# Motion capture

## Scientists track seals through winter to learn about ecology and oceanography

By Peter Rejcek, *Antarctic Sun* Editor

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It's been about 20 years since anyone attempted to follow Weddell seals through the Antarctic winter. But a multidisciplinary team of scientists is using the latest in satellite tag technology to track the movements of the world's most southerly mammals over the dark and cold months.

"Historically, that's been a big black box for seal behavior and ecology," said Jennifer Burns, a professor at the University of Alaska Anchorage and one of the principal investigators on the three-year field project. "We're getting good data on movements and dive behavior throughout the winter."

However, the project seeks not only to learn more about the animals but the ocean environment in which they swim. The small instruments that the seals carry on top of their heads also record ocean properties, such as temperature and salinity, in addition to tracking their dive profiles and location.

"The cool thing about the animal is that they're not stopped by sea ice. They can go into areas where [ships don't] have any chance of getting in, particularly the areas up near land," noted Eileen Hofmann, a professor at Old Dominion University who heads up the physical oceanography component of the study. "I think that's been a real plus for having the animals act as our physical oceanographers."

Weddell seals (*Leptonychotes weddellii*) are one of the top predators in the Antarctic, with a circumpolar range throughout the Southern Ocean. During the summer, they favor coastal habitats, making use of the fast ice, or sea ice that's frozen along the shore. In the winter, researchers believe they increase their use of the floating pack ice farther from the coast to forage for food such as sardine-sized silverfish *(Pleuragramma antarcticum*).

The seals' reliance on sea ice makes them vulnerable if changes in climate alter their habitats. Also, natural perturbations, such as the large iceberg that chocked McMurdo Sound in the early 2000s and locked in the sea ice, could also affect their ability to successfully breed and forage. Understanding the animals' behavior and physical habitat will help scientists predict how the Weddell seals will fare in the future.

Toward the end of the austral summer for the last three years, Burns, co-principal investigator Daniel Costa with the University of California, Santa Cruz, and their teams have journeyed down to McMurdo Station, the U.S. Antarctic Program's major research facility.

Their job is to locate about 20 seals each year to outfit with the electronic data loggers, which transmit their data on seal diving behavior and water column properties via satellites every time an animal emerges from the water. And, every time the tag transmits, the physical location of the seal can be estimated, providing a track of their movements throughout the Ross Sea.

"Tags are also archiving all of the information that they're collecting. They're little mini computers," Burns said during an interview at the Scientific Committee on Antarctic Research (SCAR) Open Science Conference in Portland, Ore., in July. "Getting our hands on the instrument gives us lots more data."

About five or six times more information, according to Burns, so recovering the instruments at the beginning of each austral summer in October and November has become quite important. Apparently, the tags, particularly the antennas, take quite a beating over the winter, so the data don't always flow over the satellites.

"We actually saw one animal come out of the water with our tag on and just proceed to bash into the ice several times," said Kim Goetz, a graduate student with Costa's lab, during a presentation of the team's initial results of seal winter behavior at the SCAR meeting.

About half of the animals come from a group of seals in Erebus Bay near McMurdo Station — a population that has been studied for more than four decades by other researchers, offering Burns and her colleagues a rich life history for each animal they tag. The other Weddell seals used in the study are located farther north along the Victoria Land coast, which the scientists reach by helicopter.

So far, the tags have recorded more than 200,000 dives and 7,800 conductivity, temperature and depth profiles, according to Goetz. The data show the seals sticking to the coast in the summer before moving out farther into the Ross Sea as winter approaches.

"We know they use their environment differently across seasons," Goetz said.

For Burns, the current project has provided her an opportunity to see if the seals are using the environment differently than they were 20 years ago when she was a graduate student and working with J. Ward Testa, then at the University of Alaska Fairbanks.

Testa and his team had outfitted 26 adult female Weddell seals with satellite tags in the early 1990s. The heavy metal tags had weighed more than two kilograms, and the rubber seals would sometimes fail, flooding the instrument. Still, the project offered enough data for Burns to compare against the present-day study.

She found that two decades ago the seals favored remaining closer to Ross Island in winter than they do today. Also, while there was no difference in dive depth or duration, the seals seemed to spend about 25 percent more time at the bottom of their dives 20 years ago than today, while enjoying longer surface intervals between dives.

"Foraging efficiency was also significantly higher in the 1990s versus the 2010s," Burns said.

In the winter, only two seals went farther than 50 kilometers away from Ross Island during the Testa project. In contrast, all but two seals from the current study traveled farther than 50 kilometers of where the Erebus Bay population breeds in the summer.

"A larger fraction of the population is moving out of the Erebus Bay region in winter now as compared to two decades ago," Burns said.

The reasons behind that behavior are still being analyzed, but some answers may come from the oceanography data that Hofmann and her team are teasing out of the satellite tag data loggers.

For example, the seals seem to frequent parts of the water column near where warmer circumpolar deep water (CDW) reaches toward the surface. Those tend to be areas of higher biological productivity — in other words, a biological hot spot that may offer good hunting.

Hofmann noted that the seals are offering an invaluable, high-resolution window

into the Ross Sea, often frequenting the same locations for days or weeks at a time. That means numerous profiles of the same area. While the technique of outfitting marine mammals to collect data on the physical properties of the ocean isn't new, this is the first time it's been used in the Ross Sea.

"The big thing we're getting from the animals is a view of the seasonal progression of the upper water column," Hofmann explained, adding that oceanography data allows the researchers to calculate the amount of heat in the top several hundred meters. The heat content is important to the formation and dissolution of the seasonal sea ice, which is sensitive to episodic changes in ocean and atmospheric circulation.

The Weddell seals are also helping improve circulation models for the Ross Sea, confirming some assumptions and revealing gaps, particularly in event-scale phenomena, such as storms.

"The seal data has been real important for refining the circulation model we're running for the Ross Sea," Hofmann said. "I think we'll have a much better understanding of variability in the Ross Sea. It's really the variability that's important in trying to understand climate change."

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