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Nuclear-based science benefiting all Australians

MEDIA RELEASE

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Nuclear science gives new insight on seabird evolution and health

A remarkable study led by Australian Nuclear Science and Technology Organisation (ANSTO) researchers promises to lead to important new insights about the evolution and health of birds.

The team of investigators, led by ANSTO biologist Nicholas Howell and Professor Richard Banati, have been using advanced X-ray imaging on feathers of long-distance migratory seabirds.

Feathers are like a barometer that can indicate the health of individual birds, and also of the environment they rely on.

By analysing the feathers with this new technique, researchers can obtain insights into the overall health of birds.

Also, with a better understanding of how the feathers of birds develop we can gain information about the formation of organs and tissue regeneration and on the evolution of birds.

The study produced novel images that demonstrate the complex chemical distribution in bird feathers, which promises to lead to a better understanding of the physiological processes behind feather growth.

The images showed a regular pattern of bands containing zinc, which are similar to tree rings.
There were roughly the same number of rings as days in a month of feather growth.

"Our collaboration has produced some remarkable depictions of the feathers that let us see into complex and pattern-forming, biochemical processes in cells," said Professor Banati.

It is thought these patterns may one day help scientists assess a bird's overall health retrospectively, in the same way tree rings indicate environmental past environmental events like droughts or floods

The research, published in *Nature Scientific Reports*, also has significant potential for application more broadly in developmental biology.

The advanced imaging techniques at the Australian Synchrotron enabled the team to detail the previously undocumented patterns and properties of the feather.

That specialised technology produced a map which show a range of chemical elements distributed in the feather - zinc, calcuim, bromine, copper and iron.

The patterns are not linked to pigmentation, thickness or other structural characteristics, and the authors suggest another unidentified mechanism may be at work.

The zinc pattern may reflect the estimated number of days of active feather growth, or the duration of the moult period. This highly consistent pattern may be the result of a so far unknown diurnal system.

The team collected the high-res images using the X-Ray Fluorescence Microprobe at the Australian Synchrotron.

"The highly sensitive instrument allows us to view hard biological structures in their natural state. The detector speeds up scanning of the sample, and delivers data at unprecedented resolution," said Banati.

The feathers came from three species of migratory shearwaters, birds that are known to travel over 60,000 kilometres per year on their migration to breeding areas.

"The same basic biochemical mechanisms that allow feathers to develop in birds are at work in other animals and humans," said Howell.

"Such highly regular, biological patterns hold important information, because similar to tree rings, they are a natural time stamp that records events during the growth of these patterns."

The work would not have been possible without painstaking field work in remote locations.

Single breast and wing feathers from the fleshfooted, streaked and short-tailed shearwater were collected on Lord Howe Island, several Japanese islands and Bundeena Beach (NSW) under the direction of co-author Dr Jennifer Lavers of the Institute of Marine and Antarctic Studies at the University of Tasmania.

"It is very difficult to image and measure metals in biological samples, but it is something we can do with a variety of techniques at ANSTO using X-rays, neutrons and isotopes," said Howell.

Last year, a similar approach was used to detect and measure strontium in the vertebrae of sharks.

The research in *Nature Scientific Reports* is available at http://rdcu.be/r3kD. For more information on ANSTO, go to www.ansto.gov.au. A copy of the image of the feathers is attached.

ANSTO Media Contact: Phil McCall 0438 619 987