INSIDE JEB

Sluggish metabolism keeps Greenland sharks going on meagre meals

A motion and temperature sensor being attached to a Greenland shark.

Apparently, Greenland shark is an acquired taste. The meat of these leviathans, tainted with urea and toxic trimethylamine *N*-oxide, requires fermentation and drying before it is safe to consume. But the long-lived giants of the deep are coming under increasing threat as they compete with humans for their own preferred delicacy, Greenland halibut. And their Arctic home is one of the fastest warming regions on the planet, putting these monsters in even more danger. ‘If we understand their energy requirements in the wild, we can estimate how much food they need to eat and hypothesise about their survival strategies’, says Eric Ste-Marie from The University of Windsor, Canada, adding that it is increasingly important to predict how they will be impacted by these threats. Together with Nigel Hussey (University of Windsor), Yuuki Watanabe (National Institute of Polar Research, Japan), Marianne Marcoux (Fisheries and Ocean Canada), in collaboration with Jayson Semmens (University of Tasmania, Australia), Ste-Marie headed north to Nunavut to go shark fishing.

Working with local hunters and trappers, the team set long fishing lines baited with shark treats in the Scott Inlet, Nunavut, and further north in Tremblay Sound, capturing 30 sharks over a 5 year period before carefully hauling the animals to the surface, measuring their length and attaching a temperature and motion sensor behind the head to monitor their activity. ‘Seeing a Greenland shark up close is a unique experience. Their movements are slow but powerful, their eyes are typically cloudy and their skin feels like sandpaper’, says Ste-Marie, adding that the animals were usually calm once secured alongside a boat. The team then retrieved each tag when it detached up to 48 h later. ‘Arctic field work poses unique challenges: wind, water and ice conditions often change quickly, making tag recovery difficult, especially on days when we had multiple tags to recover or when sharks swam tens of kilometres away’, says Ste-Marie.

Having previously learned from Watanabe how to extract information from the movements recorded by motion sensors, Ste-Marie painstakingly analysed the lethargic sharks’ manoeuvres and calculated how fast they beat their tails. In addition, he estimated each animal’s mass, based on their length, and calculated their metabolic rate as they propelled themselves through the depths. After months of patient calculation, Ste-Marie determined that the shark’s metabolic rate is ~21.7 mg O_2 h^{-1} $kg^{-0.84}$, compared with 187–506 mg O_2 $kg^{-0.86}$ for bull sharks, although the metabolic rate that he determined for a smaller group of sharks wearing an activity monitor for a whole year was slightly higher (~25.5 mg O_2 h^{-1} $kg^{-0.84}$).

But how much food does that translate into? Converting the metabolic rate into energy use and then into the amount of fish a shark would have to consume to provide that energy, Ste-Marie calculated that an average 224 kg shark must consume 164–193 g of fish each day. So, a shark could keep going for 5–6 days on a 1 kg Greenland halibut meal, while a 15 kg narwhal snack would support a shark for up to 175 days and 15 kg of ringed seal could sustain an animal for up to 250 days – over 8 months – before it needed to dine again.

‘Our estimates of field metabolic rate were very low across the sharks in our study. They likely do not require much energy and food to fuel their daily lives, which may allow them to survive extended periods without feeding’, says Ste-Marie, who is keen to find out how often these massive fish depend on scavenging or pursuing tasty treats to satisfy their meagre appetites.

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