Foraging behaviour of Terek Sandpipers *Xenus cinereus* in Thailand

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INTRODUCTION

Descriptions of the feeding behaviour of Terek Sandpipers *Xenus cinereus* are scarce, qualitative and mainly based on stragglers far outside their normal range of occurrence (Glutz von Blotzheim et al. 1977; Winkler 1980; Barthel & Krott 1982; Cramp & Simmons 1983). Quantitative information is only known from South Korea (Piersma 1986).

During a stay on Ko Li Bong (7°16'N, 99°20'E) off the west coast of Thailand during 1-6 December 1984, we had the opportunity to observe feeding Terek Sandpipers under excellent conditions. It is a widespread winter visitor to Thailand (Bijlsma & de Roder 1985; Parish & Wells 1985).

METHODS

Observations were made during three low tides from a pier with a length of 300 m and a height of circa 2 m, just south of the village Ban Pa Tu Pute on Ko Li Bong. The pier is surrounded by sandy mudflats, which are partly covered with debris of volcanic rocks, bivalve molluscs and remnants of mangrove forest. Walking on the mudflats was possible without sinking in.

Foraging Terek Sandpipers were followed with a telescope (Bushnell 20-45 x 60) from distances between 15 and 60 m. Each bird was watched for at least one minute, but observations were switched to other individuals when the distance between observer and bird was considered too large to obtain reliable information. One of us was following the bird, the other took notes and kept an eye on the clock. The following were recorded each minute: number of pecks, jabs (when half the bill was inserted) and probes (when the bill was fully inserted), number of catches (and whether these were successful or not), prey species, prey size, handling time (measured as the time between catching and swallowing of the prey) and intra- and interspecific behaviour.

Since prey consisted almost exclusively of crabs, prey size was measured as the carapace width relative to bill length: one tenth of the bill = small, up to 0.25x bill length = medium, and up to 0.5x bill length = large. We probably over-estimated carapace width, especially in large crabs, because captured crabs hold their legs close to the body (Piersma 1986). This also explains why large crabs recorded as prey in Nordmann's Greenshank *Tringa guttifer* (Bijlsma & de Roder 1985) exceeded gape width.

Medium and large sized crabs (>5mm) were abundant, with densities at the peak of activity of at least 80-145 crabs/m^2. These estimates were made by eye and did not take into account small (<5mm) sandy coloured crabs. Total densities are therefore much higher than recorded. Some 40 species of crabs were identified on the eastern mudflats of Ko Li Bong, the majority of which belonged to two species of the genus *Uca* (Swennen & Marteijn 1985; C. Swennen *pers. comm.*).

Fiddler crabs *Uca* sp. were abundant and occupied a burrow which was defended against other crabs. Small, sandy coloured crabs also abounded but did not have burrows. Their escape strategy from predators consisted of a sprint towards the nearest film of water and a quick disappearance by whirling sand around themselves; the settling sand partly covered the crab, which was thus perfectly camouflaged.

The activities of the first fifty or hundred Terek Sandpipers

encountered when scanning the mudflats were categorised each quarter of an hour as resting, preening or foraging (excluding birds on high tide roosts). For changes in crab abundance, we used a subjective index of density, viz. 0 = none, 1 = few, 2 = many, 3 = very many and 4 = super-abundant.

RESULTS

Volcanic outcrops, and sometimes mangrove forest, were used as high tide roosts. Here, the birds were standing close together, sleeping and occasionally preening. Usually, Terek Sandpipers left their roost two hours after high tide. Most birds waited along the waterline until the favourite feeding places became exposed, normally after one hour (= two hours after high tide). The birds dispersed evenly over the mudflats and started foraging at an hectic speed.

Foraging Terek Sandpipers intermittently rushed ahead with the body held more or less horizontal and the neck stretched forward. A sprinting Terek Sandpiper was highly diagnostic, not only as the embodiment of activity, but also due to the typical carriage of the neck, head and bill (see inset in Figure 1, based on slides). At irregular intervals, the birds suddenly stopped and pecked at a food item or pushed the bill into the substrate. Sprints usually covered 4–6m, part of which was sometimes flown. Two birds, which were followed non-stop for ten minutes each, made on average 189 (sd = 31) and 190 (sd = 17) steps per minute respectively.

The proportion of foraging Tereks was closely related to the abundance of crabs (Figure 1), which were at a maximum between 1^{h}30 before, until 0^{h}30 after, low tide. In this period, the mudflats were mainly frequented by Terek Sandpipers, Mongolian Plovers *Charadrius mongolus*, Greater Sand-plovers *C. leschenaultii* and Greenshanks *Tringa nebularia*, in densities of 10–20, 10, 5 and 1–2 birds/ha respectively. All birds foraged solitarily. Brief aggressive encounters were noted when birds intruded into each other's feeding range. Kleptoparasitic behaviour of Mongolian Plovers against Terek Sandpipers occurred frequently, and the same behaviour was seen among Terek Sandpipers, although less often.

Feeding activity, expressed as the number of pecks, jabs and probes per minute, was highest one hour before low tide (Figure 2a). Feeding success during this period was exceedingly low: the number of captures averaged one item/min, and less than 10% of the catching attempts were successful (Figure 2b-c). Most crabs were probably still foraging in the vicinity of their burrows and could therefore escape easily

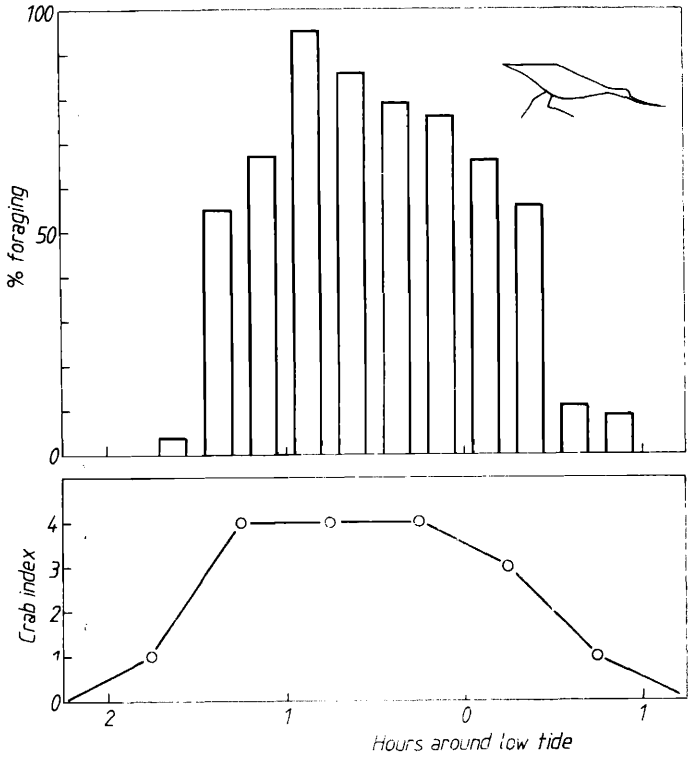

Figure 1. Percentage of foraging (including prey handling) Terek Sandpipers per 15 min (based on samples of 50 or 100 birds) and crab abundance per half hour around low tide. 0=none 1=few 2=many 3=very many 4=superabundant

when approached. Moreover, the high density of waders resulted in constant disturbance of crabs, which were correspondingly difficult to catch. Towards low tide, a slow-down in feeding was noticed with a simultaneous increase in feeding efficiency (up to 5 catches/min and circa 30% of attempts successful) (Figure 2). Crabs were very mobile at this state of the tide, venturing farther away from their burrows. The chance of catching crabs thus increased, and because each crab needed some handling time before being eaten, less time could be spent in catching crabs. Half an hour after low tide, the percentage of foraging Terek Sandpipers sharply dropped, presumably as a result of decreasing crab densities and declining feeding efficiency (Figure 1, Figure 2).

Of 2,460 feeding movements recorded from 1^{h}30 before till 0^{h}30 after low tide, 43% consisted of pecks, 38% of jabs and 14% of probes (Figure 3). Although pecking at prey items on the surface was the major feeding tactic throughout the observation period, most hectic feeding was noticed just before low tide, when crabs were abundant and active 'far' away from their burrows. The increase in jabbing after low tide was consistent with the tendency of crabs to return to their burrows as soon as the mudflats 'dried up' (Figure 1 and Figure 3).

The majority of crabs caught (63%) was small-sized, 29% were medium-sized and only 7% had a large carapace width between 0.25x and 0.5x bill length. Terek Sandpipers showed a clear preference for small crabs. This became even more pronounced towards the end of the feeding period (Figure 4). We had the impression that Terek Sandpipers actively selected small crabs. The crab species without burrows, and especially the small sandy coloured crabs, became increasingly exposed around low tide. Their chance of escaping detection decreased around low tide, because the mudflats had 'dried up'. Crab abundance greatly decreased towards low tide (Figure 1) and the remaining foraging crabs tried to escape predation by flattening on the sand and staying motionless at the approach of a predator.

Handling time of prey was closely related to prey size (Figure 5). Small crabs were swallowed immediately after capture, sometimes preceded by manoeuvering the prey into a correct position in the bill. Medium-sized crabs took more time, especially when the legs were detached. This was done by powerful shaking. The carapace was swallowed as soon as most or all legs had come off; the legs were sometimes eaten afterwards. Large crabs were clearly troublesome. Not only did it take more time to shake off the legs, it was also necessary to detach all legs before the carapace could be swallowed. This prolonged struggle attracted kleptoparasitic birds. Only one Terek was attacked (successfully) when eating small crabs (n=64).

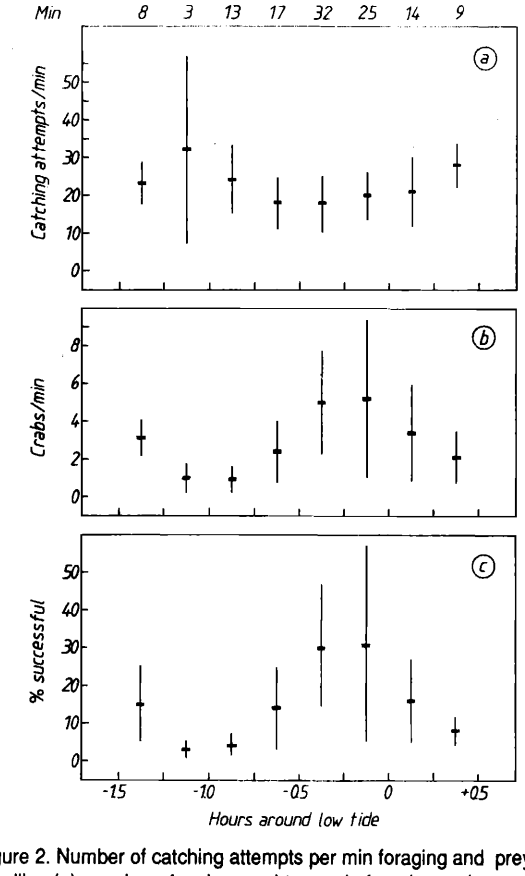

Figure 2. Number of catching attempts per min foraging and prey handling (a), number of crabs caught per min foraging and prey handling (b) and feeding success of Terek Sandpipers around low tide. Number of observation minutes are also shown.

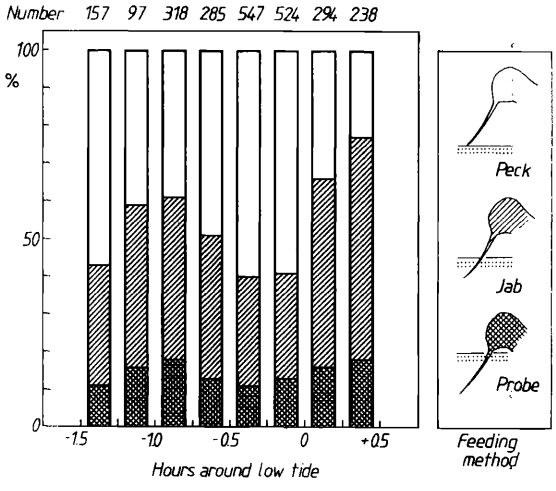

Figure 3. Methods of foraging in relation to the tidal cycle.

Three attacks were witnessed after the capture of medium-sized crabs (n=30), each time by Mongolian Plovers; one of these attacks was successful. Whilst handling large crabs (n=8), Terek Sandpipers had to evade piratical Mongolian

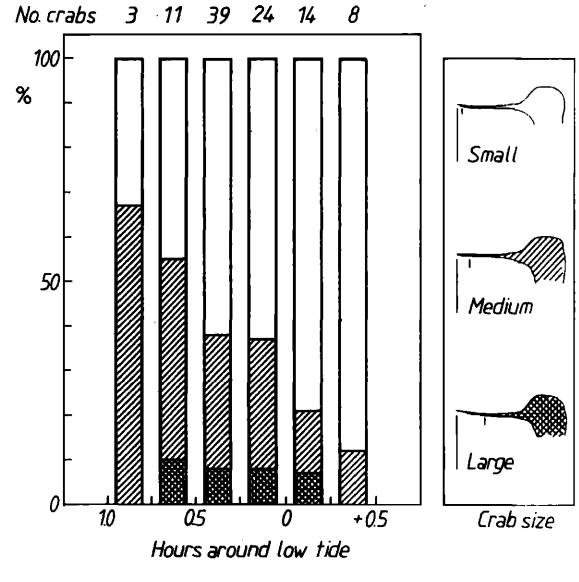

Figure 4. Size distribution of crabs caught around low tide, measured as width of carapace in relation to bill length.

Plovers and congeners six times; two successful robberies by a Mongolian Plover were seen.

Contrary to the findings of Ticehurst (1924), Smaldon (1976) and Piersma (1986), Terek Sandpipers in our study area never washed captured crabs before eating, although there was ample opportunity to do so. However, the only non-crab food item -a small fish- was washed before being swallowed.

DISCUSSION

Foraging behaviour of Terek Sandpipers on Ko Li Bong showed many similarities with those present in South Korea (Piersma 1986); small differences in feeding strategies were also noticed.

Terek Sandpipers on Ko Li Bong foraged almost exclusively on crabs, presumably mostly *Uca* sp. (C. Swennen *pers. comm.*) instead of Sandbubbling Crabs *Scopimera globosa* as in South Korea (Piersma 1986). Tereks are evidently adapted to catching crabs: the long, slightly upturned bill is perfectly suited for catching crabs and the running gate with abrupt halts - sometimes interspersed with short flights - is particularly successful when pursuing crabs. The stooped stance of the body, with still lower held neck and head, and the short legs may be adaptations to scuttling crabs, probably because the carapace is elevated whilst walking. Detecting and pursuing crabs might be easier while looking close to the ground.

Most crab species, including *Uca* sp., have burrows in which they remain for the greater part of the day. The superabundance of crabs is therefore only accessible for Terek

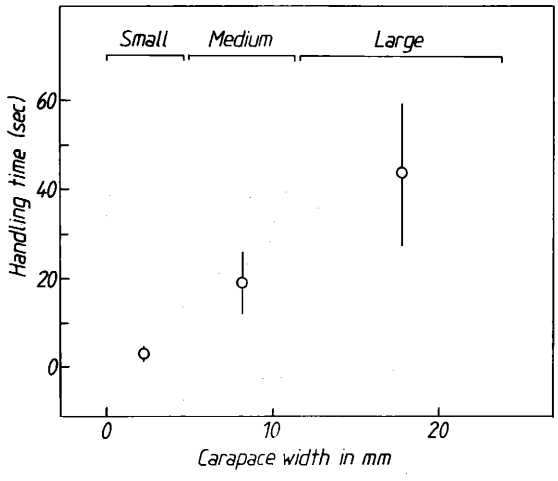

Figure 5. Handling time (including aggressive encounters with kleptoparasitic birds) for small, medium-sized and large crabs.

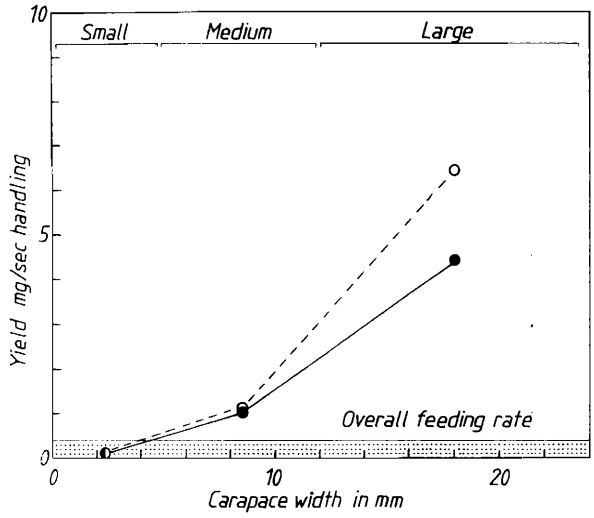

Figure 6. Profitability (mg/sec handling) of small, medium- sized and large crabs, and feeding rate (mg/sec feeding). Average carapace width of small, medium-sized and large crabs is 2.3mm, 8.1mm and 17.9mm respectively. Corresponding ash free dry weights were calculated from Figure 2 of Zwarts (1985).

Sandpipers during the two hours around low tide, when crabs emerge from their burrows to feed on the mudflats. We did not measure burrow depth, but data on *Uca tangeri* in Guinea-Bissau (Zwarts 1985) and *Scopimera globosa* in South Korea (Piersma 1986) suggest that the vast majority of crabs have a burrow depth in excess of 50 mm, thus being just out of reach for Tereks (bill length 43–52 mm, Cramp & Simmons 1983).

Small crabs, with a carapace width of on average 2.4 mm, were obviously the preferred food. The gape width of Terek Sandpipers, i.e. on average 11.2 mm (Piersma 1986), probably did not allow the birds to swallow crabs with carapace widths over 10 mm (see also Figure 5). However, according to Figure 6 small crabs are not profitable because profitability (mg/sec handling) did not exceed the overall feeding rate. On the other hand, large crabs were highly profitable, even if preys lost to kleptoparasitic birds and time lost in evading pirates are taken into account. Why then do Tereks prefer small crabs? Whereas we know that small crabs were superabundant, we have no information on the abundance of large crabs. It is conceivable that large crabs were less common and therefore harder to obtain (although the presence of Whimbrels *Numenius phaeopus* suggests otherwise). Moreover, we certainly overestimated carapace width of large crabs, so that the yield per sec handling time will be lower than shown in Figure 6. It is also possible that large crabs are only partly eaten, for example the legs but not

the carapace, although we did not witness such behaviour. And finally, if Tereks would be foraging mostly on large crabs, they are bound to attract more kleptoparasitic birds than they already did, thus increasing their chance of losing prey and time.

The synchronisity between crab abundance and foraging Terek Sandpipers is striking (Figure 1). The early peak in foraging might have been an indication of the hungriness of Tereks, even though feeding efficiency was relatively low at this state of the tide. This was offset by foraging on medium-sized crabs (Figure 4). The percentage of foraging Tereks gradually decreased with the falling tide, partly as a result of increased feeding efficiency (and more time lost in handling), but also because many birds started to intersperse their feeding bouts with preening. Piersma's (1986) suggestion that gut content and rate of digestion could limit food intake, also seems to hold in our study. Unlike the feeding behaviour of Tereks in South Korea, the birds on Ko Li Bong did not have a second peak in the percentage of time spend foraging just after low tide (Piersma 1986). Instead, foraging decreased with falling tide, as did crab abundance (Figure 1). We got the impression that Tereks had a second, but shorter foraging bout circa one hour before high tide. Many busily feeding Terek Sandpipers were seen along the waterline with incoming tide. Of 50 birds watched at this time of the day, 92% were foraging. During five minutes of observation, one bird made 121 catching attempts, of which 39 were successful. Unfortunately, we did not watch for a longer period.

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