Media Release

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Southern Ocean seals dive deep for climate data

Elephant seals are helping scientists overcome a critical blind-spot in their ability to detect change in Southern Ocean circulation and sea ice production and its influence on global climate.

According to a paper published today by a team of French, Australian, US and British scientists in the *Proceedings of the National Academy of Sciences,* elephant seals fitted with special oceanographic sensors are providing a 30-fold increase in data recorded in parts of the Southern Ocean rarely observed using traditional ocean monitoring techniques.

“They have made it possible for us to observe large areas of the ocean under the sea ice in winter for the first time,” says co-author Dr Steve Rintoul from the Antarctic Climate & Ecosystem Cooperative Research Centre (ACE CRC) and CSIRO’s Wealth from Oceans National Research Flagship.

"Conventional oceanographic platforms cannot provide observations under the sea ice, particularly on the Antarctic continental shelf where the most important water mass transformations take place. Until now, our ability to represent the high-latitude oceans and sea ice in oceanographic and climate models has suffered as a result.”

Co-author, University of Tasmania Professor Mark Hindell says the seal data complements traditional oceanographic sampling from ships, satellites and drifting buoys. “By providing ocean measurements under the sea ice, the seals are helping us to establish the global ocean observing system we need to detect and understand changes in the ocean,” he says.

The polar regions play an important role in the earth’s climate system and are changing more rapidly than any other part of the world. In the southern hemisphere, the limited observations available suggest that the circumpolar Southern Ocean has warmed more rapidly than the global ocean average and that the dense water formed near Antarctica and exported to lower latitudes has freshened in some locations and warmed in others. Polar changes are important because a number of feedbacks involving ocean currents, sea ice and the carbon cycle have the potential to accelerate the rate of change.

The seals typically covered a distance of 35-65 kilometres a day with a total of 16,500 profiles obtained in 2004-5. Of these, 8,200 were obtained south of 60S, nine times more than have been obtained from floats and research and supply ships. The 4,520 profiles obtained within the sea ice is a 30-fold increase over conventional data. The seals dived repeatedly to a depth of more than 500 metres on average and to a maximum depth of nearly 2000m. The Australian team included scientists from CSIRO, the ACE CRC, the University of Tasmania's School of Zoology and Centre for Marine Science and Charles Darwin University.

CSIRO initiated the National Research Flagships to provide science-based solutions in response to Australia’s major research challenges and opportunities. The nine Flagships form multidisciplinary teams with industry and the research community to deliver impact and benefits for Australia.

Image available at: http://www.scienceimage.csiro.au/mediarelease/mr08-136.html

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Background
Australian scientists participating included Dr Rintoul (ACE CRC and CSIRO's Wealth from Oceans Flagship) Dr Serguei Sokolov (ACE CRC), Prof Hindell, Prof Richard Coleman and Andrew Miejers (University of Tasmania), and Clive McMahon and Ian Field (Charles Darwin University).

The primary motivation for deploying sensors on seals is to understand seal behaviour and population dynamics, in order to explain, for example, why some populations are on the rise and others are on the decline. The oceanographic observations are a valuable bonus.

"From the biological perspective we are now much more able to precisely describe the foraging environment of the seals than ever before – the distribution and abundance of their food is linked to fine-scale, local ocean features so this means we are closer to understanding what influences their foraging success, " said Prof Hindell. "As changes in the marine environment are thought to have underpinned the declines in elephant seal numbers, these new insights are very valuable indeed."

Southern elephant seals (*Mirounga leonina*) regularly spend the autumn and winter feeding within the sea ice pack and high latitude waters of the Southern Ocean. In late summer, they are fitted with sensors that measure pressure (to indicate depth), temperature and salinity. The animals return to their sub-Antarctic island homes of Macquarie, Kerguelen, South Georgia and the South Shetlands from where they set off 10 months earlier. The tag is dislodged when the animal moults. Data obtained by the seals is collected every four seconds and transmitted to satellite when the animal is at the surface.

"A previous study focused on what the seal tags told scientists about the foraging ecology of the seals," said Dr Rintoul. "Our new study uses the unprecedented data coverage provided by the seals to learn more about ocean currents and sea ice."

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"The most novel aspect of the research is the use of seal data to infer how fast sea ice is forming," said Dr Rintoul. "When sea ice forms, the salt dissolved in sea water is left behind, increasing the salinity of the water beneath the ice. From the change in salinity measured by the seals, we could determine how fast sea ice forms in winter."

Sea ice influences climate by reflecting sunlight back to space (so less sea ice means more energy is absorbed by the earth, causing warming) and by producing dense water that drives the global pattern of ocean currents responsible for transporting heat around the globe. Sea ice also provides critical habitat for krill, penguins and seals. Observations from the sea ice zone are needed to determine the likelihood and consequences of changes in sea ice.