INSIDE JEB

GPS tracking insight into kittiwake muscle structure

An adult kittiwake with chick on the Middleton Island radar tower. Photo credit: Kristen Lalla.

'Use it or lose it', is the personal trainer's mantra. People and captive animals that exercise tend to have better developed muscles than those that prefer a more sedentary lifestyle. However, Kristen Lalla from McGill University, Canada, explains that the link was less clear for creatures in the wild. Although it would make sense that the most active animals would have the strongest muscles, few studies had put the theory to the test by directly comparing muscle fibre build with animal activity. Kittiwakes that nest in dense colonies on cliffs embark on foraging trips out at sea to feed their young. Given the birds' epic exertions, Lalla, Kyle Elliott (also from McGill University), Scott Hatch (Institute for Seabird Research and Conservation, Anchorage, USA) and Ana Jimenez (Colgate University, USA) realised that a colony of the birds on Middleton Island, in the Gulf of Alaska, USA, were the ideal animals to investigate the link between muscle structure and an active lifestyle.

'Middleton Island has a field research station where kittiwakes breed on an abandoned radar tower', says Lalla, explaining that Hatch has studied the birds for more than 30 years. 'The tower has been modified with nesting platforms with one-way glass, so we can walk up into the tower and see hundreds of breeding kittiwakes up close', she adds. But facilities at the site are also limited, with researchers having to bring everything they need, including equipment and food for several weeks, on the chartered flight from Anchorage. 'If you forget a critical piece of equipment, there is no easy way to get a replacement', says Lalla.

Deploying GPS trackers with accelerometers – to capture the fine detail of the birds' movements – on 37 of the tower's residents, Lalla and Shannon Whelan, also from McGill University, allowed the kittiwakes to come and go as they pleased before retrieving the data loggers 4 days later. 'We spent many hours waiting for our study birds to come to their nests so that we could try to recapture them', recalls Lalla, adding how they also collected a minute muscle sample from the pectoral muscle of 24 of the birds. 'The options for storing samples, like muscle biopsies, are quite limited', she explains, describing how they had no choice but to preserve the samples in formaldehyde prior to shipping them to Jimenez for analysis.

Analysing the flight paths recorded on the GPS tracker, Lalla, Whelan and Allison Patterson (McGill University) were astonished to see how far some of the birds voyaged, with several round trips exceeding 250 km. And when Karl Brown (Colgate University) and Jimenez analysed the muscle samples, the team realised that the birds with the fastest wing beats had the thinnest muscle fibres, while the birds with the thickest muscle fibres beat their wings more slowly. 'Kittiwakes with lower wing beat frequency are presumably not working as hard to maintain flight because thicker fibres are energetically cheaper to maintain than thinner fibres', says Lalla. Finally, the team correlated the number of nuclei – which produce proteins to power flight – in the muscle cells with the birds' flight speeds, discovering that the birds with the most nuclei tended to fly the fastest.

'Muscle fibre structure does affect movement in a wild bird, impacting their wing beat frequency and ability to sustain higher air speeds', says Lalla, adding that it might be possible to predict muscle structure by tracking bird behaviour. The team is also keen to study the effects of warm and chilly climates on the birds' muscles, to find out whether they are able to adapt their muscle to adjust to climate change.

10.1242/jeb.239681

Lalla, K. M., Whelan, S., Brown, K., Patterson, A., Jimenez, A. G., Hatch, S. A. and Elliott, K. H. (2020). Accelerometry predicts muscle ultrastructure and flight capabilities in a wild bird. *J. Exp. Biol.* **223**, jeb234104. doi:10.1242/jeb.234104

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