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differential migration in sexually dimorphic species (the latitudinal gradients in prey availability hypothesis [Elner and Seaman 2003] and the resource-partitioning

sample (s) and at all latitudes sums to unity (1), so by definition the total of the proportions cannot logically vary with latitude. Thus our linear global model is

$$\tilde{P}_{l,d} = {}_{d=1}^{7} D_d (\;{}_d + \;{}_{7+d}$$

to independently verify the accuracy of the visual sexing method. Results indicate that the visual sexing technique was accurate, with a 0% error rate in the assignment of the female sex category and a 45% error rate in the assignment of the male sex category (see Table 2). We recorded the occurrence of two major feeding modes: ••pecks•• and ••probes.•• ••Pecks•• included all behaviors that involved contact of the bill to the sediment surface. ••Probes•• included all behaviors involving insertion of the bill into the sediment, usually >1/3 the length of the site variation in the count distribution of invertebrates ($F_{1,100} = 14.62, P = 0.0002, r^2 = 0.13$), but not with inter-site variation in invertebrate biomass densities ($F_{1,100} = 2.74$, $P = 0.10$, $r^2 = 0.03$). Biofilm abundance varied significantly between sites ($F_{5,97} = 21.19, P < 0.0001$).

Latitudinal patterns in the vertical distribution of food

Our regression analyses provide unequivocal statistical evidence that the depth profiles of invertebrates varied with latitude (Table 3). For both invertebrate counts and invertebrate biomass, the difference in AIC$_c$ (QAIC$_c$) between the two best-supported models and their competitors clearly removes the lesser-supported models from consideration. The top two ranked models in both analyses show a shift in the distribution of invertebrate counts and invertebrate biomass with depth consistent with our prediction that at lower latitudes, invertebrate counts (Fig. 2) and invertebrate biomass (Fig. 3) tend to be concentrated deeper in the sediment. The •$L + D + D(L)$•• model, in which the depth effect is a function of latitude (i.e., all values of $_{7+d}$ are equal), is a more parsimonious representation of the global model, though both the global and •$L + D + D(L)$•• models present similar depth distribution patterns with latitude.

There was no effect of latitude on biofilm abundance across the nonbreeding distribution of Western Sandpipers ($F_{1,101} = 0.40, P = 0.53, r^2 = 0.004$; Table 1).

Feeding behavior

Across all sites, females used a high6f

stopover site (Mathot and Elner 2004). However, we detected no strong shifts in feeding mode across latitudes for female Western Sandpipers. Latitudinal trends in feeding mode were observed for males, with a fourfold increase in the use of probing recorded from north to south in the nonbreeding range.

Our results differ from those reported by Nebel (2005), in which no latitudinal trends in foraging giving us greater power to detect latitudinal trends in the foraging behavior of males. In contrast, the sample across the nonbreeding range of Western Sandpipers. At least two mechanisms can be hypothesized to generate such correlations: (1) latitudinal patterns in the vertical distribution of food drive differential migration, resulting in overall clines in bill morphology across the nonbreeding solved, two mechanisms can be hypothesized: (1) increasing densities of surface-feeding crabs through temperate, subtropical, and tropical intertidal zones result in depletion of surface food types at lower latitudes (Elner and Seaman 2003) and (2) increasing mean ambient temperatures with decreasing latitude result in deeper burial depths of invertebrates at lower latitudes as a means of avoiding desiccation and heat stress during tidal exposure (Nebel 2005). Future studies should aim to address this unresolved question.

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towards relevant comparisons between temperate and tropical mudflats. Netherland Journal of Sea Research 31:503…512.

Pomeroy, A. C. 2006. Tradeoffs between food abundance and predation danger in spatial usage of a stopover site by western sandpipers, *Calidris mauri*. Oikos 112:629…637.

Quammen, M. L. 1984. Predation by shorebirds, fish, and crabs on invertebrates in intertidal mudflats: an experimental test. Ecology 65:529…537.

Recher, H. F. 1966. Some aspects of the ecology of migrant shorebirds. Ecology 47:393…407.

Reeder, W. G. 1951. Stomach analysis of a group of shorebirds. Condor 53:43…45.