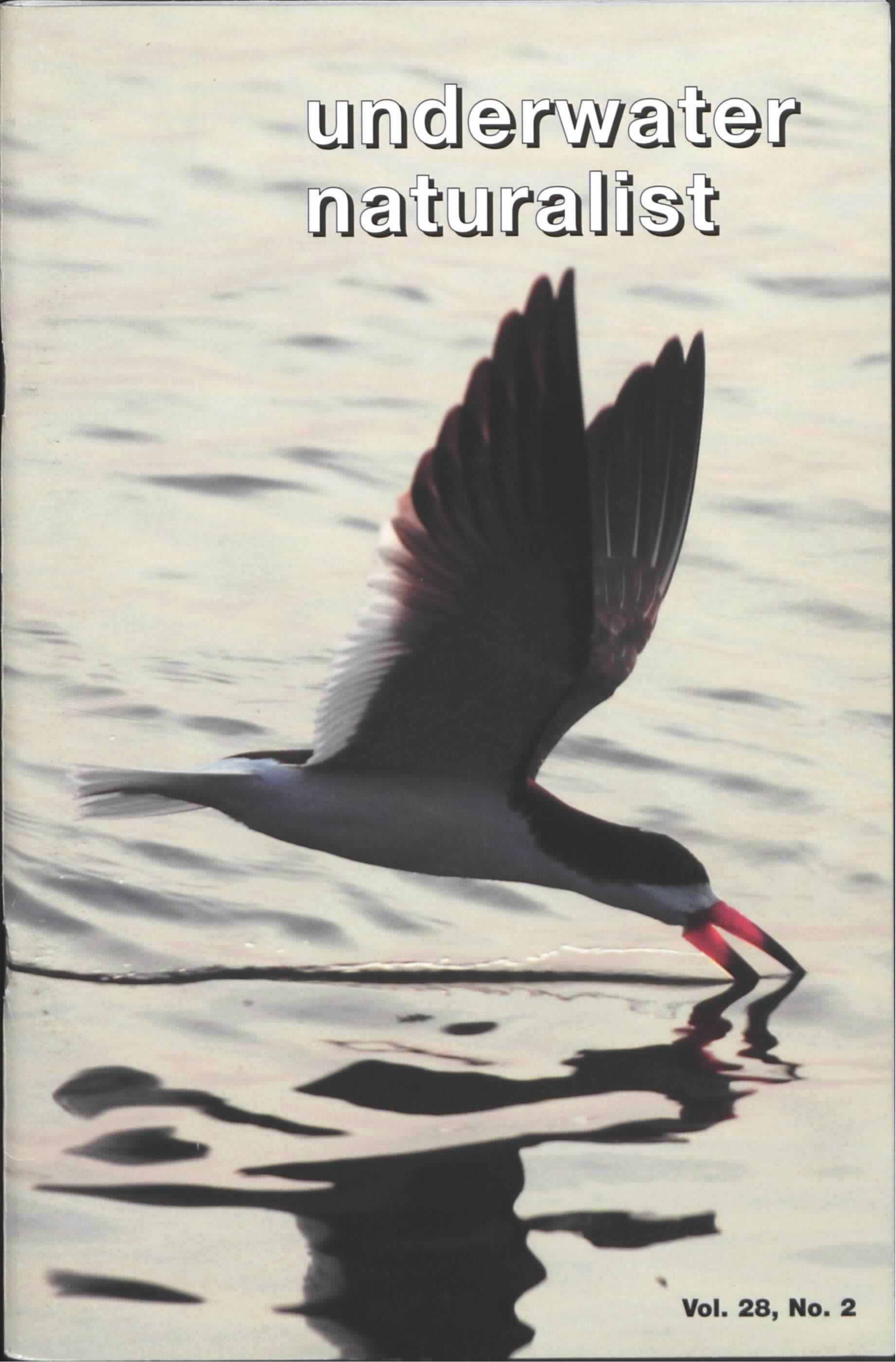
underwater naturalist



Vol. 28, No. 2

AMERICAN LITTORAL SOCIETY REGIONAL OFFICES

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

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718-318-9344

Block Island, RI: fall migration means good fishing.

BULLETIN
OF THE AMERICAN LITTORAL SOCIETY

Volume 28 Number 2

Cover Photo: by James Leedom
Black Skimmer, *Rynchops Niger.* There's more than one way to catch a fish.

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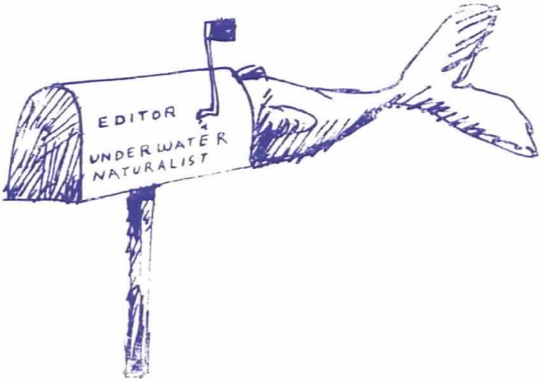


MORE ON OIL SPILLS AND PCBS

In the last issue (28/1), reader Beverly Knight of Annapolis, MD, attacks Exxon and General Electric for not cleaning up their spills in Prince William Sound and the Hudson River. Could it be that these two companies correctly disagree with the courts' findings and wish to defend their rights through the legal process? My read is that they take responsibility for their spills but question the cures, as they have every right to do.

Tyson O'Neill
Cleveland, OH

ATLANTIC STURGEON

Your sturgeon project in Delaware Bay sounds great. When can we see results?

Eleanor Jackson
Virginia Beach, VA

Ed: There's a report on the study in this issue. If you mean results of efforts to restore sturgeon populations along the east coast, that will take a long time. There are details on our website, www.littoralsociety.org.

FLYING FISH

Paul Albert's piece on the flying mobulas of the Sea of Cortez (28/1) was a gem (and the photos inspiring). It's obvious that fish can and do jump and equally clear that on one really knows why. Down our way, sturgeon and mullet jump in the Suwannee River, and I have watched humpback whales leap out of the water off Provincetown, MA (I guess they are not really fish). But, why? Albert's answer may be the most satisfying: they jump for "joyful survival." That's good enough for me.

Tom Noble
Cedar Key, FL

NATURE BOUNCES BACK

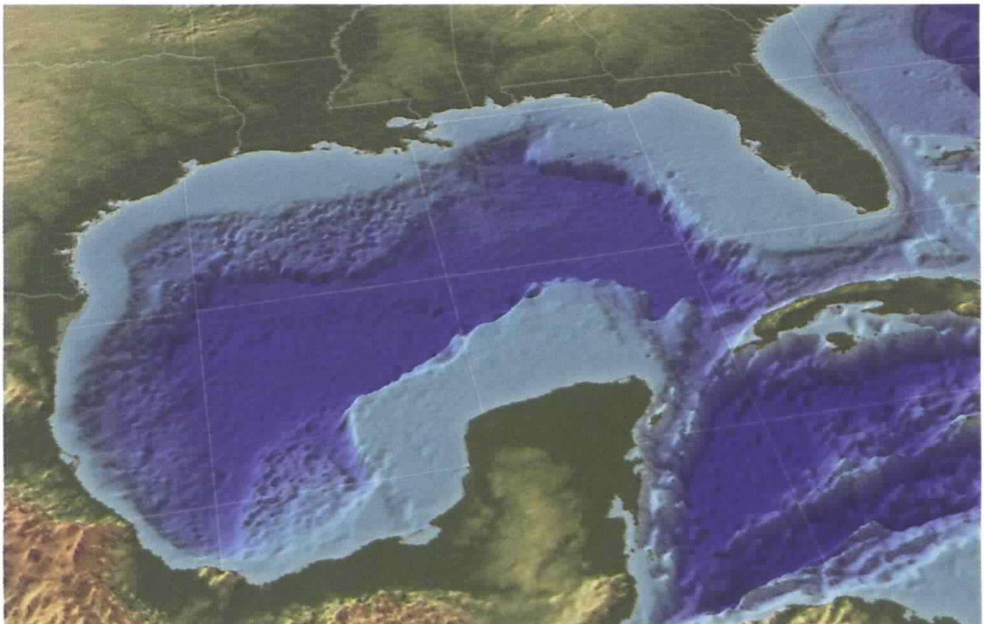
George Thatcher's Mississippi Gulf Shore Field Note (28/1) was good reading. We sometimes forget that nature can rebound after even such a violent episode as Hurricane Katrina. After all, wildlife has coped with these events over time and has developed resiliencies. The tougher question to address is what to do about man's efforts to replace permanent structures close to the water's edge at a time of accelerating sea level rise. That's not natural.

Bill Peavy
Panama City, FL

THE GULF OF MEXICO: ESTUARIES AND ALONG SHORE WATERS

BY DAVID BULLOCH

The Gulf of Mexico has been called America's Mediterranean Sea. It is a temperate to semi-tropical, semi-enclosed body of salt water separated from the Caribbean Sea by underwater sills and ledges. It is bounded by the Yucatan peninsula and Cuba to the south, Mexico to the west, the states of Texas, Louisiana, Mississippi, Alabama and the Florida panhandle to the north and mainland Florida to the east. Roughly 1000 miles wide in an east-west direction and 500 miles at its narrowest from north to south, it covers almost 600,000 square miles. It is an enormously productive and important part of this region's coastal ecosystem, and it deserves better care than it has received. Here is how it works, how it has been mishandled, and how we can enhance its restoration.



Physical Characteristics of the Gulf

Nearly 40% of the Gulf is less than 60 feet deep. Shallow shelves extend off much of its coastline. Some of these shelves end in steep escarpments that lie adjacent to deep plains. In the Midwestern portion of the Gulf, in the Sigsbee depression, the water is just over 14,000 feet deep.

The surface circulation of water in the Gulf is complex. All Gulf seawater enters

Bulloch heads the Society's Southeast Chapter from Sarasota, FL. He has served as a member, trustee, and officer for more than 40 years and contributes frequently to this journal.

through the Yucatan channel, which lies between the easternmost portion of the Yucatan peninsula and the western edge of Cuba. The surface currents from this incoming water flow northward and divide into two separate gyres, one curving to the west then north and the other flowing almost straight north then turning east then south forming what is known to west Floridians as the loop current. A counterclockwise gyre forms inshore over the middle Florida shelf, its eastern component brushing the west Florida coast.

All the water circulating in the Gulf exits through the Florida Straits, which lie between the southernmost portion of the Florida Keys and the north shore of Cuba. This water commingles with a northerly current flowing between Cuba and the Bahamas to form the Florida Current that eventually becomes the Gulf Stream.

Gulf surface water temperatures average 84F in summer. In winter, a north – south gradient forms and temperatures range from 55F to 75 F. Occasional excursions, in cold snaps, for example, can drop coastal waters by 30F almost overnight causing fish kills. In summer, in hypersaline lagoons, temperatures may exceed 100F.

Although the Gulf experiences three types of tides, two predominate; the diurnal tide – one high and one low tide per lunar day (24.8 hours) which predominates along its western and southwestern shores – and mixed semi-diurnal tides along eastern shores. Tidal amplitudes are small; maximums range from two to four feet, the higher occurring along the middle Florida coast. Sea level also undergoes seasonal changes, higher in the latter half of the year. This is caused by wind pushing more water northward though the Yucatan channel. Additionally, there has been a steady measured rise in sea level between 4 inches and one foot over the last 80 years. This may be due either to a general rise in sea level or to land subsidence or both.

Gulf Estuaries

The simplest definition of an estuary is that broad expanse of water where a river meets the sea in a bay-like enclosure. Within that area, salinities range from zero to 35 parts per thousand (ppt) with a zone of mixed salinity in between. That description fits 20 or so major Gulf estuaries. In others, river systems entering the Gulf terminate in a delta.

The Rio Grande (down to a trickle because of upstream diversions), the Brazos, the Atchafalaya, the Mississippi, the Tombigbee-Alabama (Mobile Bay) and the Apalachicola are the composites of multiple river systems that drain the continental United States from the Sierra Madre-Rockies in the west to the Appalachian mountains in the east.

The mightiest river system in the United States, the Mississippi, drains an enor-

The Mississippi River drains about half the continental United States (and some of Canada).

mous area. Its flow brings with it a huge load of suspended silt that, in the past, was deposited at its mouth and formed wide deltas. At one time, its active deltaic fresh-water wetlands and estuarine-like wetlands spread out over a broad expanse. Now, levees built to prevent flooding and, near its mouth, to narrow its channel (and thus speed its flow to keep the silt load suspended and the channel deep for shipping) prevent the sediment load, soil from half of the continental United States that once spread over lower Louisiana and Mississippi, from settling. The silt is now lost to the deeps of the Gulf.

Deltaic systems have a very narrow salinity zone. This makes life precarious for those creatures that live in the extensive fresh water marshes but cannot tolerate salt water.

There are also a number of large lakes along the middle Gulf coast that are open to the sea. Fresh water and salt water zones are almost nonexistent within them. These lake waters fall into the mixed salinities category.

Much of the coast of the Gulf is lined with barrier islands, long, geologically recent, exposed sand spits that lie parallel to the shore. The waters embayed behind these islands are often considered extensions of estuaries. In certain regions, for example, the west coast of Florida, inlets and passes not associated with rivers, coupled with fresh water inflow from streams, creeks and runoff, result in mixed salinities and waters nearly indistinguishable from the more bay-like bodies of water that mark the "true" estuary.

Along the Texas coast, behind long stretches of barrier islands, inlets are few and rivers and creeks feeding these lagoons are dry for most of the year. Evaporation exceeds rainfall and runoff to such an extent that these waters become hypersaline, that is, much saltier than that of the open Gulf.

Florida Bay is another unique area. Influenced heavily by fresh-water flow from the Everglades that form its northern boundary, this shallow water lagoon is separated from the Atlantic by the coral reefs of the Florida Keys on its east-southeastern side and is open to the Gulf of Mexico on its western side.

Although the Gulf lies north of true tropical waters, it does support a few large coral reef communities. Within U.S. waters these include the Marquesas-Tortugas off Florida and the Flower Garden Banks off Texas. Coral patch reefs also occur along the Gulf; several large ones occur off Padre Island, Texas, and on the middle grounds off central western Florida.

Along the coast shallow water hard bottom ranges from featureless bottom to areas pocked with holes, mounds, ledges and ridges. Many of these are important fishing grounds for snapper, shrimp and crab.

Within the estuary, the oyster has been the greatest reef builder, and oyster bars are common features in almost all estuarine waters. Oyster does best in waters with mixed salinities but can prosper in salty water. Large bars exist near the Anticlote Keys in western Florida and off Pass Christian, Mississippi.

Types of Estuaries

The classic estuary most common in the Gulf is that in which the salinity of its waters are almost continually less than that of the open Gulf. Within the estuary, the salinity of the water can vary enormously depending on seasonal rain and runoff. Salinity varies not only over the surface but with depth as fresh water overlays the denser salt water.

The Texas exception, mentioned earlier, occurs where long shallow bodies of water are trapped behind barrier islands with few inlets and minimum circulation and backed against a mainland with very little annual rainfall. Evaporation outpaces precipitation and the salinity can rise to 80 parts per thousand (ppt). These areas are called hypersaline lagoons. Laguna

Madre in west Texas, which encompasses Corpus Christi Bay, is an example.

There are a few estuaries where salinities hover around that of the open Gulf, between 28 and 36 ppt, because runoff and rain barely keep pace with evaporation. Galveston Bay is one such; Alligator Harbor, Florida, is another.

Although rarely thought of as an estuary, Florida Bay is a large shallow expanse open to the Gulf yet less saline than the Gulf, fed by fresh water from the Everglades.

How These Estuaries Formed

The shape of a coastline arises through one of several sequences; the land in relation to the sea is either rising or sinking due to tectonic movement or changing sea level. In the Gulf, rising sea level has been the most important factor in shaping the coast.

Most major estuaries began formation during the last ice age, about 8,000 years ago. Sea level has risen hundreds of feet, huge sediment loads have run down river, and the river flow itself has cut deep channels now drowned under the risen waters.

Waves impinging on shorelines and tidal flow alongshore have redistributed those sediments. Within the last two to three thousand years the present system of barrier islands, lagoons, and deltas so common in the Gulf, were formed. The largest estuaries, such as the Mississippi river system, are drowned river valleys as well. You can trace their existence back thousands of years by looking at a bathymetric chart and seeing the ancient canyons cut eons ago, now immersed.

Common Characteristics of Estuaries

Fresh water inflow, mixing with seawater via tides, currents and wind, particularly behind barrier islands, creates large areas of lower and variable salinities. Fresh water runoff brings nutrients and carries sediments that make the estuary so productive and provide the basis for biological systems found nowhere else.

Life in this ecosystem, either those that spend their whole lives within it or those who use its waters for a particular phase of their life cycle, must be prepared to put up with abrupt changes in their surroundings. Changes in salinity are probably the most stressful

But rapid changes in water temperature must be tolerated as well. Both determine what can survive, let alone thrive, in this environment. As a result there are fewer species of animals and plants within an estuary than exist in either fresh water or open sea, but those that can live in an estuary exist in numbers far in excess of those adapted specifically to fresh or salt water.

Currents within estuaries are controlled by tides, the downstream flow of fresh water and wind. Tidal amplitudes are low in the Gulf compared to the south Atlantic coast. For example, the tidal range at Galveston, Texas, is about one foot compared to nine feet at Savannah, Georgia. Nevertheless, low tidal amplitudes can create high velocity currents if restrictive geographic barriers exist.

Tides strongly influence the exchange of water behind barrier islands. Some areas flush out during every tide while other areas, for example, in the null zone between two inlets where exchange is slow, especially in dry weather.

Salinity gradients are an integral feature of an estuary. Salinity increases toward the mouth of the estuary. Because fresh water is less dense than salt water, tidal action may form a salt wedge along the bottom, stratifying the vertical salinity profile for a considerable distance upriver.

Dissolved oxygen inshore can vary enormously during a 24-hour cycle. Raised by phytoplankton photosynthesis during the day, it declines at night as all life continues to respire. The saturation level of dissolved oxygen in the waters of the estuary depends on water temperature;

the warmer, the less oxygen. Gulf daytime surface water averages about 5 milliliters of oxygen per liter of seawater (5ml/l).

Runoff and river flow brings with it loose grains of mineral mixtures that range in size from clay particles (less than 4 microns in diameter) to silt (4 to 63 microns) to sand (63 microns to 1 millimeter). Larger particles, pebbles, cobbles, and boulders, can be moved by swiftly flowing water but are usually transported seaward by ice or catastrophic floods. Ice has not been a factor in shaping the Gulf coast in recent times. Cobbles and small stones found on beaches are often transported there by seaweed. Growing on the stone, the seaweed makes the combination amenable to wave movement. Whole beaches have been transformed from sand to cobble by this process.

Sediments

Sediment loads carried to the sea from land are the major source of new beach sand. The migration of this continuous input, its grain size and its distribution by littoral drift along the coast as well as the shifting of existing beach sands determines its location, albeit ephemeral. Beaches erode or accrete in unpredictable ways and the costs associated with replenishing beaches and repairing undermined structures grows more onerous every year. Storms and the strong currents they create rearrange both fine and coarse sediments along considerable stretches of coast in a single event. The dynamic nature of barrier island beaches, shoals, inlets and dunes ia all the result of interactions among tides, littoral currents, wave action, storm surges and wind and can either create change slowly or alter the landscape overnight. Affected humans seem bewildered and angry when they are on the losing end but the process has been going on for some time and is sure to continue. Attempting to thwart natural change is expensive and never ends.

On its northern perimeter and as far south as Tampa, Florida, quartz sand sediments predominate, albeit admixed with clays and other fine particulates washed off the land. Fine sediments are the basis for the vast salt marshes of Louisiana.

What is called sand can vary widely in composition. Pure silica sand originates from rock-weathered quartz and produces the white, sugary beach material so coveted by local chambers of commerce. Fragments of shell and other carbonaceous material are more typical in the tropical regions of the Gulf.

Clays brought into the Gulf are rich in montmorillonite with lesser amounts of illite and kaolinite. These three minerals are the primary ingredients of clay. They often remain suspended in fresh water both because of their small size and a charge that develops on the surface of each particle. When the particles meet saltwater the charges dissipate, the particles agglomerate and settle out.

Larger particles are carried seaward mainly as a result of high current flow. A drop in stream velocity, as occurs when the stream broadens out at the estuary, causes them to settle out. Tides and currents redistribute and sort the various sized sediments in the estuary.

Carbonate sediments that come to rest are often further agglomerated by particle dissolution and reprecipitation that binds adjacent particles together. This process can continue until what you have is more like rock than sand.

Beach sand in certain areas is no longer available from offshore dredging, at least not from shallow offshore water. The southern east coast of Florida is running out of options and soon may have to either get sand from inland or foreign sources. On the Gulf side of Florida, beach sand must be brought in from miles offshore.

Nutrients

For life in brackish water to prosper, a long list of essential elements must be available in an assimilable form. Carbon, nitrogen, and phosphorus are necessary as well as a wide range of elements in lesser quantities: silicon, calcium, iron, sulfur, chromium, `manganese, copper and more.

Carbon enters the estuary as dissolved carbon dioxide (mainly bicarbonate ion) or as dissolved or particulate organic matter. This is utilized for sustenance by all creatures. In the development of some creatures, carbon is also "locked up" as calcium carbonate, in the form of shells, tests, spines and other hard parts that last long after their creators perish. These particulates can accumulate over time on the bottom and cement together to form rock-like structures. Over time, great quantities can turn into limestone.

Nitrogen, although 80% of air is unavailable to life until it is "fixed," that is, transformed into usable ions or compounds. In the past nitrogen was predominately fixed by lightning, certain plants and bacteria. Now, large quantities of fertilizer made by synthetically fixing nitrogen and the effluent NOX, from high compression auto engines, have drastically upset the natural balance of available nitrogen.

Phosphorus enters the estuary as inorganic phosphate, which is rapidly taken up by phytoplankton and bacteria in quantities far exceeding their immediate needs. This reservoir is often used by subsequent generations.

Runoff brings trace minerals with it as well as dissolved organic substances and fine silts and clays that will precipitate out of solution when they mix with salt water.

Primary producers, those small creatures that obtain all or most of their nourishment by photosynthesis, absorb most of the inorganic nutrients. These critters are fed upon by herbivores that, in turn, are eaten by carnivores. All exude waste and eventually die and decay. This material, either in liquid or solid form, is recycled by bacteria or detritus feeders. Bacterial decomposition renders these materials, from compounds as simple as urea to as complex as protein, reusable and ready to be reabsorbed back into the life cycles of the estuaries inhabitants.

Just as fresh water brings nutrients to the estuary, the water exiting the estuary carries both soluble and particulate nutrients with it. In coastal waters, these nutrients undergo a similar cycle. Thus, estuarine and coastal waters are far more productive than mid-ocean waters where fixed nitrogen, phosphorus and trace elements are often in short supply. Unlike the recycling of near-shore processes, open ocean materials are lost to the deeps. They are recycled there but that material does not make its way back to the sea surface.

Plant life in the estuary (sea grasses, marshes, wetlands, and in the far south, mangroves) perform a complex role in the flow of nutrients in the estuary, for they act both as a source and a sink for nutrients. In undisturbed environments they retard sediment losses, absorb nutrients quickly and release them slowly (through decay) and, through photosynthesis, add their own share to the food web of the estuary.

Stability of Estuaries

The dynamic nature of the estuary and adjacent barrier islands is well known to anyone who has spent time near the shore during a storm. Strong currents, waves and winds can alter a beach in hours. Inlets shoal in, or open wider, dunes move, and landscape features rapidly change.

Indigenous animal and plant life play important roles in stabilizing estuarine environments. Saltwater marsh grasses, submerged sea grasses and, south of Tampa, mangroves, hold sediments firm and trap new sediments in such a way as to accumulate them. On land facing the Gulf, dunes are stabilized by a host of salt-tolerant plants and trees. Fore dunes are stabilized by sea oats and other grass-like species. Back dunes, criss-crossed by rail-

Mangroves exist only in frost-free regions, roughly south of Tampa in Florida. They hold sediments, provide food and shelter for small fish, and buffer the shore from storm damage.

road vine and a hundred other low-profile species, bind the grains of sand that otherwise might migrate with the vagaries of the wind. In the bays, submerged aquatic vegetation (SAV) provides both sediment stability and home to countless small creatures which use it as a respite from the hungry mouths in open water.

What grasses predominate depends on the depth of the bottom (i.e. water clarity), degree of eutrophication (which can lead to epiphytic growth on the grass) and salinity. Shoal grass *(Halodule)* and Widgeon grass *(Ruppia)* are look-alikes with fine blades (1-3 mm wide). Both can live in shallow water and can stand wide changes in salinity. Manatee grass *(Syringodium)* has tubular leaves (1-3 mm in diameter). Turtle grass *(Thalassia)* has wide leaves (1 cm) is probably the most widely known of the grasses and can produce very thick beds in clean water. It is susceptible to algae growth on its leaves in over-nutrified waters. Paddle grass and Star grass are smaller grasses but often as abundant as their aforementioned relatives.

Human Impact

Like many other coastal areas of the world, the estuaries of the Gulf of Mexico have in the past and today suffer a long litany of insults from human activity. Dredging and filling, and construction of sea walls have played significant roles in degrading the biological role of estuaries along the Gulf by displacing both emergent and submerged aquatic vegetation which might normally have absorbed incoming pollutants.

Combined with polluted runoff and ensuing eutrophication, the Gulf's estuary production has fallen dramatically. Excess nitrogen, overused in fertilizers and nitrogen "fixed" by high compression engines and washed from the skies by rains, rapidly increase the quantity of microalgae in Gulf estuaries. This has two adverse effects. So many small particles in the water block sunlight and seaweeds and grasses die off. The overproduction of microalgae further increases the rate of eutrophication. At first this may seem counterintuitive because microalgae produce oxygen. However, all living things continually respire and, at night, primary production stops and respiration, which needs oxygen to take place, goes on so rapidly that the dissolved oxygen in the water of the estuary can be exhausted before morning (and light) reappear. Within that dark period without oxygen, life perishes and rapidly decays, which demands even more oxygen. When the oxygen completely runs out, the processes of decay change and anaerobic decomposition begins. This produces hydrogen sulfide, which is toxic to most life and adds to the ever expanding circle of death and decay.

The Gulf in Trouble

Like so many other bodies of great waters, the Gulf is succumbing to a multitude of insults at the hand of man. The devastation wrought by hurricane Katrina is but a minor link in a vast list of coastal problems. That 2005 storm has only partially awakened coastal residents and the nation at-large to the damage humans can inflict either by indifference or misjudgment to a major body of water.

COASTAL POPULATION

In the year 2000, about 37 million people were living in the 142 U.S. coastal counties and seven Mexican states bordering the Gulf, up by 15 million since 1960. This influx continues unabated. Local and state governments have failed to cope with this sea of humanity. Inadequate sewage facilities and poor to non-existent handling of runoff now allow more pollutants to reach Gulf waters than the effluents of industry and agriculture combined.

RUNOFF

As people arrive, new housing and infrastructure grow as well. Most new housing is typical suburban sprawl based on an automobile culture. House, patio, pool, driveway and adjacent street of a typical suburban project can cover as much as 50% of the available surface. An average shopping mall can exceed 90% coverage. These are impervious surfaces that drain rapidly in a rainstorm.

Studies in Chesapeake Bay have shown that 10% coverage of land adjacent to a receiving water body has a noticeable effect. At 30%, significant degradation takes place in the receiving water.

In older built-up areas, runoff caught by storm drains is typically piped directly into the nearest creek, canal, or river without treatment. In newer developments, water may first go to a retention pond, where by simply standing in a grassy environment, a significant portion of sediment, lawn nutrients, lawn pesticides, and oil and grease car drippings can be trapped.

Because coastal and river borders have been desirable as home sites, development occurred in these area first and there is now little or no room to retrofit retention ponds.

Sediment from a construction site flows into receiving waters if not properly handled.

Urban areas next to the Gulf can dump prodigious amounts of material into nearby waters. A study conducted by the Galveston Bay National Estuary Program in the mid 1990's found that the Houston-Galveston Bay system yearly received 25,494 tons of fixed nitrogen, 4,090 tons of phosphorus and 15,613 tons of oil and grease via runoff.

A new source of fixed nitrogen has shown up in significant amounts in waterways. Auto exhaust contains fixed nitrogen (NOX) as the result of high compression engines. These gases are washed out of the air by rain. In Sarasota County, the NOX contribution to fixed nitrogen in the Bay now exceeds 20%.

Over-application of water soluble fixed nitrogen (e.g., ammonium nitrate, urea etc) and phosphate, and insecticides (many of which are deadly to fish) has increased to a point where some municipalities are considering limiting their use.

Vanishing Wetlands

The coastal wetlands of the Gulf amount to about 17,000 square miles of which 6,000 square miles are tidal and the rest non-tidal fresh water. The surface area of the tidal and non-tidal marshes of the Gulf makes up 29% of U.S. wetlands, excluding Alaska.

Gulf coast wetland loss since this nation's founding is close to 48%. Coastal fresh-water wetland losses have exceeded losses of tidal wetlands due to conversion to agriculture. The majority of the losses are physical: erosion, subsidence, draining and filling, seawall construction and alike, and some are chemical: eutrophication, salinity changes and toxins.

In Texas, the Galveston Bay watershed, home to four million people, has lost 30,000 acres to pollution. Of that, a little less than a third has been partially restored in recent years.

Galveston Bay contains two-thirds of the oysters harvested in Texas, which amounts to 30% of the oysters harvested in the U.S. These extensive beds are declining because of rising salinity. This salinity increase is caused by upstream diversion of fresh water. Texas is starved for fresh water. Demand continues to increase and sources continue to dwindle. Increased Bay salinity also allows more oyster drill predation as well as loss to disease, primarily Dermo, an affliction that is endemic in most Gulf bays.

Louisiana wetlands are disappearing at a rate of 16,000 acres (25 square miles) a year. The reasons for this steep decline had their genesis many years ago. The enormous expanses of Louisiana wetlands were created by the changing course of the Mississippi River and its annual flooding. The River, over time, deposited millions of tons of sediment into at least five distinct deltas, creating a wetland nearly 300 miles long and 100 miles wide.

Flooding presented a problem to early settlers who began the process of containing the flow of the River by levees. As commerce increased, the embankments rose. Near the mouth of the River, where it began to spread, an embanked channel was built to keep the river velocity high enough to carry the silt to sea, lost over an escarpment to the deeps. When oil and gas was discovered underneath the delta, the vast wetlands were criss-crossed with access canals to get the drill rigs in and pipeline put down to get the products out. These canals let seawater get into what had been freshwater marsh, which meant the end of many freshwater species. As the extraction of oil products went on, the land subsided, no longer buoyed up by the underground presence of oil. Then there was the introduction of the nutria, a fur bearing, beaver-sized animal, often described as a wharf rat on steroids, whose appetite for wetland grasses soon made serious inroads on the plants that had held erosion in check. The disappearing wetlands that once acted as a buffer between land and sea could no longer absorb the storm surges generated by ever more frequent hurricanes, as the devasta-

Red mangrove thrives in salt water and serves as a strong buffer against the force of coastal storms, but is often cut down or pulled up by shoreline homeowners.

tion wrought by Katrina attests.

Coastal wetlands in Alabama and Mississippi are relatively few and total acreage small. Nevertheless, the Mobile Bay ecosystem, whose upper wetlands are now saturated with heavy metals and toxins, is unique in that it harbors mercury in quantities high enough to warrant fish and shellfish advisories over a broad expanse of the bay system. The source of the mercury is mainly from the burning of coal used in power plants. Airborne particulates are washed out by rainfall and accumulate in bay sediments.

Mobile Bay has lost most of its sea grasses to sediment deposition, which has also smothered swaths of oyster beds. Land disturbance upstream has unleashed clouds of finely suspended clay that have traveled far enough in the Bay to choke oyster reefs that lie just offshore.

Florida's freshwater wetlands are 10 times the acreage of its tidal wetlands. A substantial portion of both has been compromised: tidal wetlands by dredge and fill for development and freshwater wetlands for flood control, water supply and agriculture. Except for areas in Apalachicola Bay and smaller bays to the immediate south, most of Florida bay systems are closed to shell fishing and, indeed, no longer support some species of shellfish, specifically scallops. Scallops have all but vanished from Tampa and Sarasota Bays. Exactly why isn't known but attempts to reintroduce them have failed.

In the shallow bays of Florida's west coast, sea grasses are a critical component of their health and productivity. Easily hurt by eutrophication, once degraded beds have returned as point source sewage pollution has stopped and non-point pollution has abated. In Tampa Bay, for example, sea grasses rapidly declined from 1950 to 1985, when new legislation required upgrades in sewage treatment in the central Florida watershed. As clarity improved, sea grasses returned and are now at about 70% of their 1950 level. Non-point excess nitrogen and phosphorus is still a major problem in most bays and estuaries.

South of Tampa Bay, mangroves take the place of tidal marshes, red mangrove in particular. These trees can root in salt water by way of water-borne propagules. Their roots will absorb all manner of excess nutrients from the water. Their detritus, dropped leaves and accumulated solids, and the quiet, protected water beneath them are excellent nursery grounds for a wide variety of fish. In major storms, full grown mangroves, about 14 feet high, can absorb the energy of the storm surge without loss and form protective barriers for the coastline. That was well displayed in hurricane Andrew. Its winds totally destroyed Homestead, Florida, but its tremendous storm surge did almost no damage because it hit land along a portion of the coast well protected by red mangroves. Unfortunately, shoreline homeowners do not like their view blocked and have either pulled them out or cut them down to hedge height in so many instances they now offer only a fraction of their value in maintaining stable ecosystems.

Some of the Bay systems in southern Florida periodically suffer from a plethora of fresh water brought in by man-made systems to alleviate flooding in the interior. The Caloosahatchee River and bay too often are deluged by water from Lake Okeechobee.

Florida Bay, the recipient of over-nutrified fresh water from the Everglades, has suffered extensive sea grass loss. This significant body of water comprises nearly a 1,000 square miles.

Under Ground; Under Water

Even though surface water runoff is the major contributor of excess nutrients and toxins to the Gulf, underground leachates are another significant source of trouble. Gulf-wide, the leading culprits are outdated septic systems adjacent to creeks and rivers that directly flow into nearby estuaries. For a septic system to be effective, it must be correctly located both horizontally and vertically and not located on waterlogged soil.

The climate in the southern parts of the states surrounding the Gulf is semi-tropical. Unlike the north, seasonality devolves into two parts; wet and dry. Many septic units work fine in dry weather but as the rainy season takes over, the ground becomes saturated and septic effluent migrates quickly from its field before denitrification can occur. The same phenomenon also moves effluent from soil fouled by other human activities: oil soaked ground, heavy metal dump sites, and old municipal dumps.

Among the worst are sites that once received industrial waste: toxins may not only move laterally but also down into the water table contaminating a potable water supply as well as moving horizontally to the sea. The worst of these are called Superfund sites. The Superfund, created in 1980, was originally funded by a tax on chemical and petrochemical industries. In the early 1990's the cleanup trust fund reached \$3.7 billion and over 90 sites a year were being treated. In 1995 Congress failed to renew the tax. By 2004 the industry funds were completely gone and fewer than 50 sites a year were receiving attention. Current funding is through general revenue that must be appropriated by Congress.

Of the 1200 or so Superfund sites in the U.S., 62 lie along the Gulf coast. In Louisiana, south of Baton Rouge, two sites, one over 17 acres, the other three times as large, are considered among the most toxic in the nation. Years of dumping petrochemical waste into vast, unlined pits have created a wasteland of oils, heavy metals, and chlorinated hydrocarbons. Closed in 1980, both sites lie in swamps that are within a mile of the Mississippi River. Cleanup costs will exceed \$50 million. Initial work appears to have contained the mess but prior to beginning, the sites have already contaminated several thousand acres of nearby wetland,

Pensacola, Florida, has five Superfund sites including the Escambia Treating Company dumpsite that is laced with over 150 toxins that have contaminated ground water as far as Bayou Texar. Even reworking the site presents problems. In 1994, when the EPA started digging up contaminated soil, air-borne effluents sickened residents to a point where the EPA had to move 400 families away.

On the Anclote River near Tampa the residue from operations by Stauffer Chemical Company's phosphate processing plant, located on 130 acres and operated from 1947 to 1981, is still polluting nearby lands and contaminating close-by wells. This site has the potential of leaching into the aquifer that supplies Tarpon

Springs with potable water.

Not all the shoreline marine ecosystems in trouble are entirely the result of an influx of toxins or nutrients. Florida Bay, a wide, shallow area, is bordered by the Everglades on its northern side and by the Keys on its eastern flank. Bay degradation is in part due to inflowing waters bearing excess nitrogen and more especially, phosphorus, but also by fluxes in fresh water, too much on its eastern side and too little to the west.

The bays and estuaries in southern Florida have been greatly affected by the changes in fresh water flow from the interior. The natural ecosystem from Lake Okeechobee through the river of grass, the Everglades, has been extensively modified by human interference. Half of the original Everglades has been drained and filled. Redirected water flow has put too much in some places and too little in others. Flood control canals drain rainy season water quickly. On the eastern side, water carrying nutrients and suspended silts from sugar fields flows southward down the Snake River and Taylor Slough and on to the Florida Keys. In the Keys, the northern reefs have rapidly degraded. On the western side, surface fresh water is scarce yet that area suffers from phosphorus-induced eutrophication. Scientists believe an underground freshwater source, originating in mid-Florida where phosphate mining is done on a massive scale, is carrying phosphate south into Florida Bay.

Fish and Shellfish

Although a great deal of commercial harvesting fish and shellfish is done by individual fishermen, the total fishing effort constitutes a major industry along the Gulf coast. Commercial fishing brings in over $650 million a year at the dock. Recreational fishing, including money spent locally (rooms, meals, boats and tackle etc.) exceeds $5.6 billion annually. In many Gulf towns, the fishing business is as much a part of the culture as it is of the economy.

From the time records have been kept, the quantities of valuable species of fish caught have dwindled. In 2000, the American Fisheries Society named 36 Gulf species at risk of extinction. In 2004, NOAA Fisheries reported that red snapper, greater amberjack, vermilion snapper, red drum, goliath grouper, and Nassau grouper were overfished. The term "overfished" means the stock level is below that necessary to replace the fish taken and that commercial extinction is imminent. The next downhill terms are "threatened" and "endangered" The Gulf sturgeon is in the latter category.

The status of many fish stocks is unknown. NOAA Fisheries manages 83 species in the Gulf but has no data for 46 of them. Of the rest, 29 are considered "overfished," eleven "threatened," and one "endangered." Fishery data are poor. Commercial fishermen report what they land at the dock and recreational fishermen's catches are estimated by random telephone surveys.

Aside from over fishing, the falloff in stocks is exacerbated by habitat loss, toxic effects, and by-catch. By-catch are the non-target fishes captured but discarded, usually dead or dying, Estimates run between three to four times as many fish incidentally killed as are kept.

By-catch has been the center of controversy in the Gulf shrimp industry. Offshore shrimp netters catch juvenile red snapper in their hauls. They kill less than a half-dozen per tow but collectively a million tows are made each year. Red snapper are sought both by commercial and recreational fishermen who have been in a bitter battle for years over their allotted quotas. Several scientific panels have said that quota ought to be reduced to zero but have been continually overridden by Fisheries Council decisions.

The Gulf shrimp industry, in the last few years, has been decimated by cheap imports, high fuel costs, declining catches and Katrina. Within the past 10 years, 1500 shrimp boats have been retired or damaged by Katrina. In the past five years, shrimping effort has dropped to its lowest level since the early 1960's.

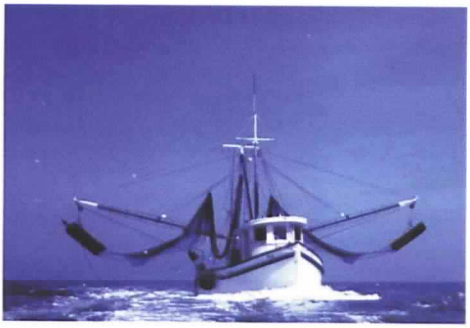
Four species of shrimp are caught in the Gulf. Their life cycle is such that smaller ones can be caught inshore and the larger, that command higher prices, are caught offshore. Irrespective of size, Gulf shrimp are being priced out of the market by imported, farmed shrimp.

The Eastern Oyster is still prolific in Gulf bays and estuaries. As stocks have dwindled elsewhere, the Gulf has become a major supplier. Louisiana ships over 40% of the annual U.S harvest. However, pollution is taking its toll. Gulf oysters are barred from sale in California. Eating raw oysters can be a serious health threat because of potential contamination by Vibrio bacteria.

Inshore pollution has led to a plethora of fish advisories. PCBs, pesticides and mercury lead the list of dangerous contaminants usually cited. Red snapper is on one such list that suggests for healthy men and women it be eaten no more than three times a month and half that for children

Prior to World War II, the oceans bounty was considered limitless, although signs of over harvesting were showing up regularly via diminishing catches. In the post-war years, fishing techniques greatly improved. Nations were subsidizing fleets that could operate worldwide. U.S. fishermen, poorly equipped and outclassed by foreign offshore fleets, began to complain about the diminution of inshore catches.

In 1976, Congress passed the Magnuson Fishery Conservation and Management Act and created an exclusive economic zone that extended 200 miles from our shores. The Magnuson Act created eight regional fishery councils. The Act was amended in 1996, and known as the Magnuson-Stevens Act or the Sustainable Fisheries Act, to specifically end over fishing, create recovery plans for



A shrimp trawler underway, nets up. The shrimp business is in dire straits from both cheap imports and towing restrictions geared to reduce bycatch of red snapper.

over fished stocks, slow up by-catch, and protect critical habitats. The fishery science was to continue to be provided by the National Marine Fisheries Service, now known as NOAA Fisheries. The data and suggestions of the Service were to be incorporated into recovery plans and the plans implemented by the Council, the majority of whom worked in the fishing industry.

Even the revised Act has failed to produce effective results. Time and again recovery plans were altered or deferred to suit immediate financial interests. The usual reason given by council members was insufficient data. Presently, the Gulf of Mexico Fishery Management Council has only seven management plans in effect: coastal migratory pelagic fish, spiny lobster, shrimp, stone crab, red drum, coral and coral reefs, and reef fish. At this writing, there still is no plan for red snapper, whose numbers now are but 3% of their former population. Red snapper was first declared over-fished in 1989. Currently it looks like gag grouper will soon join the over fished list.

Industrial Pollution

As a result of industrial expansion during World War II and its deepwater ports, the northern Gulf coastline is home to a large number of petrochemical refineries

Oil refinery at Pascagoula, Mississippi. Refineries and petrochemical plants crowd the coastlines from Alabama to Texas.

and heavy chemical manufacturers centered on the ports of Pensacola Bay, Mobile Bay, New Orleans, Baton Rouge and Galveston Bay. Adjacent bays, bayous and channels became dumping grounds for these industries. By the mid-1960's the upper reaches of the 50 mile long Houston Ship Channel was biologically dead. Galveston Bay had lost 30,000 acres of sea grass beds and wetlands because of oxygen depletion. By 1978, nearby Pensacola Bay suffered a similar fate.

The sediments of the bays and bayous of the northern Gulf coast are laced with PCB's, dangerous heavy metals (like chromium and mercury) and polyaromatic hydrocarbons.

Although the Clean Water Act of 1972 slowed effluent dumping from these plants, in 2002 the Public Interest Research Group reported that the Gulf States were the worst in enforcing bans on toxic waste effluent discharges. Texas, Louisiana, and Florida have been especially lax in enforcement of high-hazard permit violations.

A year 2000 audit by the Louisiana legislature found that 70% of their major industries were operating on expired permits. Nearly 40% of permit violation notices went unenforced. Where agencies did take action, more than 150 days had passed from the date of the violation.

Inaction by State authorities and regional federal agencies has been a common thread among environmentalists' complaints. For example, critics have accused the Louisiana Department of Environmental Quality as more concerned that industry gets its operating permits than with correcting the problems in citations. They point to Bayou Trepagnier which empties into Lake Pontchartrain. Waste from a Shell Oil refinery has produced a sludge-filled bottom there that is six feet thick in places and contains PAH's, chromium, and grease. Restoration of Bayou Trepagnier is still in limbo.

Environmentalists point out that there are dozens of other locations in similar straits and going untreated. The Northwest Florida office of the state Department of Environmental Protection has come under heavy fire for ignoring violations. Perhaps the most egregious example is the International Paper's pulp mill in Perry. It dumps untreated pulp waste directly into the Fenholloway River rendering it dead over its 17 mile course to the Gulf.

Years of toxic releases, to the air and to the waters, have taken their toll on human health. Along the lower Mississippi River, between Baton Rouge and New Orleans, there are more than 130 petrochemical plants. That zone has been dubbed Cancer Alley. Residents of small, surrounding towns, mainly black, have well above-average incidences of cancer and respiratory problems. One study of 47 families living in close proximity to a Shell Oil refinery discovered that 42% of the populace was in poor health. 34% of their children suffered from asthma and other respiratory disorders. When the wind blew in from the refinery, the air pollution was severe enough to sting their eyes.

High cancer rates are common in many other towns that lie adjacent to heavy industry areas in Alabama, Louisiana, Mississippi, and specific locales in Texas and Florida. A 2000 EPA report found that in a small area in Pensacola, industry was releasing 20,000 tons of toxins a year and spewed more toxic material into the atmosphere than the entire State of New Jersey.

In the northern Gulf States, mercury in sediments and in the air is among the highest in the nation. Rain samples in Louisiana were 96 times higher in mercury than EPA standards allow. There have also been repeated fish consumption advisories because of high mercury levels in local fish.

The connection between human health and industrial contaminants in the environment has been hard to prove. Tissue analysis of many people shows trace amounts of a long list of man-made chemicals. A Mt.Sinai study in 2003 detected 91 pollutants, of which 53 are considered carcinogens. Whether these compounds do direct harm is another matter. Harm to health is also confounded by individual life styles. All this makes the link between causes and effects tentative. Thus health officials will often say that industrial pollutants are suspect but stop short of pinning direct blame on them.

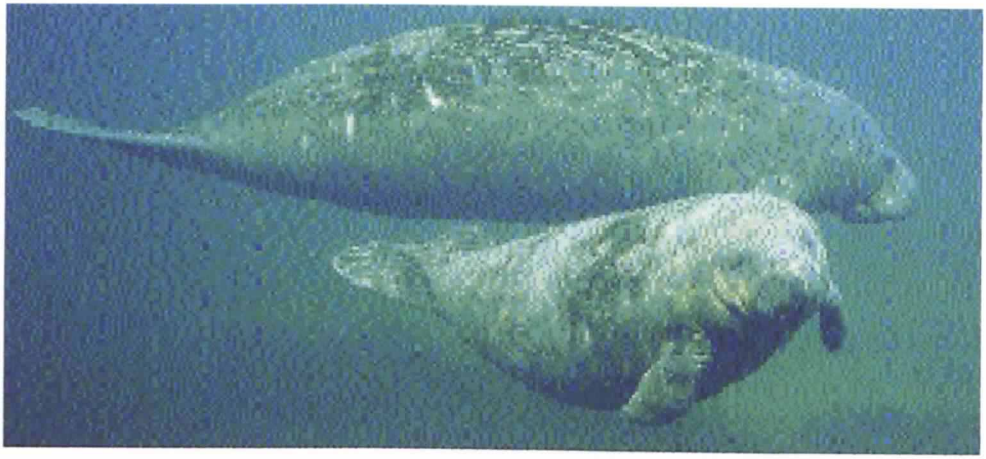
There are contaminated locales so severely compromised that its residents have had to be relocated, and the area designated as a superfund site. That happened in central Pensacola where the now defunct Escambia Treating Co., operating from 1942 to 1982, dumped creosote, arsenic, dioxin and PCB's on the ground whereupon it entered the local water table and partly percolated into nearby Bayou Texar, which empties into Pensacola Bay. Of the 2000 people who once lived there, 450 have died and the remainder suffer from a long list of ailments symptomatic of the contaminants they once lived with. Unfortunately, there are other small towns, mainly black, next to chemical plants whose residents suffer severe respiratory ills. In Alsom, Louisiana, 80% of its inhabitants are so afflicted. In Mossville, it's the same story.

Animals suffer as well as humans from the long list of toxic materials that make their way into the estuary and sea. Turtles that have inadvertently ingested floating plastic are regularly found washed ashore. Others have been found with infectious tumors on head, neck and flippers; so large their movement has been hindered. Still others die by drowning, entangled in nets or plastic discards or by being torn open by a boat's propeller.

The manatee is also often the victim of a boat propeller. Almost all adults have prop scars on their back. They also succumb to the neurotoxins released by *Karina brevis*, a dinoflagellate responsible for Florida's red tide.

Sea birds suffer similar ills: fouled in monofilament, ingested plastic, and poisoned, often from unknown sources.

Die offs of bottle-nosed dolphins have occurred without explanation. Half the dolphins (50), residing in Choctawhatchee Bay, in northern Florida, perished from an unknown poison in 1998-89. Autopsies



Adult manatee with young. Manatees are often victims of strikes from motorboat propellers; they are also susceptible to the effects of red tides.

showed they carried high levels of PCB's and DDT.

Both animals and humans can suffer the ill effects of miniscule quantities of toxins that enter the lower portion of the food web. Through a process called biomagnification, critters that initially ingest the toxin store it unchanged yet are not affected by it. As these carriers are preyed upon, the next level in the food web accumulates more of the toxin. At some point in the food web, the prey is poisoned by the higher concentration of the toxin.

Oil and Gas

Under the vast delta lands created over thousands of years by the Mississippi River system, the discovery of oil and gas deposits in the early twentieth century led, initially, to drilling on coastal mainland in Louisiana and west Texas. In the 1920's the development of the barge derrick allowed drilling on coastal marshland and later offshore in shallow water. Today, the activity is in deep water, in water as deep as 5000 feet. Concurrently, oil and natural gas extraction, collection, refining, distribution and importing created a major industrial infrastructure along the Gulf's northern coast.

Louisiana accounts for 80% of the nation's offshore production, 400 million barrels a year of oil and four trillion cubic feet of gas. Over 40,000 wells have been drilled offshore. Many of the onshore and delta land wells are drying up. Current onshore production is roughly 150 million barrels of oil and one and a half trillion cubic feet of gas a year. Louisiana has over 250,000 oil and gas wells on land or in the marshland. These wellheads are connected to receiving pipes that gather their output and run it to storage areas and thence on to refineries (oil) or to major national distribution pipelines (gas).

In the delta lands, pipes are everywhere, strewn like spaghetti, both within the marshlands and on the ocean floor. Within the marshlands canals are as ubiquitous as pipelines. To get drill rigs into the marshes, canals were dug and the dredge spoil heaped alongside them, creating embankments that, today, hinder the flow of water within the marsh. Over 10,000 miles of canals criss-cross those marshlands and over 35,000 miles of pipe have been laid. Adjacent to each drill site sits a spoil pit where drilling mud and sludge remain from the original operation.

The storm vulnerability of pipelines and offshore drilling rigs was made all too apparent by hurricanes Katrina and Rita;

113 drilling platforms were destroyed and nearly 500 pipelines damaged. Storm surge toppled storage tanks. In St.Bernard Parish, an oil storage tank was overturned spilling a million gallons of oil into adjacent marsh. That spill has left benzene in the sediments of over a square mile of marshland.

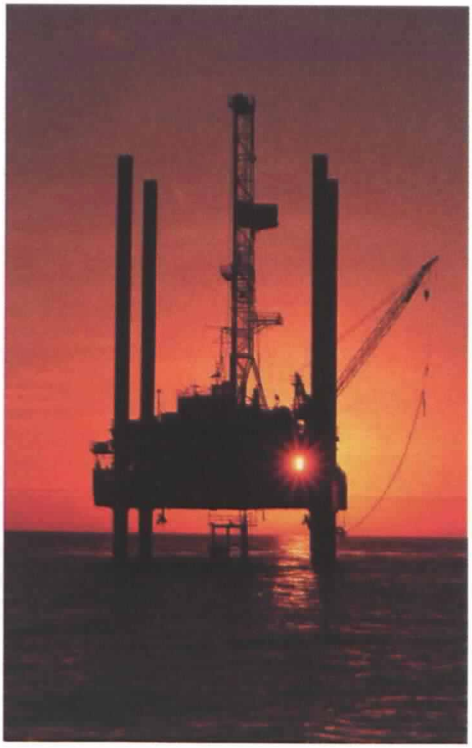
The state of Florida, which once welcomed wildcatters, has, over the last 20 years, fought off exploration in the Gulf along their western coast. At present, most of both federal and state waters (Florida has control of water 10 miles to sea on its western coast) are under a moratorium that will expire in 2012. However, several oil firms hold leases issued prior to the moratorium and are now in court trying to get those restrictions lifted.

Because Florida has a thriving tourist industry, the desire for clean beaches created this stance. They point out that over the 1980's and '90s; there have been 73 incidents of oil spills along the Gulf coast resulting in the release of three million gallons of oil. There is also the hazard of contamination from drilling mud. However, a report by the National Academy of Sciences found that less than 8% of oil spilled in U.S. coastal waters comes from tankers and pipelines and only 3% from offshore exploration. The vast majority of oil comes from "consumer" uses: effluent from pleasure boats, personal watercraft, and runoff.

The Dead Zone

Runoff has serious consequences. The Mississippi River presents a prime example. Off the coast of Louisiana, close to shore, an underwater area larger than the size of Massachusetts is without oxygen and, therefore, without animal life. Although the affected bottom area waxes and wanes from year to year, it continues to spread westward, now as far as Texas.

Bottom water hypoxia in the Gulf isn't limited to this region. Other areas, albeit smaller, include the Usumacinto in Mexico, sections of Corpus Christi Bay, and the Fenholloway River in Florida. Ephemeral occurrences along the southwest side of Florida have been connected with prolonged bouts of red tide, a harmful algal bloom caused by the organism *Karina brevis*, and pollution in Florida Bay.



One of more than 40,000 offshore oil and gas rigs in the Gulf of Mexico.

The major cause of the dead zone off Louisiana is the ever-increasing nutrient load carried south by the Mississippi River system that drains 40% of the continental United States. Fertilizers washed off farms make up 50 to 65% of the fixed nitrogen carried into the Gulf. Municipality and industrial waste contribute another 10%. Currently, the Mississippi carries 1.8 million tons of fixed nitrogen to the Gulf each year, three times what it carried in 1960.

Unfortunately, nitrogen-based fertilizer is so cheap that farmers use it in super-

Red tide (Gasparilla Island), the generic name for a number of small phytoplankton that can bloom in massive numbers over wide areas. Almost all are poisonous to some degree. In southeast Floridared tide refers to a bloom of Karenia brevis which produces especially virulent poisons released when their cells split open. The brevetoxins kill fish; accumulate in shellfish, making them inedible; accumulate in some aquatic mammals, particularly the manatee, eventually killing them; and affect humans onshore who breathe in the airborne toxin. Between sneezing and coughing, and the stentch of dead fish, red tide is anathema to the tourist trade. Although blooms have been recorded as far back as the Spanish occupation of Florida, the frequency and longevity of recent occurrences have led some to believe their severity is exacerbated by pollution.

abundance to raise crop yields. At present, a farmer can find a market with rapidly rising prices for all he can grow. Crops like corn and soy beans will continue to be in heavy demand not only for animal feed and for export but for the explosive growth of ethanol as a gasoline additive. Nitrogen-rich water over stimulates plant growth, most of which quickly dies, settles to the bottom and decomposes. This process consumes dissolved oxygen and continues under all the oxygen dissolved in the water is used up. Then a new group of bacteria continue the process forming hydrogen sulfide as a by-product. Hydrogen sulfide is extremely poisonous to animal life.

Trash

As upsetting as it is to find cigarette butts on a beach, a sure sign of an uncaring visitor, usually washed-up items can be handled by simply picking them up. Not so on a 66-mile long sandy beach in Texas, the sea border of the Padre Island National Seashore. Wind driven currents from the southeast clash with the usual clockwise rotation of the coastal alongshore current and deposit the effluvia from shrimp boats, commercial fishermen, offshore oil rigs, military vessels and cruise lines.

Shoes, computer monitors, 20-foot long buoys, hard hats, 55-gallon drums, cloth of all description wash up on shore. Some days it's oil, other days a dead turtle. Almost anything thrown into the Gulf that floats can wind up on the beaches between Corpus Christi and the Mexican border.

Only the first 10 miles is regularly cleaned. Once a week a crew of five pick up almost two tons of trash. Beyond the beach they cover, the sand grows so soft it hampers the use of a vehicle. Occasionally the Park has held volunteer cleanups on more remote portions of the beach: in 2003 one cleanup netted 62 tons of trash. .

Mexico

Gulf contamination from Mexican sources is enormous and, as yet, has not been properly quantified. A burgeoning population, poverty, lack of infrastructure and offshore oil has all contributed to heavy pollution in the rivers and bays and along the coastline. Despite years of negotiation, funding has been in such short supply that neither the extent of the problem nor their remediation has gotten to first base.

As of 2003, EPA's Gulf of Mexico program had no program involving Mexico. Congress simply won't fund them on this issue, but the relationships among academic institutions in the U.S. and Mexico have resulted in cooperation that is producing data. The Institute of Ecology in Vera Cruz is working with both Louisiana State University and the University of Maryland.

By far the largest industry in the Gulf lies offshore and is oil. Pemex, the monopoly of the Mexican government, provides over a third of all federal revenue but it is also that nation's primary polluter. Oil contamination has seriously hurt artesian fishing along Mexico's coastline. Nor can Mexican fishermen find new ground offshore. Restrictions on vessel's proximity to oil rigs have cut the available offshore fishing areas to 20% of what it was before oil was found.

Mexico's urban problems of expansion without accompanying infrastructure have meant more raw sewage and solid trash doing environmental damage among an already poor citizenry. One of the most polluted rivers in the world, the Coatzacoalcos, enters the Gulf at Vera Cruz. Prior to oil, fish and shrimp were abundant enough to feed a substantial portion of the local population. No longer. Traditional seafood markets have closed and those remaining sell imported produce to those who can afford it.

Although Mexico has enacted laws to stem industrial waste, they are not enforced. Sewage treatment is almost non-existent. The government has put most of its efforts into delivering pure drinking water.

Saving the Gulf

Although bays, estuaries and the open water of the Gulf have been wounded by a thousand cuts, at least partial remediation can be done, some inexpensively but some at enormous cost. Certainly, remediation of superfund sites is strictly a dollar issue.

Big-ticket remediation requires a balancing act among a wide swath of agencies and interests. Not only must private interests be taken into account as well as local, state and federal groups but also state and federal legislators who provide the funds for many of these projects. The side effects of all these disparate organizations are a near-continuous battle among environmentalists and non-conservation interests and the push-pull of local, state and federal politicians.

For the Everglades, half of it is lost, over 8 million acres converted to homes and farmland, mainly sugar cane, but south of Lake Okeechobee, the rest can be restored for about $8 billion. The Comprehensive Everglades Restoration Program (CERP) calls for redistribution of the flow of water from the north and significant reduction of phosphorus runoff from the sugar fields north of the Lake that currently is promoting cattail growth in the Glades and algae blooms in Florida Bay.

CERP is a collective effort between the State of Florida and the federal government. The schedule for some 50 projects runs for 30 years. This means both the Florida legislature and federal government must allot funds every year – not an easy situation. Already there have been changes in projects allowing further development and drainage plans for flood control that have some saying CERP is more about development than restoration.

The Louisiana marshland problem is another example of competing interests coupled with indifference. Louisiana wetlands are diminishing at the astonishing rate, equivalent of a football field every 15 minutes. When New Orleans was founded, there were five million acres of wetlands in Louisiana. Today the number stands at three million acres. The damage wrought by hurricane Katrina was foreseen years ago and a multitude of remedies offered. Each met with resistance from opposing interest groups and gridlock set in. At the behest of the governor of Louisiana, a long list of disparate groups came together and produced "Coast 2050: toward a sustainable coastal Louisiana." The price tag then was $14 billion. The federal government immediately said no. In the aftermath of hurricane Katrina and the apathy toward remediation in New Orleans, coupled with the reassignment of money originally scheduled for the Army Corps of Engineers for coastal repairs, the fate of the Louisiana coast still remains an open question.

The dead zone off the Louisiana coast, caused primarily by agricultural runoff in the Midwest Corn Belt, is currently being addressed by offering farmers federal payments for conservation practices such as creating swales or berms to capture fertilizer runoff from their fields. The Department of Agriculture also wants farmers to halt the practice of fall fertilizing which enhances spring planting. Many environmentalists feel that reliance on goodwill should be replaced with regulations on both nitrogen and phosphorus applications.

Almost every creek, river and estuary in the Gulf suffers from excessive runoff that carries not only nitrogen and phosphorus but also a plethora of organic compounds, many of which have unknown consequences. Runoff cannot be entirely stopped but can be ameliorated by redirecting storm water into retention ponds or swales. In far too many regions close to the Gulf, faulty or inadequate septic systems still exist. So do poorly operated package plants – small sewage treatment plants meant for low loads – that have not been upgraded since they were originally built. Properly treated wastewater can be put to good use for irrigation and suburban watering. This requires building and maintaining a holding and distribution system.

Given the opportunity, nature can perform massive cleanups but it needs large stands of marshlands, submerged aquatic vegetation, oyster beds and, south of Tampa, red mangrove stands. Open coastland is at a premium but where it can be obtained and refitted to allow nature to take possession, its long-term worth is invaluable.

The emergence of more powerful hurricanes over the last few years that have devastated low lying Gulf coastlines may bring about economic changes that will discourage rebuilding so close to the Gulf. The insurance industry is beginning to openly state that there are properties lying so close to imminent danger during a storm that they may refuse to insure them at all. A series of dangerous storms may also discourage the relentless increase in people moving to the Gulf coast and even create a trend toward moving away.

We must begin to think about how to live with the Gulf of Mexico over the long haul. If we redress our past misuses and avoid them in the future, this enormous resource can serve us well for many years to come.

THE PECONIC RIVER SYSTEM'S ALEWIFE THEN AND NOW

BY BOB CONKLIN

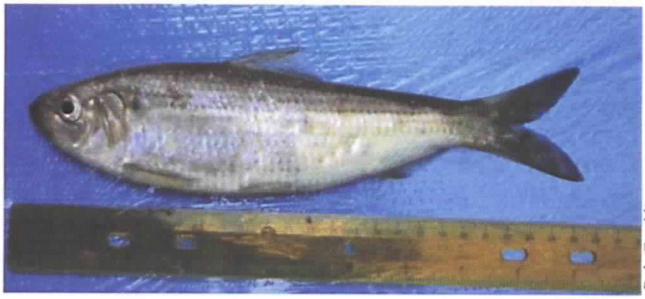
The Peconic River on eastern Long Island at one time hosted a healthy run of herring (mostly alewives) that mature in the ocean and may return to their natal streams to spawn. But, along the east coast, passage up rivers and streams has been blocked and herring populations have suffered. The Peconic River Fish Restoration Commission has begun an effort to restore herring runs in the Peconic system. It hasn't been easy but, it's working and we plan to do more.

The system was born accompanying the labor pains of the last ice age about 12,000 years ago when a continental ice sheet covered the upper regions of North America. This glacier's southeastern edge covered what was to become eastern Long Island in an east/west direction and extended southward far out into what is now the Atlantic Ocean. The glacier was estimated to be at least a mile and a half thick in places and, as it melted over decades, increased ocean levels some 200 feet.

A terminal moraine formed at the ice sheet's leading edge when the rate of ice advance equaled the rate of the ice melting. Clay, sand, gravel and rock embedded in the ice sheet's bottom layers pushed forward to the melting front edge and were deposited. This glacial debris from New England and north formed two terminal moraines with became the North and South Forks of Eastern Long Island.

Conklin is a retired marine biology teacher, Littoral Society fish tagger, and a founder of the Peconic River Fish Restoration Commission.

The South Fork of the moraine built to well over 300 feet and formed an impenetrable barrier for the retreating glacier's melt waters. When periods of warmer temperatures prevailed, the glacier retreated more rapidly and the melt waters washing from the ice's leading edges picked up the glacial debris and leveled the land in front of the ice into flat outwash plains. This flowing melt water, blocked by the South Fork moraine, turned eastward and formed the Peconic River basin and, farther to the east, the Peconic Bay system.



Bob Conklin

An adult Peconic alewife (Alosa pseudoharengus).

The river system became Long Island's longest 21 plus miles of ground water-fed fresh water becoming brackish as it enters the Peconic Bay complex.

The river originates in a red maple swamp and empties into Flanders Bay. Flanders Bay then flows into Great Peconic Bay and is filled by the tides and salt waters of the Atlantic Ocean. These fresh and salt waters form the necessary components of the alewife's life cycle.

Marine biologists refer to the alewife as an anadromous fish, maturing in the ocean but spawning in freshwater. The alewife spends most of its seven to nine years of life in salt waters before returning to fresh water to reproduce. This cycle is followed

Bob Conklin

Proposed rock ramp area for first dam on the Peconic.

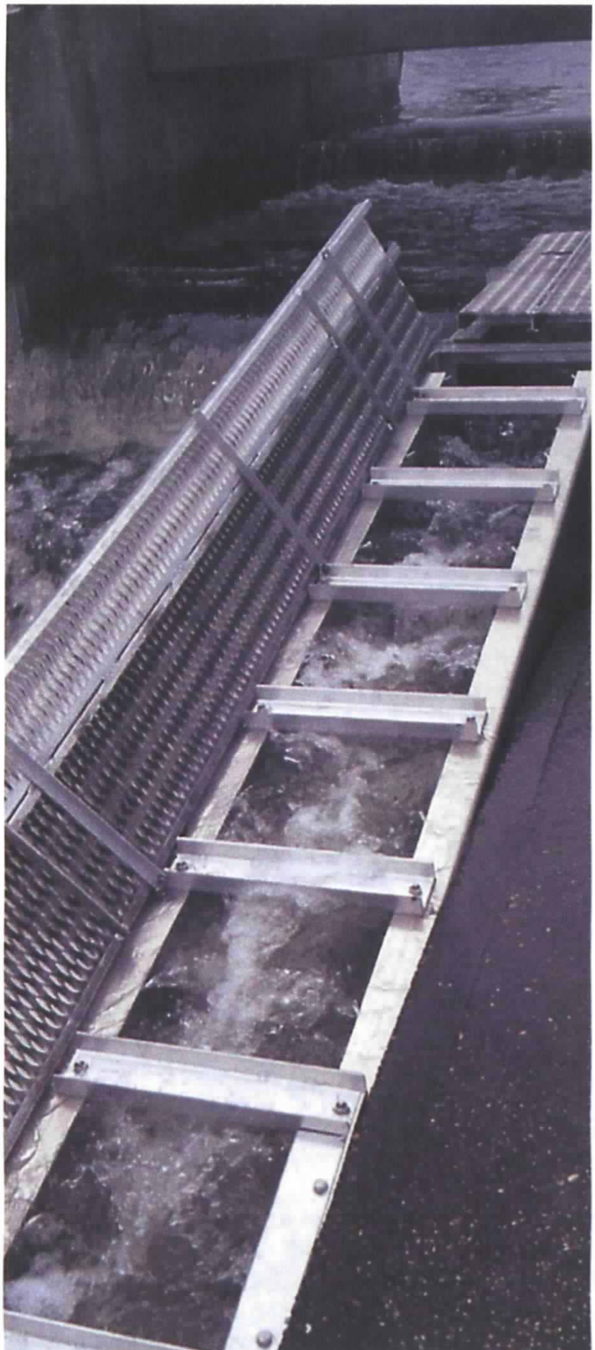
by other herring-like fishes and points to the complexity of nature and the evolutionary process. Late winter brings a migration of hundreds of thousands of adult alewives, male and female, to the Peconic Bay system spurred by the tenacity of the reproductive urge.

Native Americans, moving to this area after the retreat of the glacier, most likely took advantage of the alewife run, turning the herring into a bony food and fertilizer. European colonists appeared at the mouth of the Peconic River in 1659 where they built a sawmill; thus the Industrial Revolution arrived here, fueled by waterpower. To harness this power, they built earthen dams and spillways, blocking alewife access to many acres of fresh water spawning grounds. By the late 1880's, fresh water available to the alewife had been reduced to about two acres where fresh Peconic River waters mingled with brackish Atlantic waters. Near this juncture man had, for more than 100 years, blocked the way to the alewife's natural spawning grounds. Interestingly enough, these earthen dams and spillways can help today's alewives by greatly widening a once narrow river and creating hundreds of additional acres of breeding waters.

The negative effects of the first dam on the Peconic's alewives began to be addressed in 1995 when a state agency and a conglomerate of environmentally interested parties attempted a transfer of breeding alewives from the eastern part of the system to the fresh waters above the first dam. No one knows how reproductively successful this was but we did find out that the alewife was fragile and that many succumbed to the experience.

The following two seasons, local high school students and a loyal following of fishermen scooped alewives from below the first dam, carried them up and over the earthworks and released them to some 32 acres of fresh water spawning habitat. This is called a "herring toss." Again,

The origin of the name, alewife, is unknown. Many believe that it derives from the female tavern keepers of Elizabethan England who were large of belly like their fishy namesakes.


Rory MacNish

Alaskan steep pass ladder erected at the first dam on the Peconic River; it was moved eight feet to the other side of the spillway, where it proved more effective.

there was no way of determining whether we attained any successful spawning.

In 1999, local residents, assisted by state and federal agencies and local cooperative extensions, proposed that a fishway (ladder) be placed in this first dam The funds to support this project were raised by and from local school students, community citizens, and businesses. In the early spring of 2000, an Alaskan steep pass ladder was installed by an all-volunteer group into a 10-foot wide spillway. The ladder was fitted on the side that alewives were observed most often thrashing in the rapid current. For four weeks, the fishway founders watched the upriver exit of the steep pass but saw no fish leaving the exit. The alewives could be scooped up next to the ladder as they attempted their upstream run, but they seemed to avoid entering the mouth of the ladder.

What to do? Careful observation revealed that small schools of alewives would enter the swift water from the opposite side of the spillway where we assumed there to be a back current. They would then thrash into the main current but not cross to the steep pass, so we moved it eight feet to the other side of the spillway. Even as the pass was being secured, a worker leaning over the open top of the ladder was smacked in the face as an ascending alewife spooked and leapt from the ladder. Difficult to believe but borne out by the facts: eight feet made the difference between passage and avoidance. Immediately fish were observed exiting the ladder to the river above the falls.

A lesson well learned. Success

Spawning alewives in clean, still freshwater. They have come from the sea and their progeny will head in that direction come fall.

dealing with nature comes with being observant and flexible. Each fish passage has its own unique circumstances that must be accounted for to achieve success.

During that first season, the Peconic River Fish Restoration Commission was able to borrow an underwater video camera which we placed at the ladder's exit, taping alewives as they ascended the ladder. The camera was run for an hour at a time, and the fish were counted. The number counted led to many speculations: Do alewives swim upstream after dark? Are there nighttime migrations in some stream

Anadro...Catadro...Diadro

Fish that move between fresh and salt water at different life stages have been assigned various aliases by fishery scientists. Anadromous fish spawn in freshwater, go to sea where they grow to reach sexual maturity and then return (often to their natal waters) to spawn. Many – notably the Pacific salmons — die after spawning; some such as the alewife and American shad may spawn a year or so later; and striped bass and Atlantic sturgeon can run up rivers to spawn many times (though not necessarily every year).

Catadromous fish spawn in salt water but run to freshwater to mature. That's what American eels do – spawn near the Sargasso Sea and die; their progeny migrate up into East Coast rivers and ponds to grow up (at least the females do; most of the males stay nearer the coast in brackish water).

Collectively, these two types of fish are labeled diadromous in that their spawning sites and maturation habitats are ocean>river or river>ocean.

Here come some exceptions: Pacific salmons stocked in the Great Lakes now spawn in freshwater streams and use the lakes as their freshwater oceans to mature. Same with alewives in the Great Lakes and striped bass in, among other places, the Santee-Cooper reservoir system in South Carolina.

systems but not in others? Are their migrations affected by rain? Two hour-long tapes were recorded during the middle of the 2000 run. These were taped at what was observed to be peak migratory occurrences, based on observation of pulses of fish jumping in the white water below the falls. The videos proved that the ladder was being used; 53 alewives were recorded on the two hours of tape

The fish seemed to migrate at obstacles in pulses the way offshore wind driven waves wash a beach. The fish were most active when the tide was dropping from its halfway point and the pulses came at a rate of about every 20 minutes.

Is this a condition created at the base of this particular falls? Is this when the alewife is most easily observed? Two years later, during the run, a night tape was attempted near the end of a falling tide. The tape recorded no fish. Recorded tapes taken with infrared cameras have alewives traveling up streams at night in the Peconics, but our resident fishermen do not scoop net after sunset. Many simple basic questions about the intricacies of alewife migration still need to be answered.

The steep pass has been approved (and is regulated by state agencies) for placement from March 1 to May l which usually encompasses the Peconic alewife spawning migration. They have appeared as early as the second week in February, traveling under the ice of the Peconic Bays to begin their observed attempts at ascending the first fall on the Peconic River. The removal of the ladder around May 1 seems to make sense because upstream migratory activity has usually ended by then.

The yearly installation and removal of the steep pass has proved to be expensive and labor intensive and dangerous when coated with ice. The 17 miles of river above the steep pass supply a daily ration of plastic, wood, glass bottles, and paper which clog the baffles within the ladder. To remain functional, this debris must be removed by hand each day. The ladder is pressure washed at the end of each season and its lead net is handpicked for clinging algae and debris. The transportation of the 1000-pound structure to the falls each spring and back to its storage place present logistical problems.

A short lead net was added to the steep pass for its second season to help guide fish to its entrance. Some thought the net would act as a. deterrent, but trap fishermen routinely use this technique in their weirs. The far end of the net is attached to a cross current angled cable fastened at one end to a steel pole driven into the river bottom. The other end is attached to the adjourning bulkhead. The lead net angled to the mouth of the steep pass can be adjusted to allow for more or fewer fish to be directed to the down stream opening. This helped us allow the traditional local fishermen to scoop net a fair number of fish at this location, an attempt to balance predation and safe passage. The alewives are smoked

TAKE THAT, HERRING LOVERS

Political differences regarding the alewife are longstanding. Take this paragraph from the textbook "The Outer Lands" by Dorothy Sterling: "From the days of the pilgrims, the herring run has been a time of high excitement along the shore. Netted by the thousands, the fish were fried, smoked or salted in tubs of brine, while any surplus went to fertilize hills of corn. The catch was so valuable that when a new dam in Falmouth blocked the passage of the fish a Herring Party and an Anti-Herring Party formed. During a protracted fight, the Anti-Herrings filled a cannon on the village green with Alewives and fired it off, blowing fish, cannon and the man who fired it to bits."

and pickled and used for bait; the roe is considered by some a delicacy.

The lead net has worked well in conjunction with the steep pass at this falls. Two seasons ago record numbers of alewives were noted at the upper ends of the upriver impoundments. One of these is another earthen dam that in the past had controlled water flow for a cranberry bog. Beyond this dam lie 100+ acres of prime spawning waters, most within a county preserve, relatively pristine and protected. Ideal sand and gravel bottoms predominate in this area, constantly fed by ground waters from springs originating in Wildwood Lake. The outfall of the lake, Little River, is one of the few tributaries of the Peconic River.

A grant was applied for and quickly approved for bridging this earthwork. Plans for an Alaskan steep pass were drawn up, approved by the local regulatory agencies, and a near-future target date was set to begin construction, but upon approaching the local town government which supports the steep pass, it was discovered that a jurisdictional power struggle smolders between State and local entities over who regulates Wildwood Lake. The passage of alewives into this lake could be used as leverage by the State to supersede the local control of this pristine kettle hole. A compromise was sought — all parties recognize the ecological value of the proposed Little River fish passage but, at this time, concern about jurisdictional control trumps ecological restoration. Grant monies were returned and nature was not served. We are negotiating this issue.

On November 7, 2004 (late in the season), we observed thousands of young-of-the-year alewives migrating down Little River, presumably after exiting Wildwood Lake, strong evidence that the lake provides fertile spawning grounds. We believe alewife adults were introduced to Wildwood Lake; there is no evidence they could have negotiated the five-foot Little River dam.

Up the main stem of the Peconic, the next earthen dam blocks about 32 acres of spawning habitat. Federal, State, Towns and landowners all play their role. A by pass channel was considered here but other options present themselves. A series of step pools or a bypass channel with rock ramp-type features could be constructed to circumvent the main earthen structure. A third possible action could be to place a steep pass in one of the two presently functional culverts. Maybe lessons learned down stream can be applied here.

Grants are in the works, negotiations with various state agencies are ongoing, and local interests are being massaged. Looking back, one wonders: how did the original steep pass ever get approved? Cutting paths through the bureaucratic jungle means long, exhausting labors.

Taking into account the steep pass limitations discussed above, the commission is considered another option around the first dam. The waters of the lower Peconic flow through the described spillway and another passage, an old stone gristmill outflow. These long stonewalls change to wood bulkheads downstream, forming an ideal place to construct a rock ramp, less expensive, easier to maintain, and permanent, and the fish can be observed as they pass through the shallow waters.

A rock ramp is, as its name implies, a ramp made of various sized rocks which replace the drop of the waterfall or slow the water velocity of a rapid. Staggered boulders and a dimpled bottom create eddies and provide rest areas in the slowed water flowing over the ramp. A ramp is just as it sounds; a 25 ft. side, sloped, rock-lined incline (with at most a one-foot rise for every 50 longitudinal feet.) It provides safe alewife passage, and juvenile eels will be able to make their way among the rocks.

THE COMMISSION

The Peconic River Fish Restoration Commission is a group of some 100 individual participants. They have a stated goal: "To restore and improve diadromous fish access throughout the Peconic system to spawning and maturation habitat. The maintenance of these waters as a healthy and safe environment is paramount for the long term success of diadromous species.

The present diadromous fish stocks (especially alewife and eel) have in recent years experienced a drastic decline. Strands of the web of life have been stretched or broken. The Commission, like the Littoral Society, is interested in repairing and reinforcing these strands.

The Commission interfaces with federal, state, county, town, and other environmentally active groups, and well as the general public. In 1995, seven environmentally interested individuals formed the core of the Comission. Theye are now known as the "founders" who direct the activities of the organization. They call gatherings to discuss issues with interested participants. A majority opinion will move an action forward.

Funds for the purchase of the the first steep pass (fish ladder) came from the local public. The Commission now actively solicits for grants.

The Commission's progress to date has hinged on the volunteer work force which generated its present progress. The participants" pride of accomplishment has precedence over individual personal or financial gain.

Progress is exasperatingly slow, each step fraught with twists and turns, sometimes leading to pitfalls. The will of the participants dominates the process and ever so slowly pulls toward the achievement of renewed habitat for diadromous species.

FIDDLERS ON THE ROOF: CANOPY FEEDING CRABS IN A CAPE COD MARSH

BY DAVE GRANT AND NANCY CHURCH

The dock at Swan River, home of the crabs that feed in the canopy.

O conspiracy!
Sham'st thou to show thy dangerous brow by night,
When evils are most free?

Julius Caesar - Shakespeare

The Swan River is one of the prettiest water bodies on Cape Cod. It is about two miles, as the crow flies, from the river's source to Nantucket Sound – but twice that distance, as the swan drifts and the river meanders to its mouth on the south side of the Cape. One of several interesting features about the river is its narrow tidal inlet, which is not much wider or deeper than a motel swimming pool. It has a jetty on its west side and a small spit on the other, so it is a place that can be explored and fished in a variety of ways.

In spite of its small size, there is good tidal mixing in the lower reaches of the river and it creates a rich estuarine environment in the middle of one of the most densely populated spots along the shore. Most of the river's banks are the property lines and lawns of older homes and summer rentals, but some residents wisely allow a buffer of shrubs and trees to persist.

Motor craft are absent and on any warm day "in season" scores of canoeists, kayakers and paddle-boaters – residents and renters alike – cruise the river

Dave Grant is the Director of Brookdale College's Ocean Institute at Sandy Hook and previously wrote about hermit crabs and ocean crabbing. Nancy Church coordinates Interpretive Services and Volunteers for the Waquoit Bay National Estuarine Research Reserve on Cape Cod. They took the pictures.

between Swan Pond in Dennis, and the Sound. About 140 acres of salt marsh border the river and these wetland areas are widest downstream where the waters gently flow into the sea.

We like to explore here in September for several reasons; not the least of which is a free bungalow on the water's edge. Also, it is peak bird migration season, there is an abundance of life in the water, the crowds are gone – and so are the bugs. In the summer, gnats (no-see-ums, or sand flies – the dreaded and abundant *Culcoides* flies) can be maddening on calm days. (The landlord's shaggy dog story of the summer involved a couple that rented the cabin and called an exterminator to rid the area of these ubiquitous pests.)

The view from ship or shore is equally satisfying on the Swan, but close-up views of the marsh are obscured by shrubs or tall grasses along the edges. Tall, "high-vigor" cordgrass *(Spartina alterniflora)* at the creek's edge forms a barrier to the short, low vigor cordgrass and salt hay *(S. patens)* of the upper marsh. And since those areas are flooded thoroughly only on the spring tides, they are less accessible or inviting to paddlers.

One evening, while seeking the darkest possible spot for star-watching, we set up at the end of a long dock stretching across the marsh. It was a classic September night on Cape Cod – clear and calm. Too calm. After a short time orienting ourselves with the array of summer constellations of the Zodiac (Capricorn and Sagittarius to the south) light fog moved in off the sound and began to hide all but the brightest stars. So we had to be content with what was directly overhead, the dazzling points of the Summer Triangle, one of which is Deneb, the tail of Cygnus – the Swan. The star watch soon became a marsh study and instead we explored with flashlights.

Wetlands are wonderful at night, and peaceful conditions made this one especially magical. But the darkness offers little rest for the weary and the hunted. We could easily make out the wispy calls of migrating songbirds overhead, and there were rude squawks of herons and the slurps of bass gulping down their prey. The crescent moon hanging on the horizon meant spring tides too, and the water was quite high and on the flood it not only inundated the whole marsh, but reached halfway up the stems of the stunted, foot-high cordgrass of the upper marsh.

We made the obligatory attempt to catch blue crabs off the deepest pilings (Our net was too short and the tide too high), and then settled down to harassing bait fishes with our lights.

Observations:

> Killies (or "chubs" as they are called locally) tend to freeze in place at the bottom. (Is it a deer-in-the-headlights response, or do they not notice the light?)
>
> Menhaden ("bunker" locally) twitch and drift aimlessly as the school disintegrates, and often swim right into the dip-net. (Are they too blinded by the light or does this inhibit their normal defensive response which is to "ball up" into a tight crowd.
>
> Shiners ("silversides" locally) go berserk and start leaping out of the water in such numbers that it sounds like big raindrops if you target a large school. (Does the reflection of the light off their schoolmates startle them, or is this a "stadium wave" response that is initiated by one startled fish?)

In the shallow, upper marsh, several creatures immediately attracted our attention. At the tops of the half-submerged grasses we found fiddler crabs perching out of the water by gathering several stems and pulling the tips together for support like teepee poles. My first thought

A blue crab up in the Spartina. While their Latin names means beautifully swimmer, these could just as easily be called pugnacious climber.

was that they were simply caught away from their burrows by the rapidly rising tides "springing" up. Since the only ones we could examine closely were females, I also speculated that after the breeding season, they were no longer welcome in the burrows of the males, and so were wanderers trying to stay out of the reach of fishes.

Then we noticed tiny snails on the same stems. Was it possible the fiddlers were preying on them? Again, closer inspection revealed that the crabs were in a resting position (their eyes were folded into the sockets) but we did note that the snails were also concentrated on the dry tops of grass.

The saltmarsh snail, *Melampus bidentatus,* leads a particularly regimented life in the marsh and illustrates the complicated links between the tides and the creatures in this dynamic environment. No bigger than a pea, the snail is easily overlooked unless you know where to look for it: moving up and down the grass stems ahead of the tide. Since it is a pulmonate snail (an air breather like us) and its lung cannot function when submerged, the snail must constantly be on the move.

I've been told that *Melampus* "senses" the tide by the vibrations that resonate ahead of the rising and falling waters. In mythology, Melampus (the man) was a soothsayer who could understand the language of animals, and on one occasion, by eavesdropping on feeding termites, the talent once allowed him to escape a building before the roof collapsed.

Melampus (the snail) escapes the marsh for just a short period in its early life. Their reproduction is also tied to the tides, and gelatinous egg masses are laid before the spring tides so that they will be covered by marsh detritus and kept moist until the next spring tide; which occurs in two weeks – the time it takes for the eggs to develop. That next moon tide releases the larvae into the plankton community, and the veligers take another two weeks to develop. The lucky ones which are not eaten and manage to drift back up to the highest parts of the marsh, develop into adult snails. Although vast numbers of larvae must be lost each season, the process couldn't be better synchronized, and the snails are present in most marshes I've visited. Obviously the system works.

Movement in the grass attracted our attention. Something was slithering along, parting the stems in an orderly manner. To our surprise it was a blue-claw crab; not living up to its name *Callinectes* (beautiful swimmer) but crawling along, half out of the water. Initially we assumed it was stranded and heading back to deep water, but it soon became obvious that the crab was feeling its way across the marsh – searching. The night was getting interesting.

By reaching out with its claws, the crab would gather an "armful" of stems, and by bending them down while methodically propping its way up, was combing the grass for snails. This was confirmed visually in front of us, and audibly by soft crunches that we began to notice coming from another grass "cowlick" nearby. Apparently, other blue crabs were searching the meadow, gleaning snails (and presumably, fiddler crabs) from the tops of the marsh grass.

Our curiosity piqued, we returned the next night, and right on schedule with tide, we observed several blue crabs harvesting in the same manner. Watching them, I thought that if crabs had voices, they'd be working their way through the meadow humming something like:

"Sowing in the noontide and the
dewy eve…;
We shall come rejoicing, bringing
in the sheaves."

(Knowles Shaw ("The Singing Evangelist" - 1874)

Predator, scavenger or filter feeder? – the crab occupies a flexible position in the food web, depending on the situation. And experts like Vince Guillory (Louisiana Department of Wildlife and Fisheries) describe the blue crab's three feeding strategies as: "Raptorial": hunting for large prey by swimming with outstretched claws; "Interface feeding": from the surface of objects and on sediment surfaces; and "Plankton feeding": consuming small suspended material.

Watching them in action, it's obvious they present a challenge to their neighbors throughout the marsh, sometimes in ways that surprise us. By exploiting the upper marsh at night, crabs manage to short-circuit the food chain a bit and utilize an energy source that otherwise might not be available to them. We propose a fourth feeding strategy as described above; which, until we can come up with something more descriptive (or a better alliteration), we'll call "crab canopy feeding."

On the third night, a cold front, wind, bitter cold and heavy rains prevented us from making more observations. After that, falling tide levels kept water and crabs out of the upper marsh, but the cold, crisp nights were great for star watching. We now searched the sky with binoculars for faint star clusters – messier objects like the Beehive in the constellation Cancer. But to our dismay the star chart indicated that at this time of year, the Crab is blocked by the sun during the day.

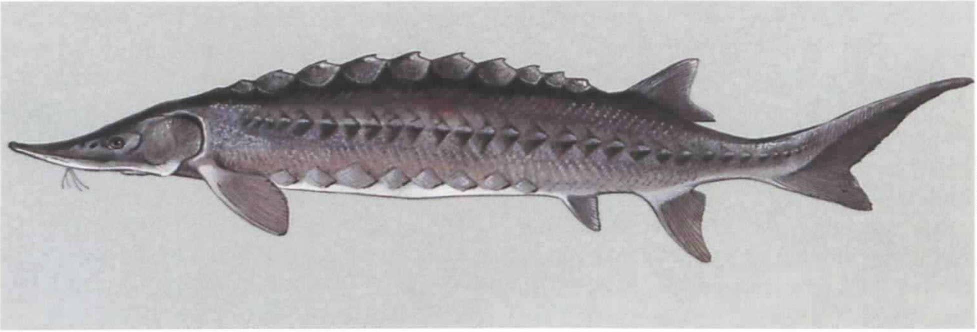
Pliny wrote that when the sun is in the house of Cancer, dead crabs lying on the sand will turn into serpents. While our crabs were not turning into serpents on Cape Cod, they certainly were acting like snakes in the grass.

TO CATCH THE STURGEON

STAFF REPORT

Forth upon the gitche gumee, On the shining Big Sea Waters, With his fishing line of cedar,
Of the twisted bark of cedar, Forth to catch the sturgeon,
Nahma, Mishe-Nahma, King of Fishes,
In his birch canoe exulting All alone went Hiawatha.

Henry Wadsworth Longfellow, Song of Hiawatha, 1854



Duane Raver, USFWS

Atlantic Sturgeon (Acipenser oxyrhychus)

A hundred and fifty years ago, Atlantic sturgeon from the Hudson River was called "Albany Beef" and was so plentiful it sold for 10 cents a pound, mostly, it is said, to Dutch settlers. In the mid-1890s, up to 1000 men would camp on the shores of Delaware Bay to process 5,000,000 pounds of sturgeon a year (75% of U.S. landings) for the Philadelphia market. In the spring of 2007, a jet skier suffered shoulder and spleen injuries when she collided at 35 miles per hour with a leaping sturgeon in Florida's Suwannee River. And a little later on the Willamette River in Oregon, half a dozen hook-and-liners battled, landed and released a white sturgeon that weighed over 1000 pounds.

Twenty-four species of these storied fish have been swimming the waters of the world for at least 100 million years, but now most of them are in trouble. Some are on endangered species lists, most are rare, and all are under more or less tight regulation. The most probable cause is over harvesting for meat and caviar, along with habitat loss and pollution.

For the 30 days of April 2007, the American Littoral Society conducted a survey of Atlantic sturgeon populations in a small section of lower Delaware Bay. The boats, nets, and hard labor were provided by two experienced commercial fishermen who searched for sturgeon near the mouth of Maurice River, a tributary on the New Jersey side of the Bay in Cumberland County about 20 miles north up the bay shore from Cape May. The project consisted of catching sturgeon, taking measurements, tagging them, collecting a small flesh sample for DNA analysis, and then releasing them. In addition, larger flesh samples from recently dead sturgeon were to be collected for contaminant testing.

The Fish

As noted, there are two dozen species of sturgeon worldwide, including the giants of Russia and the North American West Coast, and there are sturgeon that spend their entire lives in freshwater. Our research target was the Atlantic sturgeon, an ancient, long lived marine fish that populates coastal water, estuaries, and tidal rivers from Georgia to the Canadian Maritimes.. Mature sturgeon spawn in freshwater. Their young spend up to two years near where they were born, then go to sea and wander up and down the coast and into estuaries. They feed on the bottom on worms, mollusks, and crabs. And they get big, up to 10 feet long and 800 pounds, though fish that size are now extremely rare. They can live 40 years or more. Big females can lay up to 3,000,000 eggs, but may spawn as infrequently as once every five years.

Using genetic testing, biologists can identify five sturgeon races (they call them "distinct population segments") along the Atlantic coast, divided roughly into the following geographic ranges: 1) Gulf of Maine, 2) New York Bight – which includes the Delaware, 3) Chesapeake Bay, 4) Carolina, and 5) South Atlantic. While this designation lumps Hudson and Delaware sturgeon together, data indicate that the Delaware River has a distinct genetic signature of a remnant sturgeon population. Generally, mature sturgeon return to their natal rivers to spawn while juveniles move up and down the coast nosing into estuaries but not running up rivers. Biologists all along the coast want to know how these separate races are doing.

Several aspects in the life history of Atlantic sturgeon mitigate against their ability to rebuild their populations easily or rapidly. For one, while they are long lived, they are slow to come to reproductive age; it's about 10 years for males and close to 20 before females are in their reproductive prime. Thus, if the populations are way below normal, it will take some time before numbers start to climb. And, indeed, the fishery for sturgeon along the U.S. Atlantic coast was closed for 40 years in 1998, so that two generations of sturgeon get to be born, mature, and reproduce. (There remains a small, tightly regulated sturgeon fishery on Canada's east coast.)

It is also clear that the sturgeon's habitat has been damaged. Importantly, the main stems and some of the big tributaries of most coastal rivers (the Delaware is an exception) have been dammed, blocking access to spawning grounds. And estuaries and coastal rivers have been battered by dredging and filling, and by poor water quality, including low dissolved oxygen levels (the Delaware above Philadelphia was essentially blocked by pollution for decades in the past century, preventing sturgeon from reaching their traditional spawning grounds just below Trenton).

So we are faced with a severely stressed sturgeon population slow to reach sexual maturity, and few and far enough between so they have a tough time meeting up to spawn in waters whose quality is far from ideal. Even with the fishery closed down, recovery will be a long haul.

The Project

Our goal was to net, tag, and release sturgeon, the more the better, the bigger the better. The fishing gear consisted of five 600-foot gill nets, 10-inch mesh monofilament. The nets were anchored and fished to cover the bottom six feet of the Bay in water ranging from 10-30 feet deep. The nets were set within a few miles of each other around Latitude 39 06 N, Long 75 05 W, roughly 6-10 miles west of Reeds Beach, NJ. They were tended once a day, starting around 7:00 a.m. Each net was reeled onboard the fishing vessel Salty Tours, Captain Brick Wenzel, mate Rick Delsordo, fish were pulled from the net, and the net immediately reset. Operating all five nets took about 8-10

Kirk Moore, Asbury Park Press

Tending the net: gill net coming over the stern. The net fishes the bottom six feet of Delaware Bay. Fish are tangled in the monofilament mesh and brought aboard.

hours door-to-door. Everything caught in the net was counted.

The procedure for sturgeon was as follows: each sturgeon would be brought aboard and taken from the net and laid on deck. The sturgeon's tail area was scanned with an electronic instrument – a "reader" -- to see if it had a (passive integrated transponder) PIT tag already in place. If it did not have a PIT tag, one was injected into the fish near the tail. A PIT tag is cylindrical, about half an inch long and as big around as a pencil lead, previously coded (the reader can read the code; the fish carries the tag forever -- it's similar to tags used to mark pet dogs). A second, external T-bar tag is set in the fish's shoulder – they are similar to those plastic T-bars used to mark department store clothing. The fish is measured, and a small piece of flesh is clipped from the pectoral fin and placed in alcohol for later DNA analysis. If a sturgeon larger than five feet (a possible spawner) is caught, we had arranged with Delaware State University on the other side of the bay for them to rush over and place a radio tag in the fish. The University has a series of buoys up river so they can track adult sturgeon to their breeding grounds. The University has extensive involvement with the study of sturgeon, often cooperating with commercial fishermen on their side of the Bay who might capture sturgeon as bycatch.

The aim of the Littoral Society's project was to add information about the relative health of the Delaware's sturgeon population, while similar projects conducted similar research from Georgia to Canada.

The Society also reached out to local schools and commercial and recreational fishermen to emphasize the importance of sturgeon to the overall health of the Delaware estuary. Reporters from three newspapers – the Philadelphia Inquirer, the Asbury Park Press, and the Press of Atlantic City, and from NJNTV -- spent time onboard and wrote stories.

30 Days on the Bay

Here's how the actual operation played out: The five gill nets were set on Sunday, April 1, 2007, and pulled from the Bay 30 days later. In summary, five juvenile sturgeon, ranging in size from 33 to 55 inches were tagged. Three of these were netted by ALS; two were netted to the northwest by New Jersey Division of Fish, Game and Wildlife sampling for striped bass and brought to us for tag and release. No sturgeon was large enough for a radio tag. At this time, the DNA testing is not complete, so it is not possible to say whether these were Delaware fish or fish from other natal waters.

Weather did not cooperate during part of the April effort. A violent storm struck April 7, and we lost two days of fishing, followed by a few days of extra high tides, twisted and clogged nets (mostly dead vegetation washed off tidal wetlands), including massive mats of phragmites stems, and one deck chair. On April 13, another storm blew through and we lost five more days.

Other marine species caught in the nets (bycatch or non-target species) included: 1680 bunker (menhaden), 1070 horseshoe crabs, 30 skates, 12 striped bass, 8 dogfish, 3 fluke, and 1 black drum. The bunker were not caught by their gills. As filter feeders, they often swim through the water with their mouths open gathering plankton; the gill net monofilament caught them in the back of the mouth. The horseshoe crabs were generally in the lower third of the nets and increased in numbers over the 30-day period as they started their spawning journey toward Delaware Bay beaches. Eleven of the crabs bore U.S. Fish and Wildlife Service tags and were so reported.

The five sturgeon were tagged and released April 19, 23, 24, 25, and 28.

A typical fishing day went like this: Leave the dock at 6:30 a.m. after a huge breakfast of eggs and meat, toast, juice,

Kirk Moore, Asbury Park Press

Once on board, sturgeon are measured, checked for tags, marked, a sample of fin is clipped, and the fish returned. That's Rick Delsordo, left, and Brick Wenzel.

coffee and fruit (no time for lunch once the fishing started), and head down the creek past an osprey nest, wheeling laughing gulls, never-quiet willets, wading egrets and herons, once a bald eagle, and once a river otter. Out on the bay it was 30 minutes to the first net, held to the bottom with 85 pounds of anchor at each end to cope with the bay's strong currents. The net buoy was hauled on board, and the net was then hooked to a drum and hauled over the stern. Captain and mate stood on each side of the net, culling bycatch and debris as it came in. When the pull was completed, the net was reset, and it was on to nets 2,3,4, and 5. Between each pull, the Captain has to fill out what seemed like endless forms, recording such things as location, water depth, air temperature, surface and bottom water temperature, dissolved oxygen, salinity, what each net caught, and what was kept and what went back in the water.

Kirk Moore, Asbury Park Press

PIT tag is injected into sturegon near base of the tail.

When a sturgeon came on board, things could get hectic, mainly because there was work to do quickly so the sturgeon could be released in good condition. It was a rush of grappling gently with a muscular fish, reading it for previous tags, measuring it, tagging it twice, clipping a fin, and getting it back in the water. It's a 15-20 minute procedure.

Contaminant Study

The National Marine Fisheries Service used the project as an opportunity to examine for potential habitat chemical contaminants, particularly fat soluble PCBs, PAHs, pesticides, and other man-introduced chemicals in Atlantic sturgeon in Delaware Bay, a body of water at the receiving end of multiple discharges from the petrochemical plants and refineries of industrialized Philadelphia and vicinity. They will do this by collecting and testing flesh samples from sturgeon carcasses found in the river and by measuring contaminants in river and bay sediments. Remember, sturgeon tend to hug the bottom and feed on organisms there.

...

The project was managed by the American Littoral Society through a grant from the National Fish and Wildlife Foundation. Other agencies involved and generously cooperating were NOAA's National Marine Fisheries Service, NJ Division of Fish, Game and Wildlife, Delaware State University, Delaware Department of Natural Resources and Environmental Control, and the U.S. Fish and Wildlife Service. The Society aims to repeat the study – modified if advisable – for at least two more years, depending on funding. For information on Atlantic sturgeon and this project check the Society's website: www.littoralsociety.org.

From The Director's Desk

INDUSTRIALIZING THE OCEAN

The romantic image of the ocean is as a vast and unknowable realm — limitless, dynamic and unconquerable. Increasingly, what may be most wide open about the ocean is the future of this romantic character itself. Demands for energy production – from oil and gas to huge windmills and undersea turbines, mineral mining, offshore fish farming and other "entrepreneurial" ventures — are creating a future picture of crowded, industrialized oceans. Enter the "Age of Ocean Sprawl."

Romantic ideals aside, there will undoubtedly be heightened conflicts between those with designs on limited ocean space in the near shore. The downside, of course, is that the littoral zone is where all the life is. In the race to stake out space, the losers may be those who are already in the end zone – marine life, migratory shorebirds and traditional users of the ocean such as recreational and commercial fishermen. Studies of offshore wind turbine farms in Europe have shown that they divert migratory birds off traditional paths, lead to the complete "replacement" of benthic communities, and are increasingly placed off-limits to fishing vessels by governmental action. Limited commercial dock space is taken up by the wind farm's service vessels, pricing out others.

Sprawl on the dry side of the beaches is viewed as undesirable, costly and wasteful. Tremendous public and private energy is spent on the pursuit of "smart growth." Little attention has yet been focused on the implications for ocean sprawl on the seascape. There is some discussion of a land-side type approach – "ocean zoning" in response to "ocean sprawl." Separating the competing parties into their respective corners of the sea avoids addressing the most fundamental question: what values does the ocean, in its un-industrialized condition, provide for us, and what are we willing to trade those values away for? Quite simply, should we sprawl at all?

In almost all cases of the newly proposed uses of the ocean, there are alternatives: conservation and energy efficiency instead of windmills, restoration of estuaries and historic fisheries instead of ocean aquaculture, increase the fuel mileage standard instead of drilling for oil and gas (not new uses, but more of the same). None require the public to cede over the ocean to private industry. Past practice was to subsidize industry by allow it to pollute our estuaries and rivers to the point where they provided no value to the public, only the polluter. Now, sights have been set on occupying the waters themselves. The cost is lost public access and use, impacts to ecosystem values and services, diminished fisheries and displaced fishermen.

We are heading toward the age of ocean sprawl with little in the way of safeguards for ocean resources: a strong investment in marine science to bolster our understanding of effects and potential harms, development and aggressive implementation of alternatives to proposed industrial uses, and clear leadership from the federal government in response to the cues from the U.S. Ocean Commission. The next time you are sitting in traffic, fretting over high property taxes and how much you miss the farm and woodlot that used to be down the street – imagine a salty version of the same scene off your favorite beach.

Tim Dillingham

Tagging Report for 2006

by PAM CARLSEN,
ALS Tagging Director

The 2006 tagging figures are in. Thanks and congratulations to all of our taggers. The total of fish tagged was 29,756, that's 3,870 more fish tagged than in 2005. We had 1,326 recaptures, 76 more than in 2005. Our number one species tagged is still the striped bass: 22,775; number two is summer flounder (fluke), 3,174; moving into third place is tautog (blackfish), with 1,636. This is mainly due to the efforts of Captain Monty Hawkins of Ocean City, MD, who wrote in March of 2007. "Well, this time we were able to keep our state record, tautog, 20 lbs. 11 oz. Nice." Bluefish has dropped to fourth place with 1,308 tagged. The balance is a variety of species spread from Maine to the Gulf of Mexico. In April of this year, all of our data were sent to National Marine Fisheries Service, Woods Hole, MA, where it has been dispersed to the scientific community.

Sometimes tagged fish prefer to swim to Woods Hole, rather than just being recorded on a disk. On 5/14/07, a 24" striped bass was recaptured in the Great Harbor. This fish had been tagged by Ken Hollins at Seaside Park, NJ, 12/1/05 at 21".

Nearby at the entrance to Waquoit Bay in E. Falmouth, MA, on 5/21/07, a two-pound striper was caught with a tag. This 18" fish was tagged by Elmer Taylor, seven weeks before in Cliffwood Beach, NJ, on Raritan Bay. A long trip for a small striped bass.

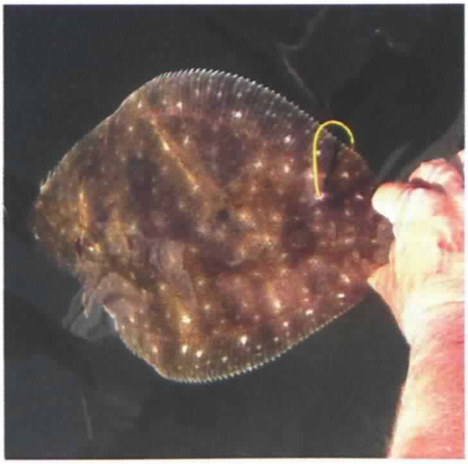
A tagged 17-inch black sea bass ready for release.

Up north off the coast of Boston lies Stellwagon Bank, a great cod fishing ground. On April 29, 2007, Capt. Al Anderson, Snug Harbor, RI, tagged a 19" Atlantic cod on Stellwagon. On June 3, 2007, this fish was recaptured by commercial fisherman, Joe Jurek, who was fishing out of Gloucester, MA. He reported the cod to be in excellent condition and feeding on sand eels on the north end of Stellwagon Bank. The cod was 20" and released. This tag and the information was turned in to Jon Loehrke, UMASS, School for Marine Science and Technology, who spoke to the fisherman. He reported, "that the cod are quite dense and healthy in the area. He has been making 45 minute tows to get his legal limit of 800 lbs. This group of fish is in the later stage of spawn unlike the fish directly to the north, in Ipswich Bay, that are starting to spawn." The data on this cod made the journey back to Sandy Hook, via a charterboat captain, a commercial fisherman, and a scientist, all concerned about the species.

In May, 2007, we received this note from Capt. Bill Russo, fishing the fork of Long Island, "These are lucky fluke. If they lived in New Jersey or Connecticut, they would have been eaten this very evening! Releasing 19" fluke is a tough sell to fishermen. Luckily, so far, I have been able to catch some 20-22" fish." Capt. Bill tags the fish his customers cannot keep.

Sport fishermen and men who earn their living by the sea must have patience. Our tagger, Jean-Luc Samyn exhibits this trait. A tagger since 1990, Samyn's last return was June of 2003. Then on 5/15/07, Harold Carpenter, fishing a gill net in the James River of Virginia, caught a 21" bluefish tagged by Samyn on Sept. 27, 2006, in Manhasset Bay, NY, four years between returns.

On the other side of Long Island Sound, Ray Leja fishing in Bridgeport, CT, tagged two, 22" striped bass, one on 10/24/99 and another on 10/11/01; both were returned from the New York side of the Sound in May of 2007 in the 30-35" range. Both of these were very nice long time returns. Leja has had many returns in between.



Returns shared by two taggers is uncommon. On 11/29/06, John Beck tagged a 17" striper at Cape May Point, NJ. It was recaptured and released with the tag, by Greg O'Driscoll in the Delaware River, at Penns Grove, NJ, on 4/19/07. On 5/15/07, it was recaptured once again, at Cape May Point and the tag removed. This 17" fish completed a full circle, up the river and back down, November to May.

Field Notes

WHAT FISH LEARN IN OUR ATLANTIC CORAL REEF

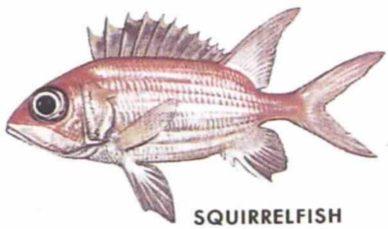
BY ART HEYMAN

This was written on May 12, 1995, just after I completed training to be an exhibit guide at the National Aquarium in Baltimore. I am still an exhibit guide there, or at least I will be until they read this article.

"Observe their behavior," the instructor yelled at us. "Behavior. Behavior. Go, observe." Do I look like someone who would defy authority? I go to the Atlantic Coral Reef and look at the fish. They swam around and around the tank. Permits and spadefish and lookdowns and blue tang and yellowtails and squirrelfish and ... Wait a minute. This doesn't make any sense. Permits always look like they are late to a party. They swim around because it's a round tank. If it were long like a spaghetti factory, they would swim laps. That's what permits and spadefish do. But not yellowtails. They don't go anywhere; they just moon around. And squirrelfish hardly travel at all. They find a nice comfortable overhang and hang out. So here I am observing these fish behave, and they don't even know how.

Let's reflect on this from their point of view: "We spend hours and hours in a dark, jiggly truck, and then we get poured into this big pool that doesn't have any tides. It looks right, but it doesn't have any seaweed and a lot of the stuff that should wave in the current doesn't. And it certainly doesn't smell right." We shouldn't really expect them to behave just as they would at home.

Now a few weeks have gone by, and some of the animals are re-establishing old habits. The squirrelfish don't stay in the caves as much as you might expect, but at least they're not chasing around anymore. The porcupinefish is still aberrant. If you want to see him on a reef, you have to go down to the bottom and find a hole and keep looking in until your eyes adjust to the dark, and then finally you see that baleful green eye glowering out at you suspiciously. He knows that everybody else knows that if somebody swallows him, he can stick his spines out mak-



SQUIRRELFISH

ing digestion very uncomfortable, but he also knows that not getting swallowed works even better. But not our porcupinefish. For the first time in his life, he is basking in the sun. "Baltimore is great for sopping up rays," he was heard to remark.

So it seems that each of the guys is adapting to the new conditions in his own way. Just what is different besides the fact that nothing stings? Well, they don't have to forage and they don't have to protect themselves, and since catching food and hiding are what they spend most of their time doing on a natural reef, those are pretty big changes.

We know a little bit about how fish adjust to changes in the "wild." For example, there is the concept of "social distance." I don't know if I made this up or heard it somewhere, but it seems to work like this: every species has, under natural conditions, a particular space that it wants you to respect. You can swim that close to him, but when you get any closer he backs off. With a parrotfish, the distance is around 15 to 20 feet. A barracuda and most of the angels don't get nervous until you are only six feet away. Soapfish are like 'possums: they don't move and hope you will go away. Groupers in an undisturbed area are so curious the social distance is zero—they come up to see what's going on and may even nudge you if you don't pay attention to them. You can tell if you are in a disturbed area when you observe that the social distances are abnormal. If there is a lot of spear fishing, the fish will become shy. If somebody is feeding the fish, they will come up and beg.

Fish learn these tricks fast and they learn them thoroughly. Wherever they got their reputation for being dumb as afghan hounds, it is a bum rap. Once snorkelmg m the Tobago Cays, I was first out of the boat. Floating on the surface, I saw some nice game fish below hovering close to the reef—not hiding, but not venturing out either. Then my buddy came over the side with his spear gun. Instantly, the sea was empty. The minute they saw that long shiny thing with the wiggly things on one end, they were gone for the afternoon. They may not be able to pronounce "spear gun," but they sure know what it is. In Grand Cayman schools of huge Bermuda chubs surround a swimmer, and if you don't feed them promptly they begin gumming you.

Yet some things they seem incapable of learning. Once I saw a fish trap on the bottom so jam full of horseye jacks, their civil rights were being violated. Rats can figure out how to deal with traps, but apparently fish can't.

I wonder how long it takes for a fish to understand he doesn't have to fear a predator. Maybe the wild offers a clue. Once I saw a magnificent four-foot snook lying quietly under a ledge surrounded by scores of small damselfish and squirrelfish and other tasty-looking morsels. They were all just floating there together—the lion lay down with the lambs in that underwater peaceable kingdom. My guess is that the snook had eaten something large recently, and he was giving off vibes that said, "At least for now, I am perfectly safe," and the little guys were reading him clearly. When he gets hungry again, will the message change and give the little guys warning? The first snook who learns to disguise that message can patent his discovery and make a fortune.

So maybe it is natural for the little fish in our tank not to be afraid of the big predators. But then, what is "natural" vs. what is learned, or what new behavior is "learned" or invented under changed conditions becomes a tricky issue. The Atlantic Coral Reef is a real, if artificial, ecosystem, and its inhabitants can be expected to learn (invent? create?) a new set of behaviors that are appropriate for living in it. Do fish get bored when they have so little honest work to do? Are bored fish more aggressive, mischievous? Do fish have a social structure? Is the social structure different in the tank from what it would be on a reef? Do fish develop similar behaviors in different aquariums even without Internet, or can we distinguish behaviors that are particular to isolated populations? Do fish play? Do they play more with so much time on their fins? Are teenage fish particularly pesky in captivity? Would restricting television help? Maybe we ought to start a whole new science of aquarium fish behavior. Or maybe it already exists. I wish somebody would tell me about it.

Field Note

JELLYBALLS ON THE BEACH OR WHERE JELLYFISH DIE IN FLORIDA

BY BARNEY COLE, WITH PHOTOS BY MRS. COLE

This is another "you never know what you will find or see walking the beaches" story.

In early February (2007) the Mrs. and I took our first short "snow bird" vacation to Florida. Our prime target area was northeastern Florida and the Amelia Island area north of Jacksonville as we thought that might be a less visited gem in Florida, it being just across the mouth of the St. Mary's River from better known Cumberland Island, GA. Amelia Island was one of the first Atlantic coast Florida resorts of the early 20th Century but languished when the railroad and real estate barons pushed on to the Miami area and decided they could make more money down there. It was so ignored that in pre-civil rights recognition times, an African-American beach resort was allowed to develop in relative peace there, American Beach; you might have seen the recent movie about it.

It is presently an island with a multiple personality and diverse history. Its western side is a commercial and fishery port (including a recently defunct menhaden. i.e., "pogy", processing plant now used to make fishing and soccer backstop nets). Its ocean side is now being somewhat "developed" for residential use, as long as the dunes hold. But it has a wonderful marshy and birdy, 'gator creek in its north-central section with good walking trails, and a semi-restored civil war fort at its northern tip. But the island is another topic and not what we want to report.

Barney Cole is a retired marine biologist who still keeps his wits about him.

On the drive from the Jacksonville airport to Amelia Island we took a detour to the southeast to drive along the northern side of the St. John's River (US A1A) because the rental car place map suggested that we would drive through some broad marshy islands and we had time to explore on our way to our B&B.

One of our first stops was at a state park on the mouth of the River across from the Mayport Naval Base: Huegnot Memorial Park. It was established to recognize an early effort by the French to establish a colony in Florida. Being across from the fully visual navy base, it wasn't the full natural experience we wanted but we needed to stretch our legs. As we walked down to the river beach, we passed within a few feet of a great white egret that glanced at us in disinterest but didn't move an inch; you could almost see the contempt in his eyes for tourists who did nothing to attract bait fish near him.

At the water's edge we soon noticed a long broad band of glistening bowl-like objects at the tide line and pulsating slowly in the shallow water next to the beach. As we walked closer it was obvious they were a type of jellyfish. Being from the Mid-Atlantic, I had not really noticed this type before but somewhere in a dark pocket in my mind the name "cannonball jelly" popped out although I did not know then if that was right.

There were thousands of them and all seemed to be recently deposited by the tide. Of course we had to inspect them closer and touch them. They were more

Cannonball jellyfish washed up on the beach at Amelia Island.

solid than the lion's mane and sea nettles we usually encounter up north, more like the similarly common, plate-like moon jelly. They were attractively colored with reddish-brown fringe to their bell, graduating to an opaque clear central bell. The short tentacles were pinkish (see photo). As we walked among them we noticed small shorebirds picking at the tentacles and I suspect, but could not see, some amphipods or such might have been there to attract the birds. On one jelly we noticed a small live spider crab still hanging on the bell.

As we walked further along the beach to the ocean side we found many more jellies that had been left earlier at the high tide line and these were beginning to desiccate into a melted plastic-like glob in the sand. There were signs in the sand that small organisms were interested in the dried jellyfish and I imagine whatever food was left in them will not be wasted by the many tide line gleaners at some point. We later saw the dried jellies along the Amelia Island beaches as well, but not as concentrated.

Traveling light, I didn't have my sea shore guidebooks with me so I had to wait until I returned home to investigate further. But when I did, starting with what has become a common prime search tool Google, I searched "cannonball jellyfish" just in case my hunch was right – it was. The poor beast that was observed dying by the thousands on the beach was the cannonball jellyfish, *Stomolophus meleagris*.

For those of you that can google (now a legitimate verb in many dictionaries), there are several good articles on it on the web such as the one by D. B. Griffin and T.M Murphy. There is (or was?) also a note and great photograph on the web of that jellyfish and its beaching on the shore opposite where we saw it a week before we did.

For those of you who can live without using computer and without getting too technical, according to the above writers, this jellyfish is also known as the "cabbagehead" jellyfish or "jellyballs." It grows to about 8-10 inches in diameter and feeds not by stinging cells but by their mucus covered tentacles which trap micro-organisms coming in contact with the tentacles. It has been reported from New England (possibly being dragged there by the Gulf Stream) to Brazil and occurs on both sides of the Pacific, as well. They are most common in the Atlantic in southern waters.

Besides the beauty they provide to the observer, they are also somewhat essential to the survival of the marine leatherback turtle (an endangered species) that uses them as a "major prey base." But believe it or not, this blob of jelly also supports an export fishery to Japan. The fishery trawl collects, dries, and sends them to Japan, who imports up to 10,000 tons of dried "jellyballs" a year worth about $25 million. So who says jellyfish aren't worth a dam and we can do well without them?

So, the mass beaching of the cannonball on the north Florida beach is one of the many seemingly sad-stories of nature. But it is undoubtedly a natural occurrence that

Close up of cannonball jellyfish with spider crab onboard.

the species has adapted to, at least until a human-fishery developed for the species. No one knows the impact of that fishery on the species population abundance however, according to the aforementioned authors. If you walk southern beaches and encounter the jellyball know that it is important to the world and not just a nuisance to where you can swim or put your blanket.

Field Note

MEMORY OF THINGS NOT SEEN...

BY GEORGE THATCHER

In my daily newspaper column on beach walking in The Sun Herald, I usually report on things seen that day along the shoreline. Mostly they are mundane observations—the flight of a herring gull, a blue crab at water's edge, errant waves, small craters left by raindrops on dry sand, and the like.

Although not recorded, the absence of things, normally seen elicits questions in my mind, such as, "Where are the brown pelicans? The answer to that query is, of course, that they leave the mainland during late spring and early summer for the nesting season on the barrier islands, returning in August, about the same time that the least terns leave on their fall migration.

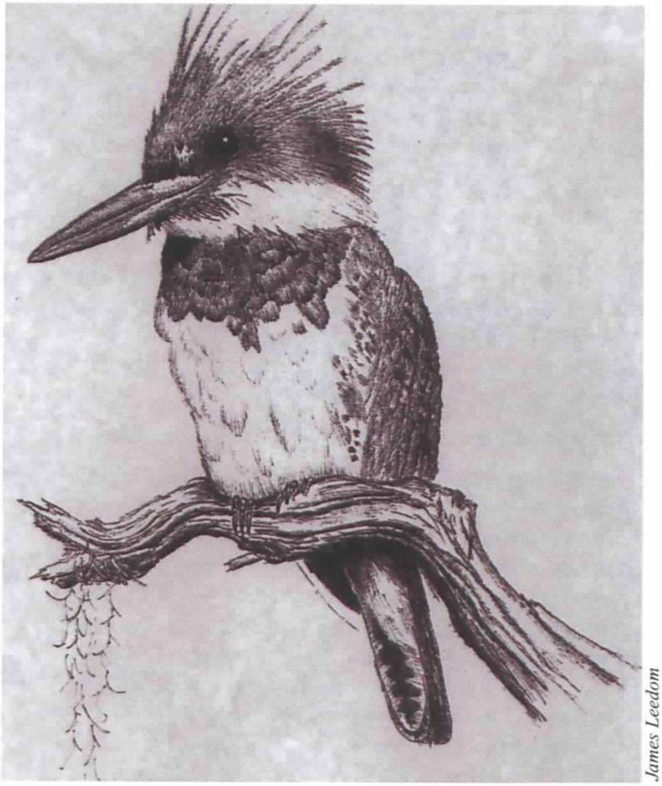
But what about other absences? In past years, one found lengths of whelk egg cases lying in the wet sand, attractive, brown necklaces. Since Hurricane

George Thatcher is UNDERWATER NATURALIST's eyes and ears along the Gulfport, Mississippi, littoral.

Katrina two years ago, I haven't found a one. Plastic-like in appearance, the empty cases assured us that new generations of whelks had been spawned.

Usually during the early summer months of June and July, numbers of stingrays formally gathered at water's edge during flood tides, lying in ambush for minnows swimming by. Although last year, only months after the hurricane, there were scores of rays lying within easy sight, beach walkers have sighted only a few this summer. Have they withdrawn to deeper water?

Also truant, at least in numbers, are blue, fiddler and hermit crabs. Of course, some fiddler' burrows—round holes in the sand—are found, but not many. In previous seasons, one would see quantities of blue crabs, "beautiful swimmers, crawling in the shallows.



Northern Kingfisher

Among missing birds is one of my favorites, the blue-belted kingfisher that would perch, unmoving for hours, on a utility line above the sea. Absent since the hurricane, the bird is acutely missed. "...Kingfishers catch fire...," wrote Gerard Manley Hopkins, a poet. I look for its return each day.

I don't want to leave readers with a dour impression of sealife along the Mississippi coastland. There is much for which to be thankful. This morning two ospreys flew overhead. On the public pier, fishermen were catching flounders in record numbers. The shrimp season is the best in years. Great blue herons stand in shallow water in the flats, while snowy egrets gambol nearbyby.

There was once a terrible loss of catfish along these shores. Termed "The Great Catfish Kill of 1996," the plague left thousands of dead fish on the beach. At the time, we were alarmed for the very survival of the species, but the following year witnessed a remarkable recovery.

Who knows the reasons for the missing egg cases, stingrays, crabs, and the absent kingfisher? Perhaps the recovering communities along the sandy strand are populating the beaches with more people, and fiddlers retreat deeper into their burrows to escape the renewed activity.

Regarding the damage wreaked here by the hurricane, we are reminded of the wise words written by Horace, the Roman poet, in the First Century BC, "You may drive out nature with a pitchfork, yet she will be constantly running back."

MY LAWN'S BETTER THAN YOUR LAWN

Q: The truck driver for our lawn service provider, Caustic Turf, has sprayed chemicals for the company for many years and appears to have grown a third eye smack in the middle of his forehead. We have two toddlers and a pet rabbit we keep outdoors (just the rabbit – her name is Bitsy Fluffy Ball). All three run around the yard a lot. Should I worry?

A: Why worry? As long as your lawn is the envy of the neighborhood, tell Caustic Turf to keep pounding chemicals to it. If they let up, your property will soon be infested with weeds, crab grass, clover, vetch, thatch, mildew, ants, grubs, mosquitoes, wasps, bees, flies, butterflies, beetles, gnats, lice, chiggers, spiders, termites, hairy woodpeckers, squirrels, woodchucks, muskrats, regular rats, moles, wild rabbits, robins, fungus, algae, mushrooms, toadstools, and, worst case scenario: D-A-N-D-E-L-I-O-N-S! However, you might consider installing an outside shower for quick toddler/bunny rinses after they come into contact with your grass. If lawn chemicals get tracked indoors, they can discolor carpet.

Q: How do the various presidential candidates stand on the issue of stinging jellyfish?

A: We posed your timely question to the candidates' campaign headquarters. Here is a sampling of the responses: "Yuck!"... "I stand four-square against all jellyfish!"... "Ooey, gooey"... "Could be bio-terrorism; I'd call in Homeland Security"... "It might be a leftwing plot"... "I'm from the Midwest; what's a jellyfish?"... "Sounds like a rightwing plot." And here's how one candidate responded in some detail: "On one hand, I would address this nefarious threat immediately. On the other hand, this jellyfish plague could be a natural occurrence. There being two sides to the issue, when I am elected president I will appoint a SCOOP (Study Commission on the Outbreak of Oceanic Pain) to conduct a comprehensive, no-holds-barred, 49-month research project to gather jellyfish facts, followed by a long-term, broad-based, conceptual, all-inclusive strategic management plan (with options). That was a great question. If you and your friends and neighbors plan to vote, I'd be happy to stop by for a chat. Meantime, please send me some money."

Q: Are women better swimmers than men?

A: It is against the policy of this journal to go anywhere near that one.

Q: What causes those sandy domes or lumps I sometimes see on wet beaches at low tide?

A: Your question is imprecise (how big are the lumps? What time of year? etc.), but let me give it a try. Two examples come to mind: one lump about the size of a four-storey, 100-unit condominium was found recently on a North Carolina barrier beach south of Morehead City. It turned out to be the toppled ruins of Sea Fronte Fantasy, a four-storey, 100-unit condominium. And, just last year, a dome the size of half a cantaloupe was spotted on Malibu Beach, California. Upon close examination it was found to be the top of a coastal geologist's head; he had buried himself just below the high tide line to conduct *in situ* research on nearshore sand grain movement (he used a specially designed rig allowing him to breath bottled oxygen through several tide cycles). He survives to this day and recently published the classic scientific paper "Observations of the Sands (and Chicks) of Malibu: A Near Death Experience."

Q: Our 17-year-old son used one of your answers as the basis for his term paper in biology and got an F. This could hurt his chances of getting into college. What should we do about it?

A: It sounds as if you son's teacher could be a communist, secular humanist, rational determinist, flat-earther, fish hugger, radical revisionist, crypto-socialist, pseudo-intellectual, or (perish the thought) scallywag. Whichever, your son is being bullied. Sue the School Board.

Coming Next Issue: What's the correct pronunciation of "geoduck?"

D.W. Bennett

AMERICAN LITTORIAL SOCIETY FIELD TRIP SCHEDULE

Here is a listing of the Society's field trips for the balance of 2007 and into early next year. For more detail, follow suggestions at the bottom of the page.

November 1-4 Assateague Island (VA) Fall Weekend – Leaders: Mickey Cohen and Don Riepe. This is an autumn treat a when the birds, butterflies, and fish are moving south. Outdoor hikes in the Assateague National Wildlife Refuge – beaches, dunes, wetlands, and ponds, plus a seafood feast, the Chincoteague ponies, evening slide shows, and a stop at Bombay Hook at sunset Sunday to see thousands of snow geese flying in to spend the night.

January 4-6 Montauk (NY) Winter Weekend – Leaders: Mickey Cohen and Don Riepe. An outdoor weekend at the tip of Long Island, after the summer crowd is gone. Birds, marine mammals, the Walking Dunes, Montauk Light, the beaches, tide pools, and cliffs. Slide shows and talks in the evening.

March 1-8 South Florida and the Everglades – Leaders: Carol Borneman and Don Riepe. South Florida's prime wildlife habitats: swamps, coastal strands, mangroves, wetlands, tidal creeks, and savannahs for birds, frogs, toads, lizards, snakes, and 'gators.

April 12-19 Rio Grande Valley and South Texas Coast – Leaders: Eva Callahan and Don Riepe. Seven days of hiking and birding near the US/Mexico border during spring migration: passerines, raptors, and butterflies featuring the Santa Ana National Wildlife Refuge where migrants from the Mississippi and Central flyways funnel through. Also habitat for half of all the North American butterfly species. We will also visit barrier beaches and estuaries for wading birds and shorebirds. (Dates may change a day or so either way.)

The complete 2008 field trip schedule will be mailed to all members in the late fall.

For details, consult your 2007 field trip schedule, phone for another copy, or go to the Society's website (www.littoralsociety.org), or phone or email Pat Coren: 732-291-0055: pat@littoralsociety.org.

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