The Artificial Reefs of New Jersey

By Peter Clarke, Senior Fisheries Biologist

New Jersey has a rich history in recreational sportfishing. Since the 1840s, recreational anglers have pursued a variety of sport fish including big game species like giant bluefin tuna, marlin or sharks off the Jersey coast along with catches of nearshore coastal species such as ling, pollock, cod, black sea bass, summer flounder, tautog and of course, striped bass.

A Structured Environment

Fish have three essential environmental requirements: suitable water temperature, available food and suitable habitat for reproduction. Habitat requirements vary considerably between species and life stages. Many species depend on some type of *structured* habitat that serves either as a refuge from predators or as source of prey organisms that live in, on or around the structure, becoming potential food for the predators. Various fish species find structure in seagrass beds or sand ridges and troughs; other species are attracted to hard structures for the abundance of encrusting organisms (prey) and interstitial space for refuge.

Where's the Reef?

Nautical charts reveal that natural hard bottom is a habitat type New Jersey generally lacks. States to our north have nearshore topography dominated by rock outcroppings, boulder fields and smaller rubble deposited millennia ago by receding glaciers. These areas provide great vertical structure for fish to live, but generally do not extend south of Long Island. To our south, natural coral and live rock bottoms are common, providing comparable vertical structure for fish habitat. In contrast, coastal waters off New Jersey are generally flat, sandy and featureless.

New Jersey's Artificial Reef History

By the 1960s, local fishermen and fishing clubs recognized that placing "artificial" structure in nearshore areas could simulate natural hard bottom habitat and provide increased opportunities for recreational anglers. Although successful, the early days of reef building were more like the wild west than a scientific pursuit, with neither planning oversight from state agencies nor a grasp on the best environmental and scientific practices.

In 1984, the New Jersey Division of Fish and Wildlife officially began its Artificial Reef Program with permitting through the United States Army Corp of Engineers to develop an artificial reef system with oversight and environmental standards. Fish and Wildlife began with four reef locations: Sea Girt Reef off Monmouth County, Garden State North and Garden State South reefs off Long Beach Island in Ocean County and Atlantic City Reef off Atlantic County. Within the first decade, the reef matrix increased to include a total of 14 permitted reef sites ranging from Sandy Hook to Cape May. Another reef was added in 2005 and two more in 2017, bringing the total to 17 reef sites managed by Fish and Wildlife. Four of these are inside the 3-mile state waters territory, while the remaining 13 sites are in federal waters beyond three miles.

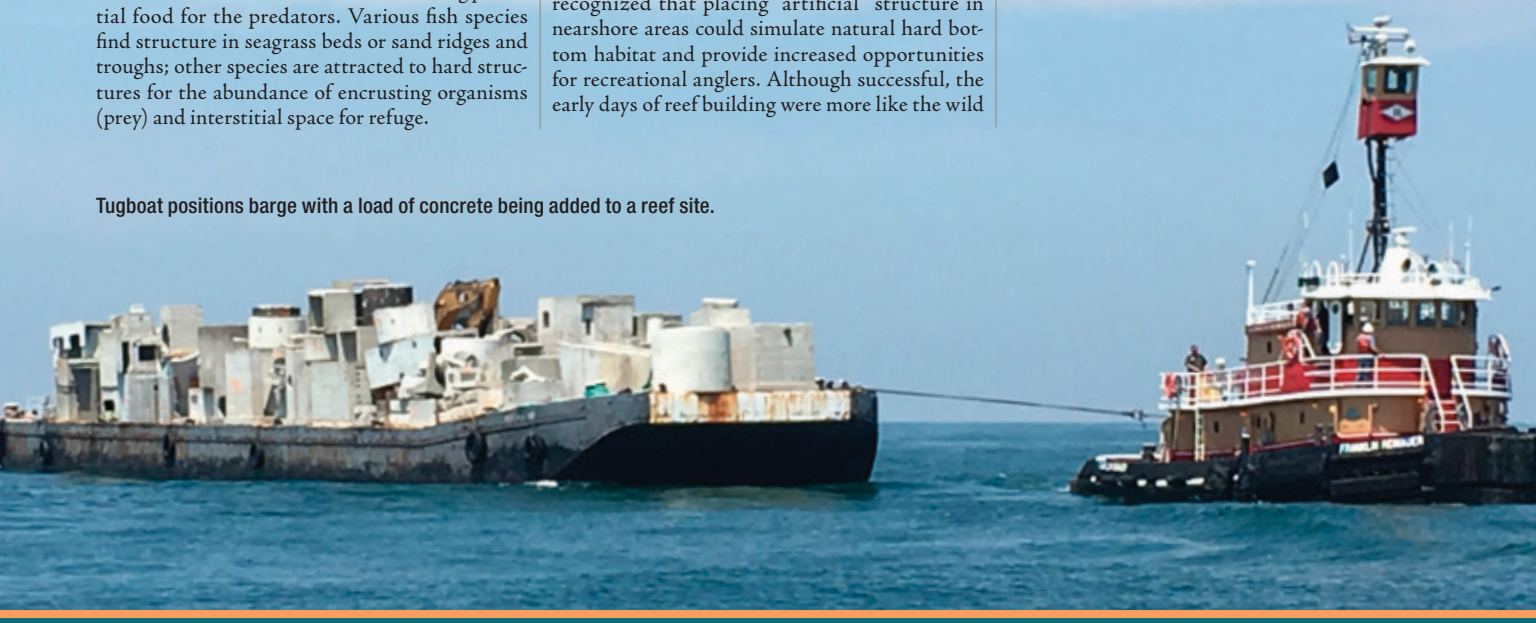
Fooling Mother Nature

Artificial reefs provide habitat through successional development, providing attachment surfaces for native species of marine plant and animal life that depend upon such structure. Prey species of fish and crustaceans that take residence on these reefs attract predatory fish species using the reefs as a place to feed, reproduce, find shelter and live. Simply put, big fish eat little fish. Artificial reefs provide the building blocks for that process.

Fishing Opportunities

When fish congregate in focused areas, anglers have an enhanced opportunity to harvest the resource. New Jersey reefs provide angling opportunities ranging between 1 mile from the shoreline to 24 miles offshore in depths from 40 feet to 160 feet. Additionally, the New Jersey Artificial Reef Program offers boundless opportunities for scuba divers, providing over 180 sunken ships or barges to explore within the reef system.

All photos: Artificial Reef Program/NJ Div. Fish and Wildlife



Tugboat positions barge with a load of concrete being added to a reef site.

Economic Benefits

Studies conducted by Fish and Wildlife's Bureau of Marine Fisheries over the past 35 years have determined that over 150 species of fish and other marine life utilize the New Jersey reef sites. The benefited species are endemic to New Jersey waters but are limited in extent and abundance by the lack of hard substrate. The artificial reef system supports recreational fisheries for several important species, contributing to the $2.5 billion economic benefit of New Jersey's fisheries industry.

Reef Materials

Historically, artificial reefs have been constructed out of a wide range of materials, but recently they have been limited to three general material types: steel, rock and concrete. Steel is generally acquired in the form of ex-fishing vessels, barges, tugboats, army tanks, and subway cars that are no longer considered suitable for their intended service. Rock is often provided through many river and port deepening projects and consists of the largest material encountered during the project period—preferably larger than a basketball and frequently bigger than a car. Concrete typically originates from bridge decommissioning projects, old piers and pilings plus road culverts or other pre-cast materials.

Before any material is deployed, its suitability is evaluated. Those determined fit for deployment are cleaned and prepared using best environmental practices. For steel and metal ships or barges, cleaning often includes removing machinery, fuel, oil and electrical components from vessels. Once cleaned, a bare steel hull and superstructure are ready to sink in the ocean. These artificial reef materials have a typical lifespan on the ocean floor of 75 to 110 years depending on the metal's quality and thickness at the time of deployment.

Concrete material goes through a similar process and must be prepared in accordance with the New Jersey Artificial Reef Management Plan which disallows any floatable material including wood or plastic waste. Concrete is a desirable material as it withstands the marine environment, often lasting hundreds of years while *gaining* strength over time. Deployed rock undergoes the same inspection process, ensuring it is free of debris including most fine sediment resulting from the dredging process. The underlying goal of material selection is to identify the largest material available for the selected site that provides large interstitial space for habitation by a variety of marine organisms.

Donations are the Key

New Jersey's reef program has no budget for material acquisition and deployment. The program relies entirely on donations from private industry in the way of direct material donations and from non-profit organizations that have environmental enhancement goals such as the Ann E. Clark's "sportfishingfund.org" and a myriad of private fishing clubs along the coast.

Vessels measuring 90 feet in length typically cost an average of $80,000 which includes acquisition, preparation and removal of contaminants plus the final towing and deployment onto the reef site. Concrete loads weighing 3,000 tons cost an average of $110,000, whereas rock is usually donated by the dredging companies.

Special Management Zone Protections

Currently the reef program has made over 4,400 deployments with considerable investment from the recreational fishing community. In 2017, through a regulation passed by the National Marine Fisheries Service, New Jersey received Special Management Zone status for all federal waters reefs, with the New Jersey Department of Environmental Protection applying the same rules to the state waters reefs. While fishing is still permitted, this bans all fixed gear from being set and fished on the seventeen New Jersey permitted reef sites. Fish and Wildlife requested Special Management Zone designation to allow reef use to be focused on the recreational harvest of fish while still allowing the sites to be used as essential fish habitat.

Primary Objectives of the New Jersey Artificial Reef Program

- Continue to construct hard-substrate reef habitat for marine fish and invertebrates;
- Provide spawning, nursery, refuge and feeding areas for marine life;
- Create fishing grounds for hook-and-line anglers;
- Provide underwater structures for scuba divers;
- Provide economic benefits to recreational fishing and diving industries.

Where Are We Now?

Our two newest reefs — Delaware Bay Reef and Manasquan Inlet Reef — are both under construction currently but open to recreational diving and fishing. To date, the Manasquan Inlet Reef has received 3,000 tons of precast concrete material plus an 85-foot ex-fishing vessel, with plans to deploy additional material soon. The Delaware Bay Reef, New Jersey's first estuarine reef site, has received 2,000 tons of dredge rock with plans to continue low profile deployments as opportunity allows.

Fish and Wildlife believes that the *actual* benefits of the Artificial Reef Program transcend these objectives, ranging well beyond the local New Jersey system by providing benefit to species in the greater Mid-Atlantic Bight region that utilize the coastal waters of New Jersey as part of their geographical range. Quality, structured habitat as a network or matrix benefits the entire region by adding biomass and enhancing overall population health.

The intent of the reef program is not to change our marine environment but to enhance a small portion of our sea floor to benefit marine species and the stakeholders of New Jersey. For those interested in becoming an active sponsor of the New Jersey Artificial Reef Program, contact the Division of Fish and Wildlife's Reef Coordinator at (609) 748-2020.

The 170-foot Navy tanker *Helis* sunk May 2005 on the Garden State North Reef.

Horseshoe Crab:

A PROFILE

By Samantha MacQuesten, Assistant Fisheries Biologist

Horseshoe crab with barnacles attached to shell, Fortescue Beach.

Matt Hencheck/NJ Div. Fish and Wildlife

Scientific Name: *Limulus polyphemus*

The Atlantic horseshoe crab, *Limulus polyphemus*, sometimes referred to as the "American horseshoe crab," is one of four worldwide horseshoe crab species that have roamed the earth for more than 445 million years, even before the dinosaurs. While "crab" is in the name, horseshoe crabs are more closely related to spiders.

Range: Atlantic coast from Maine to Gulf of Mexico; most abundant from New Jersey south to Virginia. Delaware Bay has the largest spawning population of horseshoe crabs worldwide.

Size, Maturity and Age: Size varies greatly. Females are larger than males and can reach lengths of up to 33.5 inches (including tail). Males are around half to three-quarters of a female's size. Horseshoe crabs reach sexual maturity around 10 years of age with a life expectancy of twenty years, on average. During the years before maturity, they will molt an average of 18-20 times before reaching their maximum size.

Biological Characteristics: The body has three parts: front shell/head (prosoma), back shell (opisthosoma) and a tail (telson) with small "spikes." The tail is used to flip over their body when turned upside down in the tide. Contrary to popular belief, the tail is not a defense mechanism against predators. Horseshoe crabs have several pairs of eyes, each with different degrees of light sensitivity. These crabs have no teeth; instead, they use bristles at the base of their legs to pass food to their mouth.

Food: Primarily mollusks, crustaceans and various types of worms but also algae and small animals on the ocean floor. Few predators can prey on horseshoe crabs because of their exoskeletal structure. Some species of sharks and sea turtles, as well as humans, are among these predators. While horseshoe crabs do not have many predators as adults, horseshoe crab eggs and larvae are a vital component in numerous biological food chains. These eggs and larvae provide a crucial food source for migrating shore birds, as well as for sea turtles.

Habitat: During spawning season (spring), adult horseshoe crabs congregate on sandy beaches that are not disrupted by wave action in order to mate. Females lay many egg clusters for a seasonal total that may reach 100,000 eggs. After spawning season, adults migrate to nearby estuaries or to the continental shelf. Juvenile horseshoe crabs will spend roughly the first two years of their life in nearshore areas.

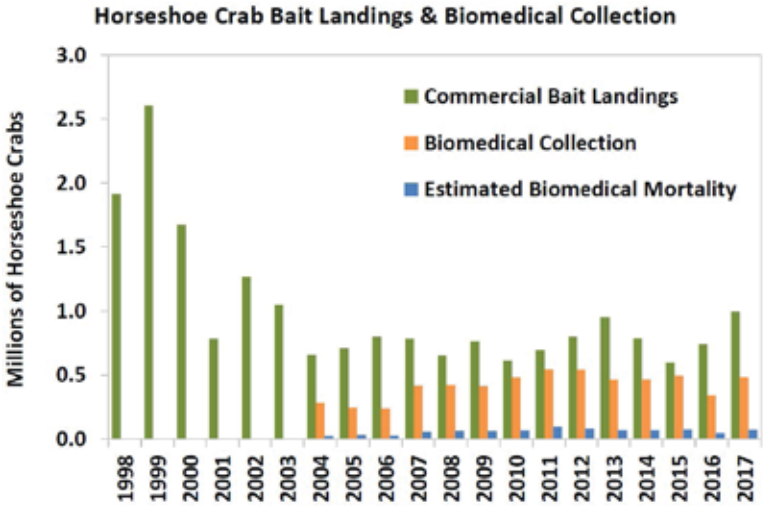
A cluster of mating horseshoe crabs during peak spawning season at Fortescue Beach.

Matt Hencheck/NJ Div. Fish and Wildlife

Habitat Importance: Beach development and shoreline erosion, both natural and man-made, are growing threats to future populations of horseshoe crabs. The limited number of suitable beaches for spawning make horseshoe crabs a vulnerable species. Without adequate beaches for egg-laying, both the horseshoe crab — and the shorebirds that rely on the eggs to fuel their long migration flight — are at an extreme risk.

History and Management: Historically, horseshoe crabs were very popular in the bait industry for American eel and whelk fishermen. In the 1990s, a severe decline in the horseshoe crab population resulted from consistent high harvests by the commercial fishing industry. To curtail the rapid population decline, New Jersey implemented a moratorium prohibiting horseshoe crab bait harvest in New Jersey waters. While some states along the Atlantic coast still have a limited bait fishery, there are widespread efforts to reduce horseshoe crab losses because of their ecological importance.

Medicinal Purpose: Horseshoe crabs are highly important to the biomedical industry for a blood extract known as *Limulus* amebocyte lysate (LAL), used to detect endotoxins such as *E. Coli* and *Salmonella* in medicines and medical devices. Although a synthetic alternative is commercially available, the



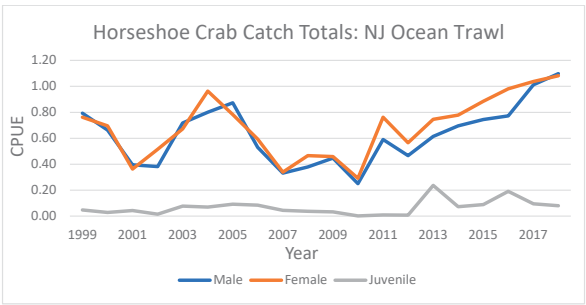
Biomedical Graph Source Document: http://www.asmfc.org/uploads/file/5ccae597HSC_StockAssessmentOverview2019.pdf

pharmaceutical and medical device industries have been reluctant to make that switch given the serious health risks posed by a potential error in identifying the endotoxin contamination. Bleeding horseshoe crabs is a highly specialized practice requiring a scientific collecting permit in New Jersey. While there is some mortality associated with extracting blood from crabs, the effect on horseshoe crab populations is negligible. A mortality rate of 15% of all bled crabs was used in the most recent coastwide stock assessment conducted by the Atlantic States Marine Fisheries Commission.

Current Research:

Author Samantha MacQuesten counts the number of male and female horseshoe crabs within a quadrat at Fortescue Beach.

- Several companies are attempting to create a synthetic bait product as effective as horseshoe crabs. If a lower cost product is successful, harvesting crabs would be unnecessary, positively impacting the commercial bait industry and horseshoe crab conservation efforts.
- To estimate the spawning population in the Delaware Bay, a survey was created in 1990. Each year in May and June, different entities from New Jersey and Delaware volunteer to survey the spawning beaches in each state. Due to the ever-changing landscape of the spawning beaches and their accessibility by both crabs and humans, the number of surveyed beaches changes each year. The 2019 survey covered 29 beaches. To perform the survey, volunteers use quadrats that measure one square meter with randomized sampling numbers and walk the beach counting the number of female and male horseshoe crabs that fall into each sampled quadrat. The same beaches are surveyed during the full and new moon cycles of the peak spawning period (May and June) at high tide. These data give scientists a representative number of spawning crabs for the entire season.
- Additional data to estimate the horseshoe crab population in the Delaware Bay region comes from the New Jersey Division of Fish and Wildlife's Ocean Trawl Survey. (See graph below.) While variability exists among the survey years, common trends are evident. The survey indicates varying trends in population fluctuations. Of interest is that populations of both males and females appear to be continuously increasing over the last five years.



Horseshoe crabs have been around for millions of years, yet humans are the biggest contemporary obstacle they have faced. It is highly important that we continue to protect this vital species by preventing overfishing and by protecting the beaches essential to their reproduction.

Sources:

- *http://www.asmfc.org/species/horseshoe-crab*
- *https://myfwc.com/research/saltwater/crustaceans/horseshoe-crabs/facts/*
- *https://www.vims.edu/research/departments/fisheries/programs/multispecies_fisheries_research/species_data/horseshoe_crab/index.php*
- *https://www.fws.gov/northeast/pdf/horseshoe.fs.pdf*
- *https://www.nwf.org/Educational-Resources/Wildlife-Guide/Invertebrates/Horseshoe-Crab*