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A response to Worthy *et al.* 2022. A swan-sized fossil anatid (Aves: Anatidae) from the early Miocene St Bathans Fauna of New Zealand. *Zootaxa*, 5168 (1), 39–50.

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Worthy *et al.* (2022a) reassessed some large anatid specimens from the Miocene St Bathans fossil assemblage (Bannockburn Formation) in New Zealand and recommended that *Miotadorna catrionae* Tennyson, Greer, Lubbe, Marx, Richards, Giovanardi & Rawlence, 2022 be considered a junior synonym of *Miotadorna sanctibathansi* Worthy, Tennyson, Jones, McNamara & Douglas, 2007. Here, we reanalyse the new data they presented and reach the opposite conclusion, namely, that *Miotadorna catrionae* is a valid species.

Miotadorna catrionae is based on a humerus from Site 9, Mata Creek, St Bathans, that was found, alongside several other bones, by a field party comprising T. Worthy, A. Tennyson, P. Scofield, V. De Pietri & A. Mannering on 8–9 February 2017. Final preparation of the fossil was carried out by A. Mannering under contract to the Museum of New Zealand Te Papa Tongarewa (NMNZ; Wellington, New Zealand), where it is registered as NMNZ S.47273 (Tennyson *et al.* 2022). Our original analysis distinguished *M. catrionae* from *M. sanctibathansi* based on its larger size and longer, more tapered humerus with a wider proximal but similarly-sized distal end (Tennyson *et al.* 2022).

Worthy *et al.* (2022a) questioned our diagnosis based on: (i) damage to the distal end of the holotype humerus, which they suggested reduced its width by 1 mm; and (ii) the purported existence of two undescribed larger humeri of *M. sanctibathansi*—CM2013.18.33 and CM2013.18.731—at Canterbury Museum (CM; Christchurch, New Zealand) that were not available for our original analysis. Specifically, they quantified the difference between the proximal and distal widths of the humeri as a ratio, which ranged from 1.24–1.52 for those specimens identified as *M. sanctibathansi* in our original analysis, and 1.56 for the holotype of *M. catrionae*. Allowing 1 mm for wear of the distal end, they argued that the true ratio of the *M. catrionae* holotype is closer to 1.48, i.e. within the range of *M. sanctibathansi*; and that one of their new *M. sanctibathansi* specimens (CM2013.18.731) has a ratio of 1.55, i.e. in excess of that of *M. catrionae*.

Following Worthy *et al.*'s assertions, we re-examined the holotype of *M. catrionae*. We maintain that the damage to its distal end is minor, with at best minor implications only for our comparative analysis. We also note that they mischaracterised the relative size of the *M. catrionae* holotype by describing both CM2013.18.33 and CM2013.18.731 as "larger". They report the proximal and distal widths of CM2013.18.731 as 27.1 mm and 17.5 mm, respectively. Thus, both are clearly less than those of the *M. catrionae* holotype (28.8 mm and 18.4 mm). Most importantly, though, we find that Worthy *et al.*'s assessment contains two key deficiencies.

First, they assumed without presenting any justification that CM2013.18.33 and CM2013.18.731 represent *M. sanctibathansi*. In our original analysis (Tennyson *et al.* 2022), we reassessed all of the large anatid humeri from the St Bathans fossil assemblage available to our team, without assuming their taxonomic affinities. By *a priori* identifying CM2013.18.33 and CM2013.18.731 as *M. sanctibathansi*, Worthy *et al.* (2022a) biased their assessment. That decision

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made the apparent size overlap between *M. catrionae* and *M. sanctibathansi* inevitable. A more robust approach would simply have treated CM2013.18.33 and CM2013.18.731 as large anatids and allowed for the possibility that they might represent *M. catrionae*, as suggested both by their large size and by the high proximal/distal width ratio of CM2013.18.731.

Second, Worthy *et al.* (2022a) analysed their material out of temporal and ecological contexts. Recent work has divided the St Bathans fossil assemblage into two biozones: an older layer characterised by the anatid *Manuherikia lacustrina*, and a younger zone defined by its somewhat smaller relative *Manuherikia primadividua* (Worthy *et al.* 2022b). The holotype of *Miotadorna catrionae* comes from this younger time zone, as do both of the new specimens reported by Worthy *et al.* (2002a): CM2013.18.33 from Site HH7 (Manuherikia River) and CM2013.18.731 from Mata Creek Site 8 (T. Worthy *in litt.* Jan 2019).

Analysing our dataset of complete *Miotadorna* humeri with respect to the two biozones shows that those with the largest proximal widths and highest proximal/distal width ratios are all from the younger time zone, while those with the smallest ratios are consistently geologically older. Specifically, the three *Miotadorna* specimens from the younger, *Ma. primadividua*, zone (NMNZ S.47273, NMNZ S.53569, CM2013.18.731) have ratios of 1.53–1.56, whereas those from the older, *Ma. lacustrina*, zone (NMNZ S.42234, NMNZ S.42794, NMNZ S.44162) fall between 1.24–1.46. This difference suggests the presence of anatomically distinct forms of *Miotadorna* in the two zones: an older and smaller one presumably corresponding to *M. sanctibathansi*, and a younger and larger one representing *M. catrionae*. Crucially, the difference between the ratios is large enough that they would remain distinct even if 1 mm were missing from the distal end of the holotype of *M. catrionae*—a claim that, as stated above, we dispute.

Another pertinent observation is that both the main bone layer of Mata Creek Site 9 and Manuherikia River Site HH7 represent lagoonal settings, the only such recorded so far in conjunction with the fossil vertebrate horizons of the Bannockburn Formation (Schwarzhans *et al.* 2023). This may hint at environmental conditions correlating with the presence of *M. catrionae*, although current data are insufficient to draw firm conclusions.

Overall, we find that the new data provided by Worthy *et al.* (2022a) support rather than overturn our diagnosis of *M. catrionae* as a distinct species, and further indicate that there may have been geological age and ecological differences between the latter and *M. sanctibathansi.* In our original study, we suggested that *M. catrionae* co-occurred with a smaller tadornine at Mata Creek Site 9, which we tentatively identified as *M. sanctibathansi* or possibly the female of *M. catrionae*. In light of the new data, we suggest that at least one of these smaller specimens (NMNZ S.53569) likely comes from a female *M. catrionae*. Further research is needed to determine whether *M. sanctibathansi* and *M. catrionae* occurred sympatrically or represent a second bio-indicator taxon pair.

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References

Schwarzhans, W., Scofield, R.P., Tennyson, A.J.D., Worthy, J.P. & Worthy, T.H. (2023) The 'Gulliver' fish fauna of an early Miocene freshwater system of New Zealand; new insights from otoliths from the Bannockburn Formation. *New Zealand Journal of Geology and Geophysics*, 66, 102–129.
https://doi.org/10.1080/00288306.2022.2153878

Tennyson, A.J.D., Greer, L., Lubbe, P., Marx, F.G., Richards, M.D., Giovanardi, S. & Rawlence, N.J. (2022) A new species of large duck (Aves: Anatidae) from the Miocene of New Zealand. *Taxonomy*, 2, 136–144.
https://doi.org/10.3390/taxonomy2010011

Worthy, T.H., Tennyson, A.J.D., Jones, C., McNamara, J.A. & Douglas, B.J. (2007) Miocene waterfowl and other birds from central Otago, New Zealand. *Journal of Systematic Palaeontology*, 5, 1–39.
https://doi.org/10.1017/S1477201906001957

Worthy, T.H., Scofield, R.P., Hand, S.J., De Pietri, V.L. & Archer, M. (2022a) A swan-sized fossil anatid (Aves: Anatidae) from the early Miocene St Bathans Fauna of New Zealand. *Zootaxa*, 5168 (1), 39–50.
https://doi.org/10.11646/zootaxa.5168.1.3

Worthy, T.H., Scofield, R.P., Salisbury, S.W., Hand, S.J., De Pietri, V.L., Blokland, J.C. & Archer, M. (2022b) A new species of *Manuherikia* (Aves: Anatidae) provides evidence of faunal turnover in the St Bathans fauna, New Zealand. *Geobios*, 70, 87–107.
https://doi.org/10.1016/j.geobios.2021.08.002