Towards a tracking of past bird seasonal migrations through geological times: an isotopic approach

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Bird seasonal long-distance migrations are a massive consequence of seasonality on wildlife, initially supposed to have originated during the Pleistocene glacial-interglacial cycles, but now accepted to have arisen much earlier, probably as early as the late Paleogene. Still, concrete evidence for past bird migrations through geological times is lacking, and hitherto there exists no method to track them. Since long-distance migrants stop over areas with contrasted climatic conditions, and since oxygen isotope fractionation is known to be climate-dependent, an approach based on this isotopic signal recorded into birds' bones seems a promising avenue. Therefore, we have first built a model of oxygen incorporation into bird' bones, for a dozen extant migratory and sedentary species after having gathered their GPS tracking data. Model outputs predict that migrating birds could be recognized from sedentary birds. Thus, an experimental protocol was built, comprising a precise bone sampling in order to isolate the isotopic signal corresponding to the birthplace versus that of the adult bird living places, coupled with a histological analysis. This protocol was first applied on extant bird specimens to test the model's tendency. The main result is that a latitudinal signal is indeed recorded into bones, and it was confirmed that a bird's migratory behavior, and more widely birds' phenologies, can be identified by their oxygen isotopic values, but only in certain cases, by comparison with local sedentary birds' isotopic signals.

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