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ORIGINAL ARTICLE

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Zusammenfassung

Männliche und weibliche Uferschnepfen (*Limosa limosa bohaii*)

1 and 2

were excluded from analysis because of insu cient data or activity sensor malfunction. The final dataset consisted of 11 tagged individuals (n_{2016} = 3, n_{2017} = 4, n_{2018} = 4), five males and six females, with 869 and 1,243 location fixes in Bohai Bay, respectively, spread relatively evenly among the tagged birds (Table S1).

In the springs of 2017 and 2018, we assessed the abdominal profiles of godwits at primary foraging and roosting sites, not distinguishing males and females. Following Wiersma and Piersma (1995), a score of 1 denoted a bird exhibiting a very lean profile, characterised by a concave abdomen. A score of 3 indicated a slightly convex abdomen, and a score of 5 a bulging abdomen. Intermediate profiles received scores of 2 and 4. Observations were repeated every 1–4 days, resulting in a total of 971 abdominal profile scores. All observations were conducted by a single researcher (B-R Zhu) to avoid inter-observer variation, and readings were taken from ~100–150 m, the closest range that allowed reliable scoring without flushing the birds.

cycle. To account for variations in sampling intervals during data collection, we used the precise duration (in hours) of each duty cycle as an o set term when fitting subsequent statistical models.

Statistical analyses

To analyse godwit activity patterns in northern Bohai Bay, we utilised a Generalised Additive Model (GAM, Hastie and Tibshirani 1987) implemented in the R package "mgcv" (Wood 2017). The model included linear and non-linear predictors to assess the e ects of sex, habitat type, and various rhythmic and temporal factors on activity. We specified an interaction between sex and habitat type to examine di erences in activity patterns across these groups. Non-linear relationships were modelled using smooth functions. We applied cyclic cubic splines to the predictors representing hours to the nearest sunset and hours to the nearest high tide. We separated smooths for each sex-habi-

Employing GPS telemetry data with accelerometers, we reveal that whereas the overall timing of migration and staging did not di er between the sexes, there were sex-specific habitat use patterns. Males predominantly occupied coastal mudflats and nearby saltworks, while females utilised a broader range of habitats, including mudflats, saltworks, and inland freshwater wetlands (Fig. 3). Over time, females gradually moved inland, favouring inland saltworks and freshwater wetlands, resulting in significantly di erent spatial distributions between the sexes (Figs 3 and 4).

In Icelandic Black-tailed Godwits *L. l. islandica*, Alves et al. (2013) argue that larger females are better equipped to exploit higher-quality foraging sites, which provide deeper-buried prey. Males, with their shorter bills, focus on shallower prey. This is in stark contrast with our finding that the larger females utilised inland freshwater wetlands and saltworks characterised by smaller potential prey types such as Chironomid larvae and brine fly larvae, respectively. The larger polychaete prey on the mudflats attracted the smaller males. The fact that females occurred more in areas with smaller prey does not mean that such areas are of lower quality (van Gils et al. 2004). Evaluated as achieved intake rates (Piersma et al. 1995), they may o er richer prey resources than coastal mudflats (Lei et al. 2021).

Physiological adaptations, particularly related to osmoregulation, would add another layer of complexity to the observed sex-specific habitat use patterns. Saline environments may impose significant osmoregulatory stress, a ecting energy budgets, body condition, and immune performance in migratory shorebirds (Masero et al. 2017). Salt glands, which facilitate the excretion of excess salt, are known to exhibit phenotypic flexibility, allowing shorebirds to adjust to variable salinity levels (Gutiérrez et al. 2012). The broader habitat use by female godwits, from freshwater wetlands with minimal salinity stress to saltworks with elevated salinity, suggests a strategy to balance osmoregulatory costs with the benefits of accessing potentially more abundant food resources. This diverse habitat selection, facilitated by their larger body size, their possibly greater dominance (see Sirot et al. 2012), and flexible osmoregulatory capacity, likely enables females to maximise energy intake during migration.

The somewhat elevated activity in the mudflat areas around high tide, especially the females (Fig. 5), represents

national and institutional guidelines. Ethical approvals were issued by the Wildlife Protection Division of the Hebei Provincial Forestry Bureau and the Tianjin Binhai New Area Administrative Committee.

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