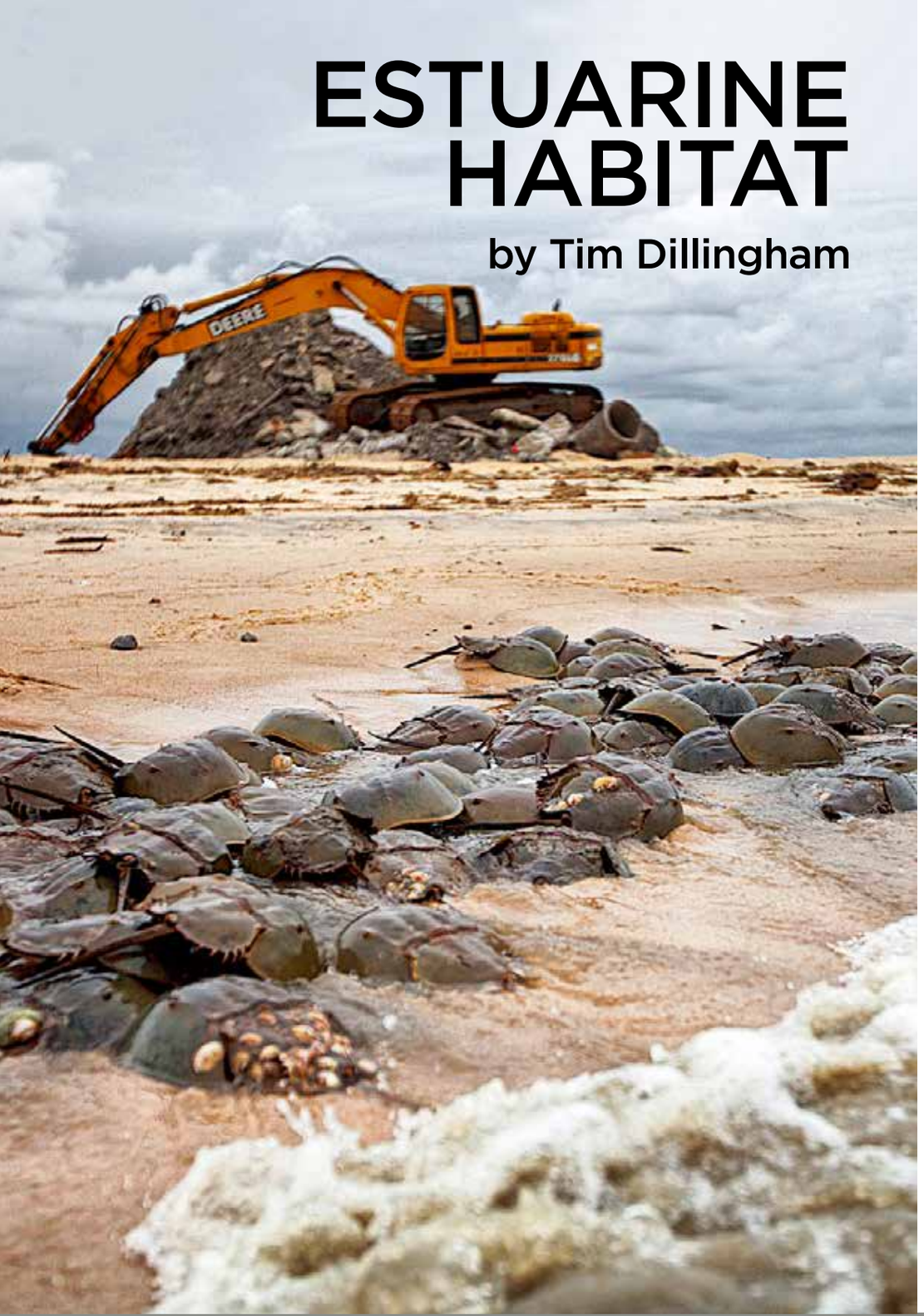
Over the next two years we will be trying out these techniques here in New York, conducting the first real census of diamondback terrapins for an entire state. New York is home to roughly 1355 miles of potential terrapin habitat, more than any other state in the northeast. This is more than a third of the terrapin habitat between the Delaware River and Cape Cod, making it a good model for the rest of the range. However, because they only live near Spartina salt marshes, New York terrapins only occur around Long Island, the lower Hudson River (at least as far north as Piermont Marsh, river mile 25), and the Hudson River Bight. Four terrapin populations in New York have been studied with mark-recapture techniques, which allows us to estimate their population sizes based on those methods. We will couple these estimates with surveys using mudsnail cyst counts and visual surveys via kayaks throughout suitable New York habitat. The result should not only be a good estimate of how many terrapins we have, but also a good test of these new techniques and increase data collection.

To help or learn more, call the Littoral Society at (732) 291-0055.

Russell L. Burke has worked at Hofstra University in New York since 1996, and is now a Professor and Donald E. Axinn Distinguished Professor in Ecology and Conservation. He has run a citizen science program involving research on diamondback terrapin in Jamaica Bay, New York since 1998, and has published several scientific papers on this population.

ESTUARINE HABITAT

by Tim Dillingham



The essence of estuaries is found in their habitats: salt marshes, eel grass beds, fish runs, mudflats, and mangroves. These habitats are the places where plants and wildlife live and create the web of life which makes estuaries extraordinary. In estuaries, soil, nutrients, and water combine in a special way to nurture marsh grasses, sea grasses, and other types of vegetation. At first glimpse, these habitats might appear to be very simple and insignificant, but they provide creatures with shelter and food. By nurturing this bounty of life, habitats make estuaries the ecological, cultural, and economic powerhouses that we treasure.

Unfortunately, much of our estuary habitat has been damaged and destroyed over the past 100 years with little regard for its many benefits. When estuary habitats are paved over, polluted by runoff, or lost to coastal land subsidence, it cripples an estuary's ability to support life. When a salt marsh is filled, it can no longer filter sediments and pollution from run off. When pollution destroys eel grass beds, young fish and shellfish will no longer be able to hide and feed in its shelter. In these little ways, habitat loss has accumulated to threaten the health of our nation's estuaries. – Restore America's Estuaries, 2015

The American Littoral Society is committed to not letting the story of America's estuaries end this way: habitat can be restored. We are undertaking a series of projects intended to restore and enhance horseshoe crab spawning beaches used by migratory shorebirds that were destroyed by Hurricane Sandy, reestablish connections between the ocean and tidal estuaries that were spawning waters for endangered river herring and other fish, rebuild tidal marshes in the heart of New York City's Jamaica Bay, and finally we are rebuilding an oyster reef in Barnegat Bay.

Each of these projects responds to a real, on-the-ground habitat need. They are also part of larger efforts to restore and protect the estuaries they occur in on a comprehensive level, often reflecting strategies in established restoration plans. In each of the project areas, we work with partners from the federal, state and local governments. We extensively involve the communities surrounding the project sites: they are often the most immediate beneficiaries of the work as wildlife returns to their backyards, and restored beaches and marshes provide storm protection to the adjacent homes and businesses.

Unfortunately, much of our estuary habitat has been damaged and destroyed over the past 100 years with little regard for its many benefits.

The scale of the challenge of restoring America's estuaries is immense. Part of the design of our restoration work aims to share the knowledge about what works, and what doesn't as broadly as possible. We are monitoring the work, and the biological responses to it – how well the wildlife

likes it, so to speak. We share this information through a variety of platforms, in the hopes that others can learn from it, and perhaps apply it to other challenges and other estuaries.

Hurricane Sandy brought the issue of resiliency to the forefront of conversations about the coast. In our work along the Delaware Bay, we describe the effort's linkages to resiliency through its impact on the ecology of the Bay, the economy of local communities linked to nature based industries, and the safety of local communities. There is increasing recognition of the value of coastal natural features such as dunes, beaches and tidal marshes in mitigating storm damages, and this is making its way into the designs of community recoveries. The Society participates in many of these forums (having been displaced by the storm ourselves), and advocates for the inclusion of habitat restoration at every turn.

The final chapter has not been written on America's estuaries, and we see great hope in estuarine restoration. As we learn from our experiences in the mid-Atlantic, and engage with others working on coastlines around the county, we envision the work expanding: within the Society, and within the region.

Previous page: As part of their annual spawning ritual, horseshoe crabs congregate on New Jersey's Moore's Beach during the American Littoral Society's habitat restoration efforts following Hurricane Sandy. Photo by Ryan Hill.

This page: Volunteers plant spartina grass at Black Wall Marsh in Jamaica Bay. Photo by Don Riepe.

Chasing Terns

The Distinctive Inca Tern

By Dave Grant

The most unique tern is found off the coast of South America. My fascination with the Inca tern (Larosterna inca) began while admiring the color plate paintings of the guano island bird colonies in Robert Cushman Murphy's classic *Oceanic Birds of South America*. He begins his essay with: "The coral-billed Inca Tern is the most outstanding example of an endemic bird in the Humboldt Current region. So distinctive is it from its closest relatives elsewhere that no one knows just what these may be.... The moustache- like tufts of feathers projecting from the angle of the mouth in this gray-bodied, red-billed tern distinguish it from all other species."

Years ago I was excited to catch a glimpse of a single Inca tern flying past our ship while we docked in Callao, Peru -- where the bird's unique head plumes has earned it the name "Zarcillo" (Ear-ring). It quickly disappeared among a flight of tens of thousands of seabirds almost obscuring the setting sun. These guanayes comprise the colossal flocks of cormorants, boobies and

Eight years later, boarding a research vessel farther down the coast in Arica, I was delighted to discover that the dock was occupied by these striking birds the Chileans call "Monja" (Nun). By good fortune our departure to sail for a month-long study of the Humboldt Current was delayed for three days, which allowed for some great tern-watching right at the wharf. Research vessels routinely accommodate scientists from any territorial waters that are to be visited, but to board, everyone needs a negative tuberculosis test. (Scuttlebutt from the crew: "Everyone in South America tests positive for TB!"). While the university scrambled for replacements, I was able to engross myself in a quick study of Inca terns.

Rather than an array of signal pennants adorning a cruise ship, we were regularly draped in Inca Terns, and after sunset the ship became festooned with Monjas. Checking the mooring lines at night I realized the hawsers

had become a preferred roost for the terns. Rare elsewhere, and like many coastal seabirds, its population having plunged from millions to thousands, it is still commonly seen along the "Inca coast" from Chile to Ecuador. And to my delight, as each hour passed, the charming Monjas were becoming increasingly plentiful on the ship, greatly outnumbering every other bird in port.

Unlike some anxious researchers onboard, I thoroughly enjoyed our delay and my nights with the terns. The ship had two lines each at the bow and stern and they behaved differently under the strain of the surging tide and ground swell in the harbor -- the outer lines stretching more, less gracefully, and occasionally shuttering.

Unlike perching birds, such as robins, seabirds are flat-footed and can't grip a perch; so not surprisingly, the terns were most crowded on the thick inner hawsers at each end. This seemed to facilitate a hierarchy in the arrangement of the birds on their night roost. About 75% of each group was adults (with their fancy plumes and dark coloration), however they were not distributed randomly. All of the birds on the inner lines were adults, and the immature birds (brown, "clean-shaven" and with less colorful bills) were relegated to the less suitable outer lines.

Previous page: Inca Tern. Photo by Kitty Terwolbeck.

Inca Terns roosting. Photo by Olaf Oliveiro Riemer.

I monitored them for many hours and the whole group regularly would take off, even if only a few were disturbed. They would circle out over the harbor, squawk a bit, and then return to sort themselves out at the lines. Adults would jockey for space by hovering and vocalizing over the juveniles and making a few stabs with their bill. I never saw young birds dislodge adults.

During the day I also noticed courtship behavior between some of the terns. This involved catching an anchovy and offering it to a prospective mate. At one point before it was too dark, a gull wandered across the parking lot and was immediately dive-bombed and chased away (More typical tern behavior near colonies).

I speculated that there may even have been birds on eggs inside the few select hollow openings in the wharf since individual birds stationed themselves at the dark entrances, defending them from others attempting to land there. This was confirmed a month later when we returned to port and the adults were much more active, returning with food and feeding fledglings.

Indeed, consulting Murphy's descriptions when I returned home, it confirmed that Inca terns nest in a variety of sites, including cavities and crevices; and that they have a wide breeding season, perhaps throughout the year. So the wharfs at the port of Arica provide suitable habitat for Inca terns, and the availability of food, rather than the season could be the determining factor in their breeding cycle. This flexibility could be an advantage during El Nino years when forage fish populations are depleted; so hopefully, the charismatic little flying nuns have a secure future.

This is an occasional feature about the various terns Dave Grant has encountered during his many travels to the far reaches of our planet. In this issue he recalls his encounters with Inca terns in Peru.

Dave Grant is the founding director of Brookdale College's Ocean Institute at Sandy Hook, from which he is recently retired. These days, while not searching for seabirds, he is involved with various organizations, such as the American Littoral Society, which are addressing climate change issues. Grant has been the chief naturalist for the Littoral Society and long-standing contributor of articles for the Underwater Naturalist. His travels have taken him to the far ends of the globe.

You are invited to support the wildlife restoration efforts through Friends of South Georgia Island at www.fosgi.org

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Monarchy in Distress

Disturbing Trends in the Viability of Monarch Migration

By Rick Cech

Even among those who do not observe nature on a regular basis, is there anyone who has not seen a monarch butterfly? Or marveled at its bright, designer-like color patterns and graceful, buoyant flight? Undoubtedly, this large, orange-and-black insect is the most widely recognized butterfly species in the United States. It has been suggested as a candidate for the United States' national insect.

The monarch is also the most extensively studied butterfly species scientifically, in large part because of its dramatic annual migration, in which monarchs from the eastern United States (a population referred to as eastern monarchs) stream southward each fall, by the tens of millions, to overwintering areas in the central Mexican state of Michoacan. In the spring, progeny of the overwintering colonists return north, in a series of generations, re-populating the eastern United States and southern Canada. (A separate migration pattern occurs in another population, the western monarchs, but more on that below.)

Since monarchs cannot withstand winter cold in the North, it is necessary for virtually the entire continental population to withdraw each year. In some warmer areas of the world (such as the neotropics and southern Florida), monarchs do not migrate, but rather form sedentary populations that dwell in specific localities throughout the year.

While seasonal movements have been documented in some other temperate zone butterfly species, the monarch's yearly cycle stands apart in terms of its scale, broad geographical range and cyclical regularity. Amazingly, entomologists did not locate the Mexican overwintering sites in the neovolcanic mountains west of Mexico City, until 1976. Before that, the monarch's overwintering behavior was highly uncertain, and many believed they overwintered as pupae. Careful records of overwintering populations and behavior have been maintained since the colonies were discovered, and much research has been conducted to determine the conditions required for colony viability.

The distressing current news, however, is that in 2014, less than 30 years after the original discovery of the overwintering sites, the number of monarchs migrating south has plummeted, by an estimated 90 percent among Eastern monarchs, and grave concerns exist as to the viability of the monarch's celebrated migratory behavior. In August, 2014, a group of conservation organizations filed a petition with the U.S. Fish and Wildlife Service to confer Endangered Species status on monarchs. Much like the Passenger Pigeon in an earlier century, we now see a revered and once abundant migratory species teetering on the edge of a highly uncertain future.

In order to understand the forces at work in this steep decline, let us begin with a review of some basic facts about monarchs and their biology.

Opening page: A monarch perches on a sunflower in Lacreek National Wildlife Refuge in South Dakota. Photo by Tom Koemer, USFWS.

Facing page: Monarchs congregate near a stream in Michoacan de Ocampo, Mexico. Photo by Pablo Leautaud.

About the Monarch

The monarch is a relatively large member of the Nymphalid family (wingspread about 1.8-inch, wingtip to wingtip). It is one of three butterfly species in its genus (Danaus) that reside in the United States, along with queens and soldiers (both of which are essentially sub-tropical species that lack the monarch's broad geographical distribution on the continent).

The monarch and its relatives are referred to collectively as Danaids, or milkweed butterflies. All share a specialized lifestyle, centered on milkweeds (Asclepias). The sap of these showy plants consists of a thick, milky latex, laced with toxic cardiac glycosides (particularly cardenolides). These steroidal chemicals originally evolved to deter herbivores. Eating them induces retching and, in large doses, disruption of heart function. But Danaid caterpillars have developed immunity to these toxins, and indeed are able to sequester them in their own bodies, rendering them unpalatable to predators. This toxicity is passed along during metamorphosis to the developing adult, where it concentrates in body areas typically targeted by predators, such as the exoskeleton and abdomen.

While the monarch undoubtedly was familiar to all inhabitants of grassland areas in the eastern United States throughout history, from Native Americans to European colonists, the species did not always go by its current name (i.e., the monarch *Danaus plexippus*). Before 1800, it went under the scientific name of Anosia archippus. Similarly, a variety of common names were used over time, including web-footed danay, storm king and king billy. The modern name

of "monarch" was first published in 1874 by Harvard entomologist Charles Scudder, who is generally credited with having coined the term (although it may have had earlier origins in folk vernacular).

The Monarch's Lifestyle and Seasonal Migration

Entomologists study the eastern monarch as a biologically distinct population. In early spring, we can find these butterflies overwintering in forests of oyamel fir (Abies religiosa), concentrated on a dozen or so high peaks in the neovolcanic mountains of central Mexico (part of the east-west Transverse Neovolcanic Belt), at altitudes between 9,000 and 11,000 feet. They thrive in the humid environment produced by damp clouds that frequently enshroud their habitat.

Beginning in February, overwintering adults begin flying northward from the colony, to mating territories in northern Mexico and Texas, where they produce the first monarch generation of the new season. Then, in a series of successive generational "leaps," emigrant populations recolonize the East. Unlike the fall return migration, which can be highly concentrated, however, the spring repopulation is gradual and inconspicuous, more like a rising tide than a surging cascade.

The timing and abundance of this northward emigration depends on a variety of ecological factors. In "good years," when northern Mexico and Texas are relatively moist, with moderate gentle rainfall, northbound monarchs may have a comparatively easy time locating suitable food plants (milkweeds) and producing interim broods. In drought years, by comparison, or in years with cold or persistently stormy weather, the way north may be fraught with obstacles. As with all North American migrants, moreover, from songbirds to dragonflies, the destruction of traditional stop-over habitats by human developers has been a source of increased population stress.

When it is time to breed, male and female monarchs mate by joining the tips of their abdomen. The male passes a sac (called the "spermatophore") to the female, which contains sperm cells plus nutrients which improve her fitness as she prepares to produce eggs. Monarch eggs are small, light spherical bodies with tiny ribs, placed singly on the underside of a milkweed leaf. First-cycle caterpillars emerge quickly (3-5 days) and begin to feed on the host plant leaves, already absorbing toxic cardiac glycosides. Females tend to favor plants with medium toxicity (neither too high nor low).

The monarch's caterpillar (or larval) stage lasts about 9-15 days, during which time its body size increases dramatically, by some 2,000 times! The result is a gaudily colored caterpillar, 1-2 inches long, with yellow, black and white zebra stripes and black, antenna-like structures extending from the head and rear. With its larval growth complete, another 9-14 days are spent in the smooth, green chrysalis, before the next-generation adult emerges to carry on the process.

Facing page: Monarchs cluster for warmth at sunset on the leeward side of a pine tree at Cape May, NJ. Photo by Don Riepe.

The conspicuous colors of the monarch's four life phases, from caterpillar to adult, are not a matter of coincidence. The visual displays presented by toxic organisms are often highly eye-catching and memorable, which allows predators to associate their distinctive appearance with the implicit message, "don't eat me if you want to feel well afterwards." In a series of famous scientific studies conducted by Lincoln Brower and Jane van Zandt in the 1950s, Blue Jays quickly learned from experience to avoid monarchs and similar-looking butterflies. (Brower, a leading monarch expert, has referred to these studies as "The Case of the Barfing Blue Jay.")

During the summer, eastern monarchs produce between one and four broods at northern latitudes (depending on date of arrival). Adults from these "summer broods" have comparatively short lifespans, typically from two to six weeks. The final, migratory generation, produced from August onward, is very different. Migratory adults are born sexually immature (in "reproductive diapause"), a condition which persists until the following spring. In addition, adults in the migratory generation weigh more, having the capacity to accumulate fats and lipids in their bodies, which fuel their long journey. In addition, their forewing shape is somewhat more elongate, forming one of nature's most efficiently conformed gliding organisms, able to conserve strength by riding tailwind currents or staying aloft on rising, warm air "thermals."

Facing page: Monarch feeding on swamp milkweed near Sand Lake, National Wildlife Refuge, South Dakota. Photo by Tom Koerner, USFWS.

Even more amazing is the fact that the migratory generation of eastern monarchs emerge with the capability to navigate over broad expanses of geography, at a level comparable to birds, using an internal "time-compensated sun compass," and possibly additional mechanisms as well. This capability allows them to pursue a comparatively direct and purposeful itinerary, over as much as 2,000-3,000 miles, from summer breeding grounds to Mexican mountain roosts. Along the way, coastal observers along the Atlantic shore may observe large roosting "creches" of monarchs that form each evening as the sun wanes.

Survival on the Wintering Grounds

Even before the recent, sharp decline observed in overwintering Eastern monarch populations at their Mexican mountains retreats, survival during the winter was treacherous for migratory adults. For one thing, a number of natural enemies of the monarch are found in concentration at the wintering sites.

Two species of birds, among dozens found in the roosting areas, have found different means of circumventing the monarch's chemical armor. One, the Black-headed Grosbeak (Pheucticus melanocephalus), has developed biological tolerance for moderate levels of monarch toxin. It feeds in cycles, visiting colonies to feed before taking a "time out" to let toxin levels subside. Grosbeaks may take advantage of the fact that individual monarchs can vary significantly in toxin loads; apart from simple differences among individuals, based on caterpillar feeding history or other factors, females are known

to contain 30% more toxin than males (but they also are more nutritious, so there may be something of a trade-off here from the grosbeak's perspective). Also, by the end of the winter toxin levels may have diminished in many individuals naturally, allowing grosbeak predators a greater entree.

On a different tack, the Black-backed Oriole (Icterus abeillei), cannot tolerate cardenolides, so this species instead picks its monarch prey apart, avoiding the toxin-laden cuticle in favor of less poisonous muscle and abdominal tissue. Together, these two avian predators may consume as many as several million monarchs each winter, or between 7 and 44 percent of the entire population. They are able to forage most successfully in small

clusters (where a comparatively large number of individuals is accessible along the surface), a factor which may lead to increased average sizes in winter roosts.

Another winter monarch enemy is the black-eared mouse (Peromyscus melanotis), the only mammal known to successfully exploit overwintering monarchs for food. The mice prey on monarchs near the ground (including those recently deceased from other causes), and may account for 4-6 percent colony mortality.

Weather is another source of threat to winter monarch colonies. Rainy cold fronts that descend periodically on the oyamel forests from the north can drench roosting monarchs, and when followed by clear, cold skies, roosting butterflies can be cold-stressed or frozen to death. And while dense oyamel fir stands provide significant protection in such inclement conditions, illegal logging in recent years has significantly thinned the forests, thus exposing monarchs to greater hazard. (Large-scale illegal logging has been curbed in recent years, but low-intensity logging continues in and near the monarch preserve, which may pose continuing threats.)

Among the monarch's serious enemies is a Danaid-specific protozoan parasite – Ophryocystis elektroscirrha (or "OE" for short). The OE parasite exists in the environment in highly durable spores. When these spores come in contact with a monarch (especially when ingested by monarch caterpillars when encountered on milkweed leaves), they open into the single-celled protozoan stage, which infests the monarch's abdomen.

It then feeds on body tissues before burrowing out through the cuticle and forming more spores, which can be dropped onto nearby hostplants or transported for long distances by adult "carriers." monarchs infested with OE may be deformed or stunted, and many die before ever emerging as adults. Infested monarch rearing facilities (such as those established to ship monarchs by mail for release at wedding ceremonies or the like) have the potential to greatly escalate the incidence of this extremely harmful protozoan. Spores can pass among overwintering adults at Mexican roost colonies.

Monarch Threats Away from the Wintering Grounds

As invertebrates, monarchs, have prodigious reproductive capacities. Yet dwindling numbers in recent years offer credible grounds for concern. Along with weather and habitat disturbances, which can be exacerbated by loss of habitat and the vagaries of climate change, another source of threat has been cited in recent years: widespread use of herbicides containing glyphosate, the principal ingredient in Roundup, in conjunction with the planting of genetically modified, glyphosate-resistant food crops (such as corn and soybeans).

Across the U.S. Midwest, corn and soybean fields have been a "breadbasket," both for agricultural production and for eastern monarchs; it has been estimated that as recently as the late 1990s, about half of the overwintering monarchs in Mexico began life on milkweeds growing in Midwestern agricultural fields. When used persistently, glyphosate is lethal to milkweeds. According to a recent Center for Food Safety report, the number of acres treated with glyphosate has increased from 17 million acres (in 1995) to 157 million acres (in 2013), and the incidence of milkweeds in agricultural fields has decreased by 99% since 1999.

The use of genetically modified plants with associated herbicides may escalate in the near future, as many agricultural "pest plants" have developed tolerance for Roundup (milkweed not included), leading to the development of still more powerful herbicide-and-resistant-crop combinations. Very recently, the International Agency for Research on Cancer released a study which concluded that glyphosate is "probably carcinogenic to humans" and linking it to non-Hodgkin lymphoma in farmworkers; both assertions are strenuously denied by the manufacturer.

California Monarchs

So far, we have discussed only the eastern monarch. There is also a smaller, largely segregated western monarch population that breeds west of the Rocky Mountains and winters at Pacific coastal locations. Less population decline has been observed in this population to date than with Eastern monarchs (50 percent versus 90 percent, according to a recent report). Among the stresses that may affect this population is the prospect of continued, unremitting periods of drought in western states.

Conclusion

The monarch butterfly almost surely will not become extinct as a species anytime in the foreseeable future. Sedentary populations exist in various warm locations around the world, which do not evidence signs of severe population stress. What is at stake presently is the viability of temperate zone populations (the eastern and western monarchs). Also at risk is the more subtle, but important "threatened behavior" of mass monarch migration. Could eastern monarchs exist as a population if their current migratory structure collapsed? That, of course, is difficult to say, but it is a possibility we should not be eager to explore.

An active field naturalist, author and photographer, Rick Cech is an affiliate curator at the Yale Peabody Museum of Natural History in Entomology. He is the principal author and photographer of Butterflies of the East Coast: An Observer's Guide (Princeton, 2005), and wrote A Distributional Checklist of the Butterflies and Skippers of the New York City Area. Rick co-authored the National Audubon Society Regional Guide to Florida. His recent works include editing and photography for the iApp Audubon Butterflies - A Field Guide to North American Butterflies, and development of the FoldingGuides regional butterfly series.

Editor's note: Healthy, natural coastal dune plant communities can be critical to migrating monarchs passing through New Jersey, as they host food plants favored by the butterflies. Likewise, the American Littoral Society recently planted a pollinator garden in Hopewell Township, NJ that includes milkweed plots for monarchs. The garden is part of a grassland project designed to create a riparian buffer zone that will reduce the amount of agricultural fertilizer getting into a nearby waterway.

Cod

A Biography of the Fish That Changed the World

By Mark Kurlansky

Reviewed by Pim Van Hemmen
Assistant Director
American Littoral Society

Most of us have eaten cod, either at home, in a restaurant or as part of our fish and chips.

But how many of us know that this supposedly most boring of all fish allowed the Vikings to cross the ocean; is 70 percent protein when dried; and in the middle of the 20th century caused Iceland and Great Britain to come to physical blows, with Iceland winning all three fights?

These are just some of the many fascinating facts revealed in Mark Kurlansky's 1997 book.

Kurlansky takes the reader on a thousand year journey with Vikings, Basques and Newfoundlanders, and to all the countries whose economies and residents were dependent on cod. And there were many.

Along the way Kurlansky educates us about people like Clarence Birdseye, who did a whole lot more than just freeze fish; the fishermen whose livelihoods depended on cod; explorers; merchants and even chefs.

Between chapters Kurlansky shares cod recipes from the present back to the Middle Ages. Although these recipes are not necessary to the reading of this great fish tale, it adds a nice culinary touch which also proves how so many cultures relied on cod.

Sadly, like most fisheries stories, this one doesn't end well either. With the advent of motorized vessels and improved techniques man destroys another of the ocean's great bounties.

Kurlansky is an apt storyteller. If you want to learn more about the history of the countries on both sides of the North Atlantic and how cod helped sustain and create them, this book is well worth your time.

It's also a great reminder that we have a long way to go in creating a sustainable fisheries plan, or soon there will be no more fish to eat.

Pirate Hunters:

The Search for the Lost Treasure Ship of a Great Buccaneer

By Robert Kurson

Reviewed by Tim Dillingham
Executive Director
American Littoral Society

Morgan. Blackbeard. Kidd. Anne Bonny. Black Sam Bellamy. The names of the great pirates evoke images of an age of sail and piracy long gone, but hardly forgotten. But the ships that carried these pirates' names forward through history are the rarest things to find in the sea.

Robert Kurson, the author who documented the search for the identity of a German submarine discovered off the coast of New Jersey, has captured, again, the story of divers piecing together a puzzle to unlock a historical mystery. This time it's the location of the Golden Fleece, the ship of Joseph Bannister. Bannister is no common pirate: he's a successful merchant captain, who at the height of his career in the late 1680s turned to piracy. His motivation for such an unlikely move becomes another thread in the narrative of "Pirate Hunters: the Search for the Lost Treasure Ship of a Great Buccaneer."

Two divers, John Chatterton and John Mattera decide to risk everything in an attempt to find the Golden Fleece, and begin an adventure that ranges from the Dominican Republic to old Spain and back. The story of how the two undertake their challenge is woven into a rich exploration of the politics of piracy in the late 17th century, as well as a great lesson in the tricks of the treasure hunting trade.

It is the personal stories of the divers which underpins the entire effort: their backstories, personalities and philosophies are inextricably linked to how they search for the Fleece, and present a picture of admirable modern day explorers, and lovers of the secrets of the seas.

The Littoral Crossword

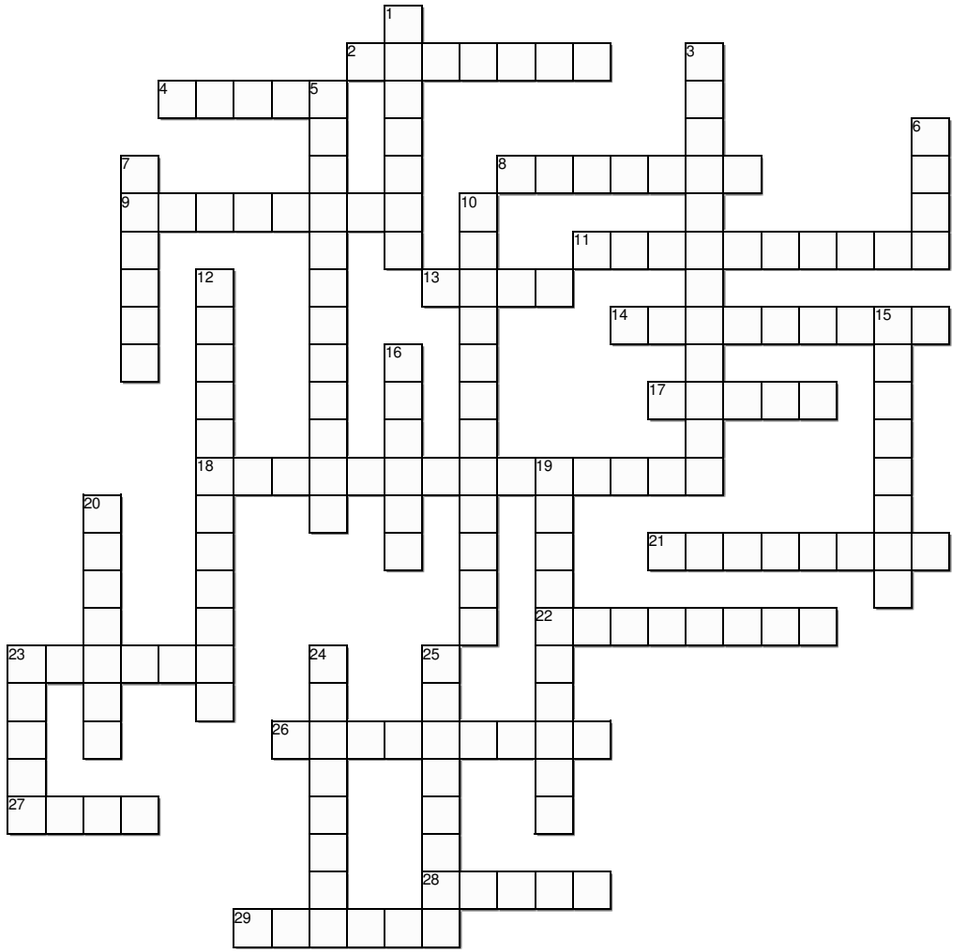
Complete this littoral zone themed crossword

Across

2. a threatened medium-sized shorebird
4. a fish with a compressed body
8. soft bodied invertebrate in a hard shell
9. a fish at risk of extinction and popular because of its roe
11. a synonym for littoral
13. planktonic tunicate that moves using jet propulsion
14. area of accumulation above the high tide line
17. a large and slightly receding bay
18. harmful effect of pollution in bodies of water
21. an oily-fleshed fish historically used as fertilizer
22. another name for striped bass
23. an unpaired fin on the back of a fish
26. a horseshoe crab is one
27. oyster larvae after it attaches to a substrate
28. plant-like microorganism that may show up in blooms
29. a diving bird with binocular vision

Down

1. a fishing method that uses a vertical net
3. ejection of internal organs as a defensive mechanism
5. the shark lady
6. a piniped
7. diurnal bird of prey
10. a tern-like bird that feeds by flying low over the water
12. New Jersey's state shell
15. plant nutrient that pollutes bays and estuaries
16. metal in a horseshoe crab's blood
19. a fish that lives in the sea but returns to fresh water to spawn
20. a migratory butterfly
23. natural storm protector of coastal areas
24. a coastal marsh turtle
25. a polluted New Jersey bay



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The American Littoral Society promotes the study and conservation of marine life and habitat, defends the coast from harm, and empowers others to do the same.

Caring for the Coast Since 1961

The Underwater Naturalist welcomes contributions from its members, the scientific community and readers-at-large. To submit an article, or to propose a story for publication, please contact Dave Hawkins at dave@littoralsociety.org.

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