How diving leatherback turtles regulate buoyancy

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Virtually nothing is known about leatherback turtle diving strategies, but on Nov. 12, 2010, an international team of UK and US based scientists publish their discovery that leatherbacks regulate their buoyancy by varying the amount of air they inhale before they dive. Fitting nesting leatherbacks with triaxial accelerometers, temperature and pressure gauges, the team were able to make the first detailed recordings of leatherback turtle diving behavior.

Leatherback turtles are remarkably versatile divers. Routinely diving to depths of several hundred meters, leatherbacks are occasionally known to plunge as deep as 1250m. The animals probably plumb the depths to avoid predators, search for prey and avoid heat in the tropics. However it wasn't clear how these mammoth reptiles regulate their buoyancy as they plunge down. Sabrina Fossette from Swansea University explains that no one knew how the turtles descended so far: do they swim down or become negatively buoyant and plummet like a stone? Curious to find out how nesting leatherbacks plumb the depths, Rory Wilson and his long time collaborator, Molly Lutcavage, decided to deploy data loggers containing triaxial accelerometers on leatherback females as they nested on beaches on St Croix in the US Virgin Islands. They found that leatherbacks probably regulate their buoyancy by varying the amount of air they inhale just before submersion and publish their discovery on Nov. 12, 2010 in the Journal of Experimental Biology.

'When you first see a leatherback turtle coming out of the water it's like a dinosaur it's really impressive,' says Fossette, having just returned from

collecting data in the Indian Ocean. According to Fossette, Andy Myers, Nikolai Liebsch and Steve Garner attached accelerometers to five females as they laid their eggs, and then waited 8-12 days for the reptiles to return to the beach to lay more eggs having headed out to sea. Retrieving the accelerometers, the team found that only two of the five had collected usable data, but the data loggers that functioned showed 81 dives that the team could analyse ranging from 64m down to 462m.

Back in Swansea, Fossette, Adrian Gleiss, Graeme Hays and Rory Wilson analysed the temperature, pressure and acceleration data collected by the loggers. Describing the accelerometer data Fossette says, "You can almost see the animal swimming. It's the first time we could see the locomotor activity during those deep dives."

Extracting the acceleration data that showed the leatherbacks' movements, the team could see that the turtles dived deeply at an average angle of 41deg as they began their descent. Initially the turtles swam with each flipper stroke lasting 3s, but as they descended further they swam less hard until they stopped swimming all together, became negatively buoyant and began gliding down. At the bottom of the dive, the turtles began swimming as they heading to the surface and continued swimming until they regained buoyancy near the surface and began gliding again.

Fossette explains that many diving animals exhale before they leave the surface to minimise the risk of decompression sickness, however, leatherbacks do not. They dive carrying a lung full of air. Curious to find whether leatherbacks vary the amount of air that they inhale to regulate their buoyancy, Fossette and Gleiss compared the depths at which the turtles became negatively buoyant with the maximum depth that they reached. The team found that the deepest divers remained buoyant the longest and started gliding at deeper depths. So the turtles probably regulate their buoyancy before diving by varying the amount of air they

inhale. Fossette also says, "The nesting turtles may glide for 80 percent of the dive's descent to optimise their energetic reserves, which is crucial for the production of eggs."

The team is now keen to look at the diving patterns of leatherbacks in their foraging grounds in the North Atlantic. Fossette explains that nesting turtles lose weight while foraging turtles are gaining weight and this could affect their buoyancy and diving behaviour. However, tagging a 400kg turtle in the ocean is a much bigger problem than tagging them on a beach.

More information: Fossette, S., Gleiss, A. C., Myers, A. E., Garner, S., Liebsch, N., Whitney, N., Hays, G. C., Wilson, R. P. and Lutcavage, M. E. (2010). Behaviour and buoyancy regulation in the deepest-diving reptile: the leatherback turtle. J. Exp. Biol. 213, 4074-4083. jeb.biologists.org/cgi/content … abstract/213/23/4074

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