

## Life History Transmitter Project Background

Scientists use remote sensing technology to study animals in hard-to-reach areas where they cannot easily see them. One example of remote sensing technology is the Life History Transmitter (LHX). This is a special recording device or satellite tag that researchers put inside the body of Steller sea lions to study their life history.

The Steller sea lions once numbered 300,000 worldwide but there are now 75,000 or less individuals. The Western population from the middle of the Gulf of Alaska to Japan is endangered while the Eastern population from the Gulf of Alaska to Northern California is threatened with extinction. Although the population declined many decades earlier, scientists are still uncertain why. Many aspects of marine mammals' lives are a mystery since they spend a good part of their time underwater. Oregon State University researcher, Dr. Markus Horning, developed the Life History Transmitter to find out how Steller sea lions in Alaska are dying and why their population is not recovering.

Veterinarians put this LHX tag into young Steller sea lions. The tag remains free-floating inside the animal's body and records their body temperature throughout the life of the animal. This information is stored in a tiny computer within the tag. Once the animal dies, its temperature drops significantly. (Marine mammals are homeotherms like people and maintain a relatively constant body temperature.) The tag uses the temperature to determine if the animal is dead. Inside the animal's body the tag cannot transmit because the body blocks the signal. The tag must somehow get out of the body to send its information to a satellite. After the animal begins to rot and fall apart, the tag can come out or if the sea lion gets eaten, the tag will fall out. A tag in water will float to the surface. The tag, once it is out of the body, will try to determine if it is in air or water. If the tag is in air on the beach or if it contacts air at the water's surface, it can send its information or data to the satellite.

How does the tag tell the scientist how and where Steller sea lions die? They use the temperature of the dying animal to calculate its mass at the time of death and make inferences about how the animal died. Researchers tag young Steller sea lions of a known age, and each tag has a code that gives the animal's identity. Based on the age of the animal, gender, and estimated body condition (weight, body measurements, relative amount of fat and muscle) at the time of death, they can figure out the sea lion's weight at the time of death. Surprisingly, a Steller sea lion's weight can tell a lot about its death.

As the sea lion dies, its body acts as an insulator. It cools slowly and eventually reaches the temperature of seawater or air depending on where the body goes. Meanwhile the tag is still taking temperature measurements. Scientists use the rate at which the body cools to determine the cause of death just like coroners do for humans by using cooling curves. Steller sea lions with a large mass cool more slowly and those with a smaller mass cool more quickly. The cooling rate (temperature over time) gives scientists an indirect measurement of the mass of the dead, sea lion.

The pattern of cooling, sudden or slow and gradual, can also indicate the cause of death. For example, in a Steller sea lion dying of disease or starvation, the body stays intact and cools slowly. If the mass of the animal (based on its cooling curve) is somewhat less than

expected, but it still cools slowly, the animal has likely died of starvation or disease that causes weight loss. However, if the tag inside the sea lion experiences a rapid cooling, this indicates the tag has come out of the animal's body. This usually occurs when Orcas eat sea lions as they often tear and shred their prey. If an orca eats a sea lion, but the tag remains inside the body, the body part with the tag will be dramatically smaller and will cool much more rapidly. Unlike an animal that dies of starvation, the cooling curve is sharper.

For example, the scientist receives an email saying "Stella" the Steller sea lion has died. They know that Stella was two years old when she was tagged in 2005. Stella died in 2010. This means Stella is 7 years old. Using the average weight for an adult Steller sea lion female, scientists estimate her weight as 300 kg. Based on that weight and using cooling curves for a given average water or air temperature, scientists can determine it will take hours or days for the body to cool. The difference in the actual cooling curve versus the predicted cooling curve give the mass of the animal upon death. The pattern of cooling abrupt versus slow gives the cause of death.

Here is Stella's actual cooling curve:

