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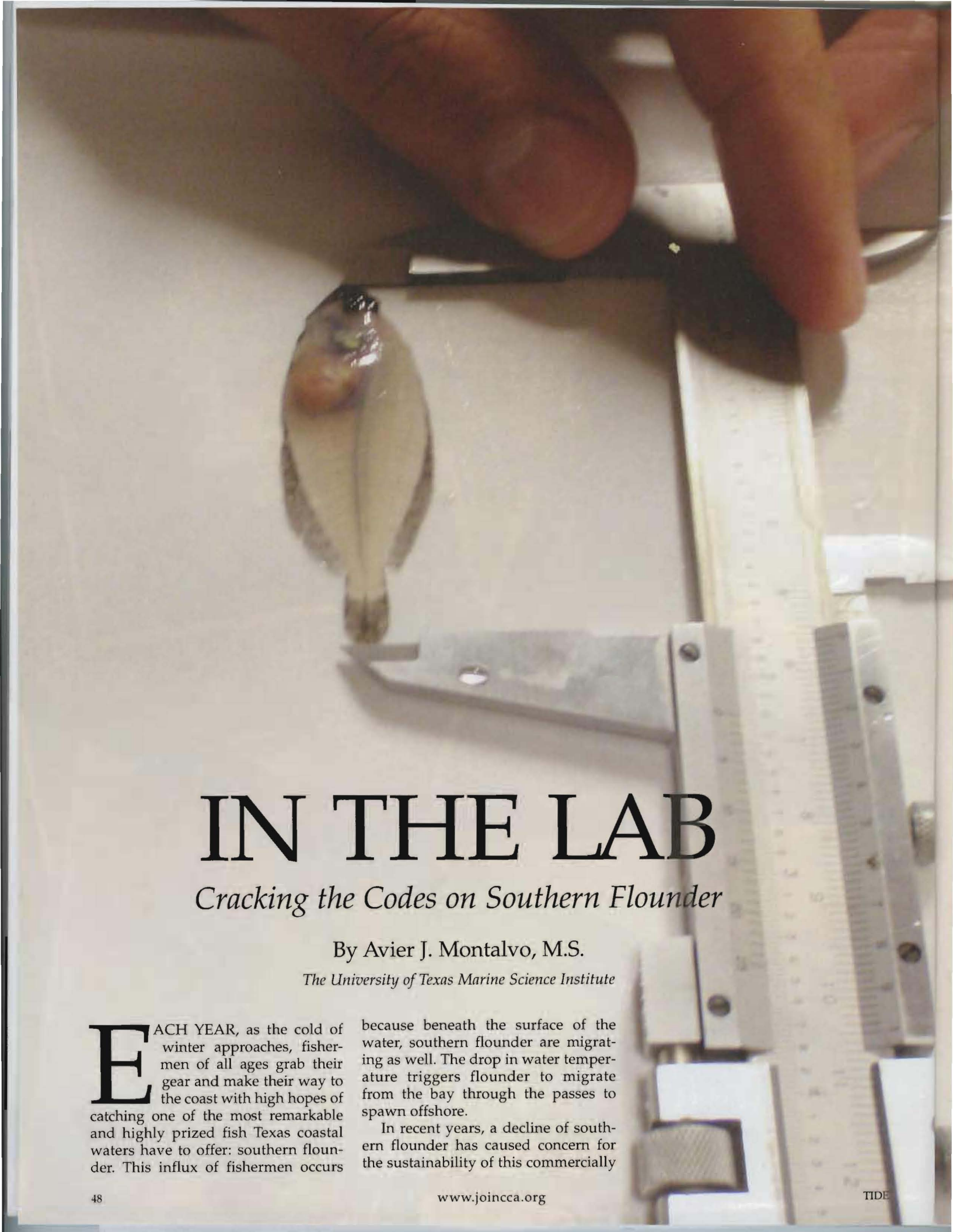

IN THE LAB

Cracking the Codes on Southern Flounder

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EACH YEAR, as the cold of winter approaches, fishermen of all ages grab their gear and make their way to the coast with high hopes of catching one of the most remarkable and highly prized fish Texas coastal waters have to offer: southern flounder. This influx of fishermen occurs because beneath the surface of the water, southern flounder are migrating as well. The drop in water temperature triggers flounder to migrate from the bay through the passes to spawn offshore.

In recent years, a decline of southern flounder has caused concern for the sustainability of this commercially

and recreationally important fish. This has sparked interest by the Texas Parks and Wildlife Department to implement a restocking program for southern flounder.

Aside from being perfectly adapted for life on the bottom, what makes southern flounder special? There is a considerable size difference between the sexes, with female flounder growing much larger than males. In fact, male southern flounder seldom exceed 12 inches in length, and with current regulations set at a minimum of 14 inches, the fishery hits females hard.

We wanted to know which temperatures alter the sex ratio and at exactly which point during development temperature influences the sex of a flounder.

Even more remarkable is how sex is established in southern flounder. In many familiar animals, sex is inherited based strictly on the genes passed on from parents. In humans, for example, the Y chromosome results in the production of males. But in a surprising number of animals, sex is determined or influenced by the environment during a critical period early in their development. In the case of southern flounder, both genetic and environmental factors play a role. The sex of males is genetically determined and irreversible; however, the sex of females, while initially genetically determined, can be reversed by temperature. This was first shown by researchers in a North Carolina laboratory, where it was discovered that a water temperature of approximately 74°F produced equal proportions of males and females. Temperatures above and below 73°F produced disproportionately more males.

At the Fisheries and Mariculture Laboratory (FAML) of The University of Texas Marine Science Institute, Dr. G. Joan Holt and I explored the effects of temperature on sex determination in southern flounder from Texas. Specifically, we wanted to know which temperatures alter the sex ratio and at exactly which point during development temperature influences the sex of a flounder.

Determining the sex of juvenile southern flounder is no easy task, however. The fish are so small that we could not assess their sex visually. Therefore, we had to remove the developing reproductive organs and measure a temperature-sensitive enzyme called aromatase to determine whether a fish was developing into a male or a female. Aromatase converts testosterone (a male hormone) to estrogen (a female hormone). High levels of aromatase indicate that a flounder is developing into a female, while low levels indicate a genetic male or a female becoming a male.

We spawned flounder broodstock and conducted carefully designed experiments at the CCA Texas Laboratory for Marine Larviculture at FAML. We exposed two distinct size groups of juvenile flounder (approximately 1.5 and 2.5 inches long) to five different temperatures that represented conditions the juvenile flounder might experience in the wild once they reached the estuaries. And we found some interesting differences between our results and those of the researchers in North Carolina, suggesting that there may be genetic differences between the two populations.

For the smaller juveniles, we saw a 50:50 ratio of males and females at 64°F but a dramatic decrease in females as temperature increased up to 86°F. The larger juveniles also had a 50:50 ratio of males and females at 64°F and the proportion did not change significantly at other temperatures. This suggests the time when southern flounder from Texas are between 1.5 and 2.5 inches long is a critical period in their development for determining their sex.

These findings are very important for stock-enhancement programs for southern flounder in Texas. Equal proportions of both sexes can be produced at 64°F and then stocked, but it is uncertain whether flounder should be stocked at a 1:1 ratio because it is not known what sex ratios occur in the wild. Alternatively, now that we know the timing of sex determination in southern flounder from Texas, they can be reared and stocked prior to 1.5 inches. This will allow the environment to determine the sex; however, stocking at such a small size might increase mortality rates, thereby reducing the effectiveness of stocking efforts.

This work was conducted in, and wouldn't have been possible without, the CCA Texas Laboratory for Marine Larviculture established in 2007 at The University of Texas Marine Science Institute Fisheries and Mariculture Laboratory.

Avier J. Montalvo earned his B.S. in Marine Fisheries from Texas A&M at Galveston in 2007 and recently completed his M.S. in Marine Science in 2010 from The University of Texas Marine Science Institute (UTMSI). He was born and raised in Port Lavaca, Texas, and has lived on the Texas coast ever since. Avier is an avid fisherman and has been a proud member of the Costal Conservation Association for 6 years.