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A New Approach to Bird Ichnology

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Summary

Published data relating to bird traces tend to focus on bird footprints and fossil eggs. The latter are no longer considered as trace fossils. This focus on bird tracks has undoubtedly resulted in other types of bird trace fossils being overlooked. By examining modern bird behaviour and the associated traces (neoichnology), this can provide us with information to inform the search for ancient equivalents. Localities where bird footprints have been recorded are likely to yield other types of traces including feeding traces, resting traces, nest sites, leks, coprolites or urolites, landing and takeoff traces. Modern examples of these traces are presented to provide templates to assist their recognition in the fossil record.

Method

A literature review has been undertaken on bird ichnofossils, with the vast majority of the papers describing bird footprints. In the absence of fossil data, observations of recent bird traces in both sediment and snow have been recorded. The combination of modern and ancient bird traces (i.e. ichnology and neoichnology) has allowed an Atlas of Bird Ichnology to be created, with the modern examples acting as examples of what to expect corresponding ichnofossils to look like.

Types of Potential Bird Ichnofossils

Footprints
Considerable work has been done on ancient bird footprints. The KSU ichnology website lists 43 ichnospecies of bird footprints, most preserved in interpreted ancient coastal deposits. There are also lake margin examples. Some footprints are webbed (palmate) while others are simple tridactyl (three toed) tracks. Anisodactyl tracks with impressions of the hallux preserved make up a third category. A statistical summary of bird footprints will be completed prior to the conference using a wealth of references. In Mesozoic examples, there is a risk of confusing such tracks with small dinosaur tracks, but in Tertiary deposits it is usually fairly straightforward to recognize ancient bird footprints.

Fossil bird footprints may be preserved in a variety of ways related to their creation and taphonomy. One example is where many birds have paddled in the sediment, either in shallow water or in a terrestrial setting. The purpose of such activity is thought to be to attract worms. This leaves what is known as a “bird disco” with hundreds of overlapping footprints. Several birds foraging along a shoreline or lake margin will leave subparallel trackways, while a single bird may leave only a few isolated footprints.

Feeding traces
Some prior work has been undertaken on fossil bird feeding traces. Descriptions are mostly restricted to prod marks, which are preserved as small circular ichnofossils. This is a feeding

method employed by plovers and also by ostriches. However, birds utilize many other feeding strategies, including impact scars, shell drops, dabbling, storage and scrapes. Each of these feeding methods leaves a different type of trace, none of which have ever been identified in the fossil record. One type of modern feeding technique is “swishing” or “scything”, where a bird moves its beak from side to side through the sediment. This feeding style is utilized by avocets, stilts and ibis. A previously unpublished discovery of a Miocene example of this phenomenon will be presented, demonstrating that a wider variety of fossil feeding traces exists than previously recognized. This fossil is tentatively named *Commeoichnus* (sweeping back and forth trace) (Noad in prep 2025).

Nesting traces
Some modern birds nest in scrapes or use a few pebbles to define their nests on beaches or the hinterland. Others use twigs, grasses and other foliage to construct nest structures. The preservation potential of such structures is extremely variable, but it seems likely that many ancient accumulations of plant material may represent nests that have simply not been recognized as nests. These may include very large nests such as eagle nests. The presence of bones or other organic remains in the nest may allow them to be identified as fossils. More work is needed on the possible taphonomy of all types of nests to suggest what ancient analogues may look like in the fossil record. A few examples of nests preserved in tufa, dating back to the Pleistocene, have also been described.

Resting traces
As far as the author is aware, no fossil bird resting traces have been identified. Several examples of dinosaur resting traces have been described (Lockley et al 2016). Examination of modern goose resting traces in melted ice from Calgary, Alberta, has allowed a template of sorts to be erected, with an oval body shape and two rear facing webbed feet leaving an impression in the ice. Other large terrestrial birds, such as ratites, are likely to leave ichnofossils very similar to those of dinosaurs.

Leks
A single example of a possible dinosaur lek has been described from Utah (Lockley et al) with scratch marks preserved on a single bedding plane. The equivalent bird ichnofossils would likely be overlooked as simply random marks on bedding planes, hence the need for palaeontologists to remain vigilant. An association with fossil bird footprints would provide supporting data.

Landing and Takeoff Traces
A series of goose and duck landing traces have been recorded in snow around Calgary. The long scrapes may include an initial set of wing marks, followed by a skid and finally a resting trace. A long furrow may have marks from the wing tips on either side. Such potential ichnofossils should be identifiable in bedrock.

Other potential traces
These include fossil bird coprolites, although the liquid nature of the excreta may make their preservation potential low.

Proposed Atlas of Bird Ichnology

Work is in progress to record as wide a variety of modern and ancient bird traces as possible. This will provide a framework to help to identify the more esoteric bird traces in the fossil record. It is believed that most of the traces described above have been overlooked, due to taphonomy and limited preservation potential.

Significance of this work

It is believed that a large proportion of bird ichnofossils have not been recognized in the fossil record. The application of modern datasets, using a neoichnological approach, has the potential to substantially increase the number and diversity of bird traces that are identified in outcrop.

Acknowledgements

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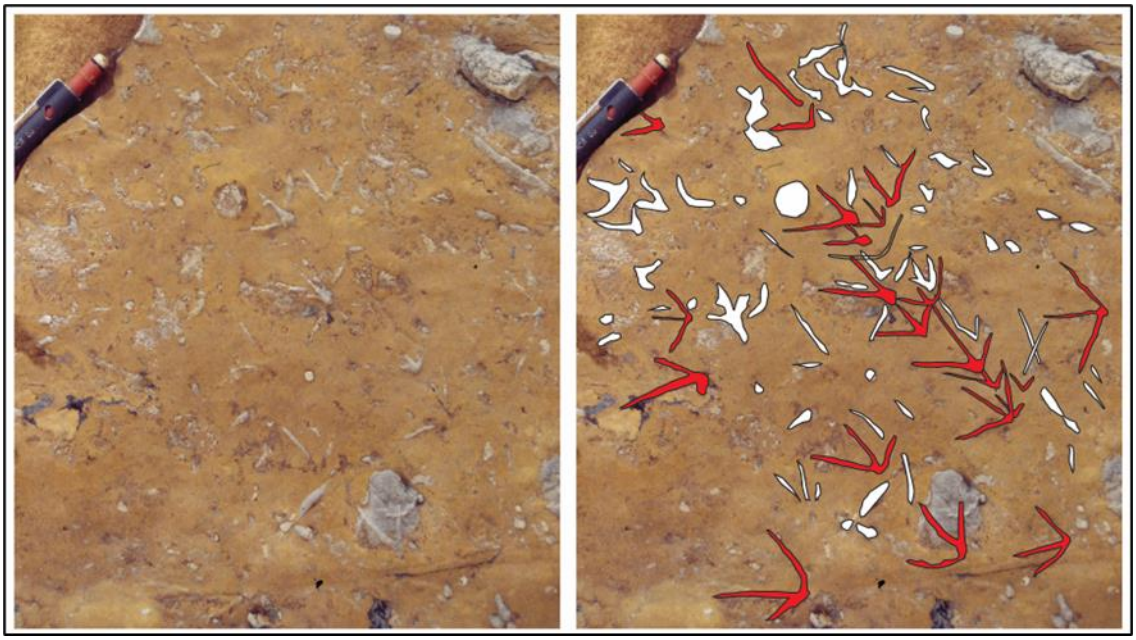

Figure 1. Fossil bird footprints and prod marks with interpretation, from the Miocene Sandakan Formation of eastern Sabah, Borneo.

Figure 2. Swish feeding traces from the Miocene Sandakan Formation, eastern Sabah, Borneo.

Figure 3. Example of modern swish trace from St. Lucia, South Africa

Figure 4. Prod and zigzag feeding traces made by plovers (with associated footprints), observed on the modern Elbow River bank, Calgary, Alberta

Figure 5. Goose resting traces observe din ice close to the Zoo Bridge, Calgary, Alberta

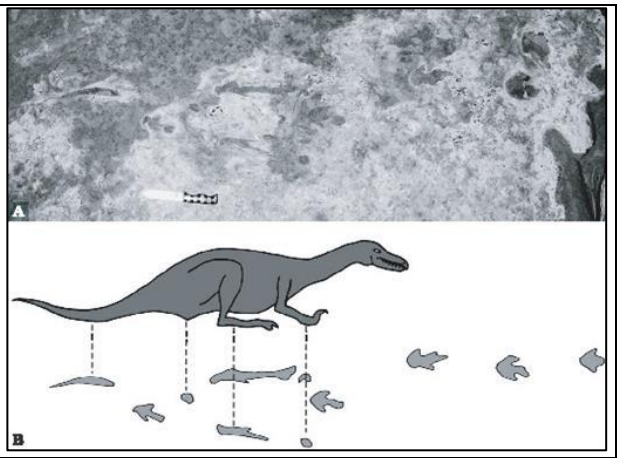

Figure 6. Dinosaur resting trace (Milan et al)

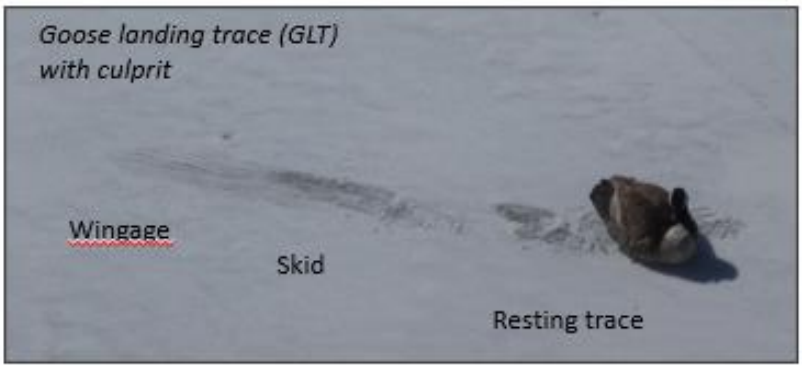

Figure 7. Goose landing trace seen in snow at Inglewood Bird Sanctuary, Calgary, Alberta

Figure 8. Duck landing trace from the same location