Céline Godard-Codding is studying the critically endangered western gray whale species.

Semiarid Lubbock, Texas, sits 3,200 feet above sea level and more than 500 miles from the nearest ocean. To those outside of Lubbock, it’s known for cotton and blinded dust storms. It’s perhaps the last place one would expect to find cutting-edge research in the study of marine life. Yet, through The Institute of Environmental and Human Health (TIEHH) at Texas Tech University, that’s exactly what’s happening out here on the dusty plains of West Texas.

Céline Godard-Codding, associate chair of the Department of Environmental Toxicology and an associate professor of endangered species toxicology at TIEHH, is leading a worldwide research effort to study the health of the western gray whale, a critically endangered species found only along Russia’s Pacific coast, and has developed a new method that could impact her entire field along the way.

**Whale research**

Her part in the research began five years ago after ExxonMobil asked the Russian government for permission to drill in the waters where the western gray whales feed. As part of the subsequent government-mandated environmental assessment, which examines how such activity might impact the already endangered species, Godard-Codding was hired to lead a study of whether the whales also reproduce in those waters.

“There are only about 300 or so left, so there’s a lot of concern about that population of whales,” Godard-Codding said.

The trouble is, western gray whales are extremely shy and avoid human interaction, so it’s difficult to obtain information about them. In contrast, their so-called “sister” population, the eastern gray whales, found all along the Pacific coast of the United States, are much more comfortable around humans.

The initial research had three goals: to study the western gray whales’ reproductive and feeding habits and examine their genes in comparison to those of the eastern gray whale. The latter process would allow scientists to determine whether the two species really are separate from one another.

Now leading the program entirely, Godard-Codding is studying the whales’ reproductive fitness in her laboratory at TIEHH and has subcontracted with specialists around the world for other parts of the research, which has expanded greatly over these five years.

"It started as only whether the whale was pregnant or not; that’s it," Godard-Codding said. "I've since expanded that part of the program because, with hormone analysis, you could potentially look at more than just if the whale is pregnant or not. The more information we have about these animals, the better we can have science-based conservation efforts.

"I have colleagues at Purdue University looking at the population genetics and colleagues at the University of Alaska-Fairbanks looking at feeding habits. We're doing all of that based on tissue collected from biopsies because, obviously, they're critically endangered, so you want to try and gain some samples that can be obtained in non-lethal and minimally invasive ways."

**Small samples**

Russian scientists collect whale tissue using a crossbow and special hollow-tipped arrow that can obtain a specimen smaller than one segment of a finger. But Godard-Codding said not to worry – it doesn’t hurt the whale.

"There are standards and regulations on the size of the arrow tip compared to the size of the whale, and that’s all approved by the National Oceanic and Atmospheric Administration as to what we can use," she explained. "It’s done by someone who has expertise in doing that, and there are studies that have shown that it does not affect the whales."

"We’ve seen in some published literature that when you miss and the arrow strikes the water, it startles..."
Challenges do a lot of lengthy validation, and we’re still working on it.” So, it’s not like we got the sample and then we could just plug it into the instrument. We’ve had to try and optimize the methodology on, and it’s full of unusual fats. So, even experts in the field are like, ‘Well let’s try this, let’s try that,’ just to prepare the sample so we can put it in the instrument. It’s not a typical matrix at all.” That said, Godard-Codding said the work is definitely worth the effort because of the wide ramifications it could have for science as a whole.

“I feel it has a lot of potential to really be helpful to scientists and to the field,” she said. “It’s providing information that will help scientists interested in hormones know that they have a different option that can be a lot more sensitive and may require a lot less tissue.

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At the end of the day, it’s like trying to solve a mystery with only a few clues.

“If I was working on rat liver with an instrument that’s run all the time in pharmacological testing of rat liver, we could just get the sample and, the next day, we could run the experiment. We could have results in a week or a month,” Godard-Codding said. “This may take us two years to get the samples. We don’t have a lot of material to try and optimize the methodology on, and it’s full of unusual fats. So, even experts in the field are like, ‘Well let’s try this, let’s try that,’ just to prepare the sample so we can put it in the instrument. It’s not a typical matrix at all.”

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“T’m excited because this has been a way for me in my lab to collaborate with a lot of very interesting colleagues. I think it’s good for the students and good for the university. I just wish all I envision would already be here. It’s science: It always takes a lot longer than you want it to take.”

While it’s good for the whale that the sample is tiny, it does present some difficulties for Godard-Codding, particularly because she isn’t the only researcher needing to examine whale tissue.

“Since this is a U.S.-Russian collaboration, the biopsy is divided in half,” she explained. “I get half, and then I subdivide it; part of it goes to Purdue, part to the University of Alaska-Fairbanks and part stays here.

“Those are the challenges that scientists studying endangered species often have to deal with: what kind of samples, how many samples and the size of the samples. It’s very limited.”

‘A new step in the field’

To solve this problem, Godard-Codding has been working to develop a new method of hormone detection that would be more sensitive and require less tissue.

“A lot of the analyses of hormones in skin biopsies have been done using an immunoassay, which is just a kit you buy and doesn’t require a lengthy or difficult training,” she said. “Those are great when you have a limited amount of money and don’t have access to more sensitive and very expensive instrumentation like we have here. So, one of the first things we wanted was to see if we could use our more-sensitive instrumentation to analyze hormones in the skin by a whale skin biopsy.

“We were able to demonstrate that it’s feasible, and we got that published. That was a big step, because there are not a lot of people looking at hormones in cetaceans – it’s kind of a new field to begin with – and most of them are not analytical chemists, so they were using the immunoassay. This was a new step in the field.”

Imмуnoassays, she noted, require a greater amount of tissue than the new method, so she expects to achieve more results with the same sample.

“One of the challenges some scientists have had is that, with only the sub-portion of biopsy they had, they can analyze only one hormone with those kits,” Godard-Codding said. “Whereas with the same size, I can look at as many as five, six, eight, maybe 10 hormones, so I think it has a lot of potential for the field. I’m excited about that.”

Now that she’s proved the new method works, Godard-Codding is trying to make it even better.

“We’re still working on the optimization and validation of our methodology because gray whale skin, and a lot of other cetacean skin, is a very unique tissue that few researchers are used to,” she explained. “It’s very fatty, and it has a type of fat that’s kind of different from other mammalian fat. So, when we first started, we had to develop a new methodology to try and remove all the fat. Otherwise, it would clog the instruments. These are very expensive, very sensitive instruments. So, it’s not like we got the sample and then we could just plug it into the instrument. We’ve had to do a lot of lengthy validation, and we’re still working on it.”

Challenges