THE INDUSTRY'S RECOGNIZED AUTHORITY FOR DESIGN, ENGINEERING AND APPLICATION OF EQUIPMENT AND SERVICES IN THE MARINE ENVIRONMENT

Reprint

SEA TECHNOLOGY

Marine Electronics • Instrumentation • Systems Design • Marine Pollution • Ocean Research • Diving
Ships and Structures • Antisubmarine Warfare • Offshore Engineering • Product Development

Water Temperature is Tool For Managing Lobster Resources

Underwater Temperature Monitors Aid in Study of Lobster Population Cycles, Weather Patterns Correlation

By William S. Evans
National Sales Manager
Ryan Instruments

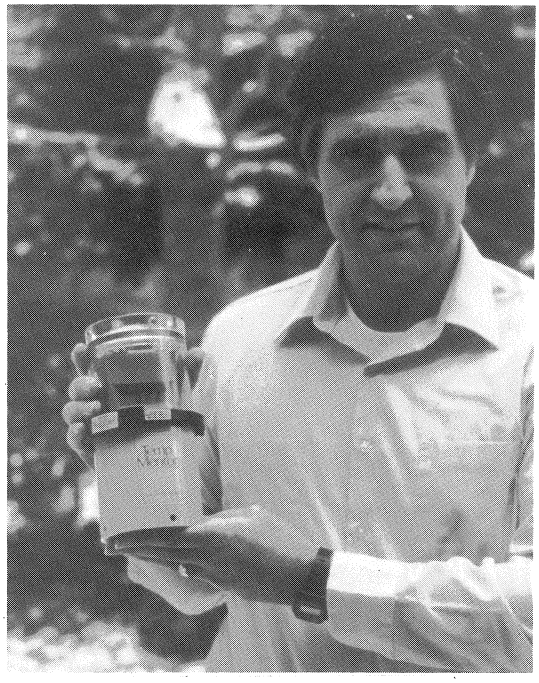
Water Temperature is Tool For Managing Lobster Resources

Underwater Temperature Monitors Aid in Study of Lobster Population Cycles, Weather Patterns Correlation

By William S. Evans
National Sales Manager
Ryan Instruments

Lobster. That "priceless" delicacy that graces menus at popular seafood houses and finer restaurants. It is a valuable marine resource from the New England coast that brought in $145.2 million (dockside value) in 1988. Landings in 1989—according to the National Marine Fisheries Service—were at record highs for the second year in a row with nearly 53 million pounds caught.

Marine biologists in Massachusetts, which supplies about 30 percent of annual landings, are seeking ways to manage this valuable resource. Water temperature is one of the keys and researchers there are studying the relationship between Massachusetts coastal water temperatures and lobster population cycles.



Massachusetts fisheries biologist Bruce Estrella, holding Ryan TempMentor, directs pilot project begun in 1985 to study relationship between weather, water temperatures, and lobster abundance. Above, crewmen lowers TempMentor, anchored to cement mooring, in Cape Cod Bay waters in early 1988. Divers then place unit in protected area—under boulder or in shipwreck—to avoid trawler damage. Estrella reported unit still delivering accurate readings at project end 18 months later.

The tools used are time/temperature monitors. The state's Division of Marine Fisheries began using TTMs for a pilot program in northern Buzzards Bay in 1985. Currently they are using seven Ryan Instruments (Redmond, Washington) TempMentors™ in Massachusetts coastal waters as the primary data gatherers for a long-term study.

Unexpected Findings

So far, temperature records from the TTMs indicate that northeasterly winds affect water temperature at lower depths and in a shorter time period than previously expected, according to Bruce Estrella, senior marine fisheries biologist in the fisheries division.

"There are three ways the fisheries division would be able to use the time/temperature information on a long-term basis," Estrella said.

"First of all, temperature information is essential in developing an accurate computer model for lobster populations," he said. "Water temperature has been shown to affect lobster abundance at two critical times: when lobster are first hatched as larvae and when five-year-old lobsters are on the brink of reaching a harvestable size."

Lobster larvae are more likely to survive their first year of life if waters

are warm because they will feed and grow into the safer bottom-crawling stage more quickly. Similarly, five-year-old lobsters feed more in warmer waters, thereby increasing the likelihood that they will grow into that year's harvestable pool of lobsters.

"Secondly, if the fisheries division someday has to implement controls on catches of recently molted lobster, which are vulnerable to shell damage by fishing gear, the water temperature information would be very valuable in delineating areas where they are concentrated," Estrella added.

"But what's most important is that someday we hope to predict the yearly abundance of lobster with our knowledge of water temperature readings in conjunction with other population-dynamics data," he said. "This sort of information would be helpful to lobster fishermen. They might scale back if they know it's going to be a good year, they can gear up to take advantage. They can alter their behavior to their benefit."

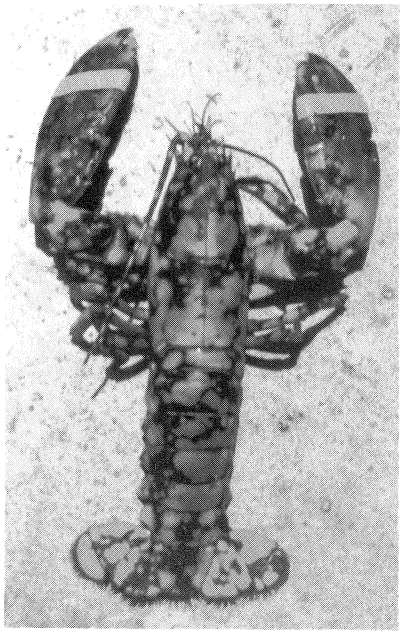
Fishing Methods 'Too Efficient'

The basic problem for the lobster industry is that fishing methods have become too efficient in landing the larger, mature lobsters. Each year, the lobster resource sustains considerable losses from fishing mortality. Lobster fishermen can only keep lobsters that grow to a legal catch size. In other words, the size of each year's harvest is naturally limited by the number of younger lobsters "recruited" to a legal size of 82.6 millimeters or 3-1/4 inch carapace length (as measured from the rear of the eye socket to the rear of the body shell). Lobsters must molt—*i.e.,* shed their shells—in order to grow and the rate at which they grow is highly correlated with water temperature.

"The lobster fishery is heavily dependent on this growth for a continuous succession of recruiting year classes," Estrella said.

For years, industry observers have theorized that the proportion of lobsters growing to a legal size for the summer catch is directly related to the severity of the weather for the preceding spring, winter, and fall. Colder weather reduces coastal water temperatures and slows down lobster growth.

Laboratory studies have determined that some lobsters begin to molt in water temperatures above 5° C, but the majority don't molt until water temperatures reaches 10° C. In the lab, there's a direct relationship between water temperature and the activity level patterns and feeding rate of lobsters. Lobsters are more active in warmer water; when they move more, they feed more. And the more they feed, the more quickly they grow.



Landings of New England lobster, like this one, reached record highs in 1989 again with nearly 53 million pounds caught.

"We have seen fluctuations in lobster abundance over the years, and they seem to be in conjunction with the preceding winter and spring temperatures being colder," Estrella said. "We'd like to gather data to substantiate the claim. Seeing what you think are trends—and having solid data to describe and prove it—are two very different things.

"For example, in 1984 we had such a poor year, we believe, due to the cold weather," he noted. "The following spring, in 1985, we had a lobster glut. Prices dropped through the floor. People were rolling wheelbarrows full of lobster out of the seafood markets. There's a strong potential for that phenomenon being explored and predicted by studying fluctuations in water temperature."

The 'Ideal' Monitor

But before the fisheries division could begin its study, it needed to find a suitable temperature monitor. That wasn't easy.

"There are several companies that make monitors accurate within one-tenth of a degree (Centigrade)," Estrella said. "But the monitors were usually too cumbersome, or not flexible enough in terms of programming and deploying, or too expensive."

Estrella finally experimented with a Ryan TempMentor for a pilot study in northern Buzzards Bay in 1985. It had the features the fisheries division needed, such as:

- A waterproof case that is pressure-resistant to depths of 500 feet, well within the depths of Massachusetts coastal waters
- Weighing ten ounces and measuring 3 x 6 1.5 inches, it was small and lightweight enough for divers to deploy easily
- A temperature resolution of 0.1° C and degree of accuracy within 0.3° C
- Ability to program the instrument's monitoring sequences. The fisheries division programmed the TTM to take a temperature reading once every two hours for as long as 530 days
- User-friendly software and RS-232C cable to download the information. "The procedure for downloading is quite simple," Estrella said. "And the software is menu-driven with very good prompts"
- Ability to present the information in chart or table form
- Proven track record in fishery research, water resource, and thermal pollution studies.

For someone who wants to conduct seawater temperature monitoring experiments, Estrella gives this piece of advice: hide the monitors inside a shipwreck. "Shipwrecks represent an ideal location for securing a temperature monitor," Estrella said. "They prevent destruction of the monitor by fishing trawlers. The shipwrecks also enhance our ability to find the monitors. If there are no shipwrecks in the area, we put the monitors near a large boulder."

The agency is currently deploying seven TempMentors, and three are stowaways in shipwrecks.

One fisheries TTM is located off Boston Harbor. Four are located in Cape Cod Bay within a 5-mile radius at depth zones of 0-30 feet, 30-60 feet, 60-90 feet, and 90-120 feet. One is located in northern Buzzards Bay; another is near southern Buzzards Bay, south of Elizabeth Islands.

"We left one monitor in the 18 months, and it worked just fine," Estella said.

Excited About Link

While the data from the temperature monitors are preliminary. Estrella is still excited about TTM information that links northeasterly winds to cold water temperatures at depths as low as 120 feet.

"We've found hints that temperature at water depths of 90 to 120 feet may be affected by northeasterly winds in a very short time period, which is something we hadn't anticipated," he said. "It seems that fluctuations in bottom temperatures can be explained by studying coastal wind patterns."

Surface waters in the fall and winter tend to be pushed down to the bottom by the northeasters, according to Estrella. The "down-welling" of surface water reduces the bottom temperatures by only a couple degrees centigrade, but it may be enough to affect lobster feeding and movement patterns.

Data only Rudimentary

Estrella cautioned that the temperature data are only rudimentary and

Estrella cautioned that the temperature data are only rudimentary and
must be correlated over a longer time span. Still, he's enthusiastic about the possibility of someday making forecasts for the oncoming season's lobster population.

When one of Estrella's colleagues—Jay Krouse, a marine resources scientist with the Maine Department of Marine Resources—learned about the application of time/temperature monitors, he soon began using the underwater instruments to conduct his own research off Maine's coastal waters.

"The more information we can find out about what factors control lobster abundance, the better we'll be able to manage the resource," Estrella said. /st/

William S. Evans previously was president of the Evans Research Group in Seattle, a subtidal and intertidal dive research firm studying waste management and its effects on coastal marine ecosystems. He earned his master's degree in fisheries from the University of Washington.