

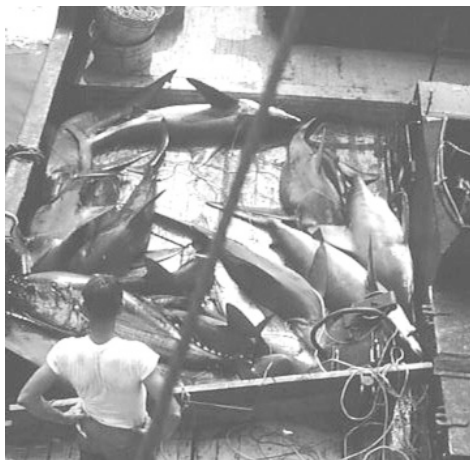
Shark Trip Brings Research Career Full Circle

On a warm July morning in 1961, undergraduate Jack Musick of Rutgers University stepped aboard a commercial trawler to begin a summertime study of sharks off the New Jersey coast.

VIMS Professor and international shark expert Dr. Jack Musick has just returned from the very same waters, where he fished the same stations and gear that he had used 44 years before. His goal was to capture a unique long-term record of changes in shark abundance.

"I've wanted to do this for years," says Musick. He got his wish when the R/V *Bay Eagle* set sail from VIMS on July 18th for the 10-day cruise.

Musick says that a direct comparison of shark numbers across a span this long is unprecedented. His 1961 cruise took place 14 years before *Jaws* sparked the sport fishery that first began to take significant numbers of



This photo from Musick's 1961 trip shows the catch from a four-hour longline set. The set returned a large number of sharks and other fish.

large sharks from Atlantic waters. The recent cruise comes 12 years after federal regulations first sought to manage the commercial fishery that had devastated shark stocks during the 1980s.

Musick's use of the same gear and stations sets his work apart from other recent studies of shark population trends, most notably an analysis in *Science* by Canadian researcher Ransom Myers. Myers used a technique called "metadata analysis" to conclude that populations of large coastal and oceanic sharks had declined by more than 75% in the past 15 years.

Although Musick agrees with Myers' general conclusion, he questions his methodology. Myers' metadata analysis entails combing through existing scientific and commercial fisheries records to extract relevant data, in this case the number of sharks reported as bycatch.

"Myers compares longline catch rates from the 1950s and 60s with more recent catch rates from observer data in the commercial fishery," says Musick. "During that time the fishing gear and depths have changed completely. It's like comparing apples and oranges."

Today's longline fishery uses monofilament line and, instead of fishing in the top 100 or 200 feet for swordfish, fishes at 400 or 500 feet for big-eye tuna.

"You just can't make those comparisons," says Musick. "There

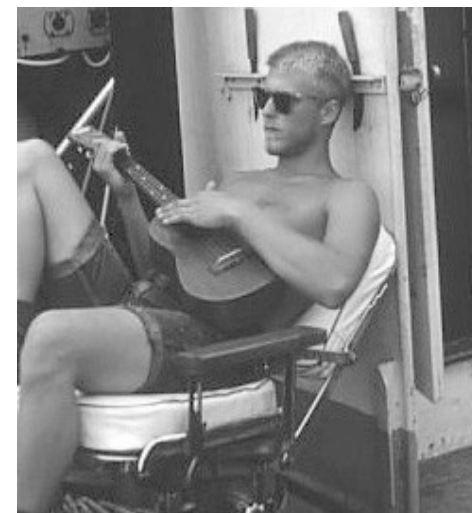
isn't enough overlap in the gear or target species."

In Musick's case, the gear overlapped completely, making for a statistically robust comparison. His crew used the exact same type of main line, drop lines, hooks, and bait (menhaden) that he used on the initial longline cruises in 1961.

"We set a mile and a half of main line, which is a 3/8-inch braided and tarred nylon with anchors and buoys on each end. That line has 100 dropper lines, or gangions, each around 12-feet long. Each gangion has a couple of feet of steel leader that goes to the hook, because a shark will bite through otherwise."

Musick's *Bay Eagle* crew, headed by graduate student Jason Romine, set the same 19 stations between Cape May and Sandy Hook Bay. VIMS graduate students Chip Cotton, Andrij Horodysky, Dave Portnoy, and Vince Saba, along with Captain Durand Ward and lab technician Demetria Christo rounded out the crew.

Musick's longline set-up was initially developed for swordfishing. He and mentor Jack Casey stayed at sea all through the summer of 1961, deploying longline sets from a commercial trawler donated to the Sandy Hook Marine Lab by a local fishing company. "The Lab Director managed to get the help of the Smith Menhaden Company, which had a local plant on Sandy Hook Bay. Mr. Smith contributed fuel, bait, crew, and everything else, for the entire summer of 1961," says Musick.



Jack Musick takes a break during the 1961 longline cruise.

The only changes in gear that Musick has made are to help ensure that setting the line is safer and more efficient. "We now use quick clips to fasten the gangions to the main line," says Musick. "Back then the clips hadn't been invented. Instead, you used a slipknot, and you had everything coiled in galvanized tubs. If the lines tangled, and that happened often in rough seas, you just tossed the whole tub over the side. Otherwise you could get tangled in the gear and pulled overboard. You'd then go on to the next set and worry about it when you came back. Because the line is fairly stiff, the tangles would often fall out as it soaked."

Musick thinks it will take about a week to get a ballpark figure of the change in shark numbers between 1961 and present. A particularly interesting aspect of the comparison will be that between sandbar and dusky sharks, the two most common species along the New Jersey coast. Sandbar populations have responded well to shark management plans. Dusky have not (see sidebar).

Musick's graduate student Dan Ha has already digitized the original 1961 data, which until recently had been held at the National Marine Fisheries Service (NMFS) office in Narragansett, Rhode Island. A researcher at the office had found the original hand-written field notes in a tattered box after Musick's mentor Jack Casey retired from there about eight years ago.

The timing of the New Jersey cruise was just right, says Musick. "I've got Dan Ha doing some pretty sophisticated analyses of our own long-term shark data right now, so it was a perfect time to go back up there." Funding agencies agreed. The cruise was funded by NMFS through the National Shark Research Consortium, of which VIMS is a member.

The VIMS' Shark-Monitoring Program, which Musick established at the Institute in 1973, uses the same 1961 longline gear that his team used on the recent New Jersey cruise. The program is now the world's longest fishery-independent study of shark populations. It clearly records the decline that concerns shark researchers and managers around the world.

Fishery-independent surveys are critical for long-term monitoring of marine populations, as they are designed to minimize the bias inherent in commercial fishery records. Bias in those records arises from changes in gear, fishing methods, target species, and fishing effort.

"Our surveys show a decline of almost 50% between 1973 and 1985," says Musick. "After that the commercial fishery kicked in as the demand for shark fins increased in China, Japan, and other places where those items are a delicacy. By the late 1980s, a lot of our large shark species were over-fished to the point where only 15% of the population remained."

A federal management plan for sharks was implemented in 1993. Since its passage, scientists have seen some local shark species, including sandbars and blacktips,

recover to about 50% of 1970s levels. But other species, like the dusky and sandtiger, haven't responded as well.

Reproductive differences help explain the discrepancy. Sandbar sharks take about 15 years to mature and have 10 young every 2 years. Dusky reach sexual maturity around 20 years and average 8 pups every 3 years. "The dusky's intrinsic capacity to increase is lower, so you wouldn't expect as rapid of a response," explains Musick.

"With sandtigers," says Musick, "it's the reproductive potential. Sandtigers are a bit bigger than sandbar sharks, they mature a year earlier, but they only have 2 young every other year instead of 10. We see more sandbar sharks, but sandtigers have just stabilized at very low levels."

Once a research survey shows a shark species to be overfished, federal regulations require a management plan. That plan must include a strategy to restore the species to a pre-fishery condition in 10 years. The plans recognize that some species may take more than a decade to recover because of their lower intrinsic rate of increase.

"A lot of the sharks fit into that category," says Musick. "Mandated recovery periods have thus become more flexible to account for differences in life-history strategies."