Researchers help salmon farmers confront threat to their industry

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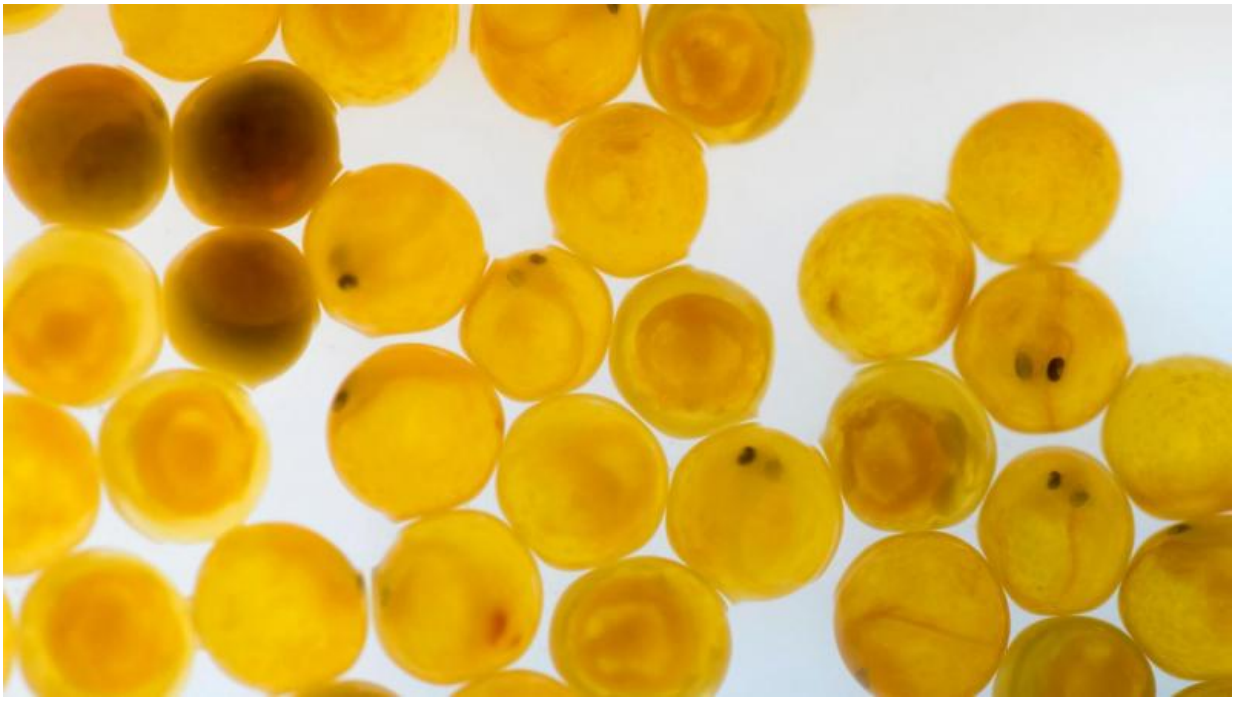

Credit: University of Maine

It's a mystery that has puzzled University of Maine assistant professor of marine biology and aquaculture Heather Hamlin and the salmon farming industry in New England: the decline in egg survival.

The survival rate of fertilized salmon eggs had been as high as 80 percent. But beginning in 2000, salmon embryos began dying in large

numbers and the average survival rate fell to around 50 percent.

Previous studies have shown that a range of factors can negatively impact egg quality and production, including nutrition, stress, temperature and the endocrine status of the female. Until recently, businesses such as New Brunswick-based Cooke Aquaculture, which runs farming operations at several sites in Maine, knew little about why some of its eggs were dying and others were surviving, despite having come from same strain females, cultured under similar conditions.

Now a UMaine study has found that two hormones may play significant roles in achieving an 80 percent embryo survival rate. Hamlin and LeeAnne Thayer, a UMaine Ph.D. candidate in marine sciences, wrote about their findings in the journal *Aquaculture Research*.

For the past five years, Hamlin and Thayer have been taking tissue samples from Atlantic salmon ages 2–4 at three sites: the National Coldwater Marine Aquaculture Center run by the U.S. Department of Agriculture at UMaine's Center for Cooperative Aquaculture Research in Franklin; and two sites owned by Cooke Aquaculture—a fresh-water breeding site in Bingham and a sea cage site in Eastport.

In their research, Hamlin and Thayer incubated fertilized eggs and monitored their development. What they watched for was the development of the embryos' eyes in the bright orange eggs—a good indication that the egg will ultimately hatch.

For Hamlin and Thayer, a major focus of their research has been the endocrine system, which includes the hormones, the tissues that produce them and the genes that regulate them. Because hormones regulate much of reproduction and embryonic development and many other systems, the researchers wanted to determine if there was a difference in the hormone profiles of the females producing batches of eggs with high and

low survival rates.

Hamlin and Thayer found that female Atlantic salmon with the highest levels of 11-ketotestosterone, an androgen, and 17-beta estradiol, an estrogen, were more likely to produce embryos with an 80 percent survival rate.

The project was a natural next step in Hamlin's research career focused on the intersection of endocrinology and reproductive health. The Hampden, Maine native received her bachelor's and master's degrees from UMaine. She was an assistant professor in the department of obstetrics and gynecology at the Medical University of South Carolina before returning to her alma mater in 2011.

"How do I use what I've done in the past to address problems that are important to Maine?" says Hamlin. "It's a really important part of our scholarship and research. It has less utility, in my opinion, if it can't benefit the people of Maine."

Hamlin found the research project that would allow her to fulfill this goal a few months before beginning her job in Orono. That spring, she was invited to a salmon hatchery roundtable in Bangor. Commercial aquaculture producers, marine scientists and state and federal officials gather biannually to discuss challenges facing hatcheries in New England. At the meeting, Hamlin learned about declining embryo survival rates in farmed Atlantic salmon.

Hamlin's Ph.D. research at the University of Florida had examined how pesticides, nitrates and chemicals in plastics affected the reproductive health of alligators, sharks, chickens, Siberian sturgeon and turtles. Later, in South Carolina, the reproductive endocrinologist worked at the Hollings Marine Laboratory, where she did research on marine animals in an effort to learn more about problems impacting maternal fetal

health.

In the declining survival rates of salmon embryos in New England, Hamlin saw an opportunity to use her expertise in endocrinology and reproduction to help solve a major problem facing an industry vital to Maine's economy.

Cooke Aquaculture operates salmon farming operations in New Brunswick, Nova Scotia, Newfoundland, Chile, Scotland, Maine and Washington and sea bass and sea bream farming operations in Spain. The Cooke family of companies now includes wild salmon and groundfish processing, through Icicle Seafoods, Inc. in Alaska, as well as shrimp, oyster, scallop, king crab and other products through the Virginia-based Wanchese Fish Company and a hake fishery and processor, Cooke Uruguay (formerly Fripur).

Cooke representatives were among the industry officials at the salmon hatchery roundtable in Bangor. Hamlin introduced herself after hearing about the salmon embryo survival problem, and proposed working together to solve the issue.

The declining embryo survival rate creates unpredictability, which means the company must produce more eggs than needed to ensure a consistent supply of salmon for the marketplace.

Hamlin will now turn her attention to hormonal processes related to egg assembly, ovulation or post-ovulatory aging. In the next phase of her research, Hamlin plans to analyze arrays of mRNA transcripts, or transcriptomes, in the tissues of farmed Atlantic salmon to see which systems inside the fish are the most stressed.

"That could really help us sort of identify that needle in the haystack," says Hamlin. "We can start to identify very specific pathways that might

be affected. Then we might be able to definitively identify causes. That's a relatively new area of research."

Provided by University of Maine