

CORRESPONDENCE

Lipid content of whale blubber cannot be measured using biopsies

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Sampling cetacean blubber using retrievable projectiles (biopsy hereafter) has facilitated a wealth of knowledge on *inter alia*: migration, life-history, trophic ecology, population structure and pollutant burden. Although observable behavioural responses in humpback whales (*Megaptera novaeangliae*) are usually mild or moderate (Noren and Mocklin, 2012), biopsy sampling is invasive and ought to be employed judiciously. Christiansen et al. (2020) compellingly argue that blubber lipid-content measurements could inform health and life-history assessments of humpback whales. They aimed to determine a relationship between blubber lipid-content (biopsy) and body shape (aerial photogrammetry). This is a laudable goal: validation of aerial photogrammetry for measuring internal body condition by proxy, would present a less-invasive alternative to biopsy sampling. However, it has previously been shown that the lipid content of biopsy samples is not representative of blubber *in situ* (Ryan et al., 2013). Therein, the blubber lipid content of a dead fin whale (*Balaenoptera physalus*) was estimated, comparing biopsy samples with control samples excised by scalpel. Percentage lipid content (mean±s.d.) was significantly lower and more variable for biopsies (37±6.6%, $n=15$) than controls (81±1.2%, $n=3$). The large discrepancy is likely a result of the biopsy dart rupturing adipocytes, precluding the use of biopsies for estimating blubber lipid-content (Ryan et al., 2013). I argue that this sampling effect could explain why Christiansen et al. (2020) did not find a relationship between metrics of internal and external body

condition. Moreover, I discourage further use of biopsy sampling for measuring blubber lipid content due to sampling biases (Kershaw et al., 2019; Krahn et al., 2004; Ryan et al., 2013). This is especially relevant to longitudinal studies where repeat sampling increases the potential for adverse effects on the welfare of individual whales.

References

- Christiansen, F., Sprogis, K. R., Gross, J., Castrillon, J., Warick, H. A., Leunissen, E. and Bengtson Nash, S. (2020). Variation in outer blubber lipid concentration does not reflect morphological body condition in humpback whales. *J. Exp. Biol.* **223**, jeb213769. doi:10.1242/jeb.213769
- Kershaw, J. L., Brownlow, A., Ramp, C. A., Miller, P. J. and Hall, A. J. (2019). Assessing cetacean body condition: Is total lipid content in blubber biopsies a useful monitoring tool? *Aquat. Conserv.* **29**, 271-282. doi:10.1002/aqc.3105
- Krahn, M. M., Herman, D. P., Ylitalo, G. M., Sloan, C. A., Burrows, D. G., Hobbs, R. C., Mahoney, B. A., Yanagida, G. K., Calambokidis, J. and Moore, S. E. (2004). Stratification of lipids, fatty acids and organochlorine contaminants in blubber of white whales and killer whales. *J. Cetacean Res. Manag.* **6**, 175-189.
- Noren, D. P. and Mocklin, J. A. (2012). Review of cetacean biopsy techniques: factors contributing to successful sample collection and physiological and behavioral impacts. *Mar. Mamm. Sci.* **28**, 154-199. doi:10.1111/j.1748-7692.2011.00469.x
- Ryan, C., McHugh, B., O'Connor, I. and Berrow, S. (2013). Lipid content of blubber biopsies is not representative of blubber *in situ* for fin whales (*Balaenoptera physalus*). *Mar. Mamm. Sci.* **29**, 542-547. doi:10.1111/j.1748-7692.2012.00578.x

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CORRESPONDENCE RESPONSE

Response to: Lipid content of whale blubber cannot be measured using biopsies

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Ryan (2020) states that Christiansen et al. (2020) 'compellingly argue that blubber lipid-content measurements could inform health and life-history assessments of humpback whales'. Rather, the manuscript

poses that body condition (not lipid% specifically) can yield important information about humpback whale life history and health. Blubber lipid content has historically been used as an indirect proxy for body

condition, as has body morphometry measures obtained by photogrammetry. Methodological comparisons, such as those performed in this study, are imperative for advancing robust body condition evaluation and are much needed for evaluating the strengths and limitations of respective approaches, and hereby directing researchers towards the most appropriate methods for new investigations (Castrillon and Bengtson Nash, 2020).

Ryan succinctly summarises the sampling artefacts associated with ascertaining blubber lipid% by remotely biopsied blubber tissue. The authors are in complete agreement with Ryan on this point and indeed dedicate the latter part of the discussion (4th paragraph) to outlining the role of such artefacts as possible confounding factors in the lack of any observable correspondence between photogrammetry and blubber lipid measures in the current study. Importantly, the remotely biopsied tissues analysed in the

current study were sub-divided for seven different biochemical and chemical tracer analyses, of which lipid% was merely one, demonstrating the value of the remote biopsy approach for cetacean research and health assessment.

References

- Castrillon, J. and Bengtson Nash, S.** (2020). Evaluating Cetacean Body Condition; a Review of Traditional Approaches and New Developments. *Ecol. Evol.* **10**, 6144–6162. doi:10.1002/ece3.6301
- Christiansen, F., Sprogis, K. R., Gross, J., Castrillon, J., Warick, H. A., Leunissen, E. and Bengtson Nash, S.** (2020). Variation in outer blubber lipid concentration does not reflect morphological body condition in humpback whales. *J. Exp. Biol.* **223**, jeb213769. doi:10.1242/jeb.213769
- Ryan, C.** (2020). Lipid content of whale blubber cannot be measured using biopsies. *J. Exp. Biol.* **223**, jeb227710. doi:10.1242/jeb.227710

doi:10.1242/jeb.227850