Scientistsâ€™ Study of Antarctic Seals May Lead to Insights on Aging

by Bend Weekly News Sources

A team of scientists has just returned from McMurdo Sound in Antarctica, where they have been analyzing the diving and oxygen-carrying capacity of aging Weddell seals in a study that may shed new light on aging and possible protective mechanisms.

Markus HorningThe study is unusual because its focus is on older animals and how they retain their ability to hunt for food and reproduce despite a lifetime of seemingly debilitating physical exertion.

â€œWeddell seals have well-known compensatory mechanisms that allow them to routinely swim underwater while holding their breaths for 30 minutes to an hour,â€• said Markus Horning, a researcher with the Marine Mammal Institute at Oregon State University and principal investigator on the study. â€œSuch diving behavior is likely to result in periodic hypoxia â€“ or low levels of oxygen â€“ in some tissues, especially swimming muscles.

â€œWhen a mammalâ€™s system is suddenly re-oxygenated after hypoxia, it is likely to create high levels of reactive oxygen species that are implicated in aging and can cause damage to cells, as happens to mountain climbers and other extreme athletes,â€• Horning added.

Part of the research team leaves a Weddell seal to recover and focuses on removing equipment and other gear before the ice melts. (photo by Markus Horning, OSU)Since diving animals routinely experience reoxygenation when breathing at the surface following a dive, the researchers expected to find that Weddell seals would exhibit fairly rapid aging. But few such signs appeared.

â€œOlder seals appear to be diving quite well and have no trouble feeding or reproducing,â€• Horning said. â€œTheir only apparent sign of aging was some wear and tear on their teeth. If aging occurs, then it will happen at the level of organs and tissues, while the whole organism still remains quite functional.â€•

Horning said these findings suggest that Weddell seals have a compensatory or protective mechanism â€“ either physiological or behavioral â€“ that reduces the impact of possible oxidative stress.

This was the first of two field seasons for the researchers in the study, funded by the National Science Foundation. Horning, who also is an assistant professor of fisheries and wildlife at OSU, worked with co-principal investigator Jo-Ann Mellish, from the University of Alaska-Fairbanks.

McMurdo Sound Weddell seals are an ideal species for this aging study, Horning says, because almost all of them have been tagged, documented and identified as individuals by researchers since the 1970s and the ages of those individuals are well-established. An added benefit is that this particular group of seals rarely strays beyond the sound, sealed in by the sea ice, creating a natural laboratory.

During the recent December 2006 field study, the researchers collected small blood and muscle samples from seals. They also applied recording devices to the sealsâ€™ fur to monitor their diving depth, swimming speed and flipper movement, while also recording electro-cardiograms (EKGs). They were able to determine how long these large seals â€“ which weigh 500 to 1,300 pounds â€“ would maintain their dives, how frequently they summoned up bursts of energy, and what their recovery rate was from an exerting dive.

Markus Horning (left) checks the gums of a Weddell seal as part of a National Science Foundation-funded study on aging, while other researchers draw blood samples and prepare for other tests. The seal recovered rapidly and was released. (photo courtesy of Oregon State University)What they discovered was a fascinating physiological response by the seals. When diving, the animals reduced the flow of blood to many of their organs including their skin, liver and kidneys, while keeping their hearts, brains and swimming muscles supplied with blood and oxygen. They reduced their heart rate from about 100 beats per minute down to 40 beats â€“ and sometimes as low as five per minute â€“ to adjust blood output from the heart to this reduced circuit.

â€œThis ability demonstrates the remarkable capacity of seals to manipulate their physiology and metabolism, and to adjust to extreme circumstances,â€• Horning said. â€œOne of our next steps is to compare how older animals adapt their blood flow and heart rate and compare it to younger animals. That may be one area where the older seals may exhibit compensatory mechanism to reduce the impact of reduced muscle performance.â€•

The scientists theorize that the sealsâ€™ compensatory process could come in a couple of different ways. One possibility is that their â€œplasticity,â€• or range of physical behavior, is so wide that efficient dives fit within their physical abilities â€“ even with declining muscle performance at an advanced age. Or they could have highly active anti-oxidant enzymes, or â€œscavenging systems,â€• that remove the reactive oxygen species as they form, reducing oxidative stress and slowing the decline in muscle performance.

â€œItâ€™s also possible there is a combination of both ideas,â€• Horning said. â€œThey may have a wide behavioral plasticity and physiological protective mechanisms to reduce the damage.â€•

If the seals do have enzyme-powered scavenging systems that help them compensate, it could have implications for understanding how humans might deal with oxidative stress and related aging.

Horning says the study should also help researchers fine-tune population models for different marine

mammal species in addition to Weddell seals. Many of the current models, he says, may not accurately reflect the continuing role of aging adults.

â€œA lot of these seals are 25 to 30 years old,â€• Horning said, â€œand they are still actively hunting for food and reproducing and showing little negative effect.â€•

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