Tracking marine food sources

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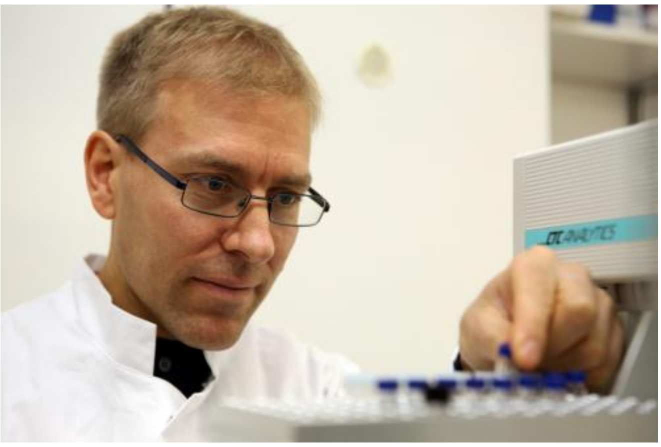

Thomas Larsen introduces a new method based on stable isotopes that can trace one of the most essential compounds for life, protein amino acids, back to the original source. Credit: Copyright: Future Ocean, Christian Urban

Oceans cover nearly 75 percent of the earth's surface and have always been an important source of food and resources. Yet overfishing, pollution and mismanagement threaten marine ecosystems and thus one of the earth's most important sources. We can help to restore these ecosystems by understanding how they work and what affects them. Marine ecosystems have a multitude of organisms that depend on each other for food and nutrients. Researchers know surprisingly little about where marine living animals get their nutrients because the origins of nutrients used to be intractable once it had been digested by the animal. An international research collaboration of scientists together with Kiel's Cluster of Excellence "The Future Ocean" now introduces a new method based on stable isotopes that can trace one of the most essential compounds for life, protein amino acids, back to the original source. These findings have recently been published in the international journals *PLOS ONE* and *ESA Ecology*.

To address the issue of tracing the source of amino acids, Dr. Thomas Larsen of "The Future Ocean" collaborated with researchers from California and Alaska to develop a method that from very small amount of samples can determine where animals obtain these essential nutrients. They discovered that all life forms leave traces or 'fingerprints' in amino acids during biosynthesis. With these fingerprints, which are based on naturally occurring isotope variations, it is possible for the first time to distinguish between algal, bacterial, fungal and plant origins of amino acids through tissue samples. This discovery makes it possible to find out what animals have been feeding on without observing them directly or examining their stomach content.

"The new fingerprinting tool is particularly well suited for investigating foraging habitats and nutrient sources among marine animals", Dr. Thomas Larsen of CAU's Leibniz Laboratory for Isotope Research points out. The newly developed method was applied in a study of the University of Hawaii on the feeding ecology of the green turtle Chelonia mydas living in the central Pacific Ocean. For these endangered marine turtles it is critical to receive insight into the turtle's feeding habits and requirements a method that disturbs the turtles minimally. Here the fingerprinting method proved to be superior over more intrusive methods such as applying GPS-devices to the animals. From previous observations it is known that Chelonia mydas migrate between inshore areas and the open ocean. Juvenile animals stay offshore in the pelagic zone, whereas adult turtles move to coastal habitats. These different habitats are reflected in different diets: In inshore areas, turtles feed on plant based foods such as macroalgae, while pelagic turtles feed on animal based foods such as jellyfish. With the new fingerprinting method it has now become much simpler than with tracking devices to determine whether the turtles feed. The study showed that migration patterns and feeding ecology of these turtles are more complex than previously assumed.

An unknown aspect of the turtles' nutrition was revealed in this study for the first time: microbes living inside the guts of the turtles synthesize essential amino acids that are passed on to their host. But it is only turtles feeding on plant based foods that receive microbial supplementation of amino acids. It appears that microbes responsible for fermentation and digestion of hardly digestible foods in the gut of turtles also help in compensating for nutritional insufficiencies of low quality foods. This microbial supplementation leaves a distinct fingerprint that with high certainty can show whether adult turtles recently have changed between inshore and pelagic habitats. The study demonstrated a change in feeding grounds for one adult turtle but it is not well known how often and why adult turtles would migrate to the open sea. A possible explanation could be to take on additional energy supplies for breeding from animal based foods. Given these observations run contrary to commonly held understanding of nutritional ecology in marine turtles, this study demonstrates the potential for the fingerprinting method not only to explore the complex relationships between a host and its intestinal microflora, but also for a better understanding of foraging habits and habitat requirements of marine species.

More information: [1] Thomas Larsen, Marc Ventura, Nils Andersen, Diane M. O'Brien, Uwe Piatkowski, Matthew D. McCarthy (2013). "Tracing Carbon Sources through Aquatic and Terrestrial Food Webs Using Amino Acid Stable Isotope Fingerprinting." *Plos One* 8(9). dx.doi.org/10.1371%2Fjournal.pone.0073441

[2] Karen Elisabeth Arthur, Shaleyla Kelez, Thomas Larsen, C. Anela Choy, Brian N. Popp, (2013). "Tracing the biosynthetic source of essential amino acids in marine turtles using d13C fingerprints." *Ecology* (In Press). www.esajournals.org/doi/abs/10.1890/13-0263.1