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Variability of wintering waders at a roost in coastal Kenya

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Many wader species gather in monospecific flocks during rising tides and later congregate in large heterospecific groups in undisturbed sites close to the feeding areas (Ferns 1992). Along the coast of Kenya, waterbirds spread widely to forage on sandy beaches and on reefs during low tide, so counts at roosts are the only technique which can provide complete data (Bibby *et al.* 1992). Usually only one or two roosts can be censused per day, within two hours of the high tide. In order to census the waders on a long stretch of coast with several roosting sites, many days are needed. It is also necessary to assume that the birds have a relatively strong roost fidelity, otherwise double counts may occur. However, small scale movements are known to occur in response to specific weather conditions (Bainbridge & Minton 1978, Townshend 1981) including drought (Lane 1987) and heavy winter rains (Warnock *et al.*, 1995), moon phase (Hale 1980) and tides (Ruiz *et al.* 1989, Shuford *et al.* 1989). It has been suggested that counts should be repeated several times, and that at least five counts should be conducted over a winter period, since "it is almost certain that some of them will have to be discarded" (Prater 1979, Rapold *et al.*, 1985, Bibby *et al.* 1992). We focused our attention on a waterbird roosting site on the Kenyan coast, where few data are available on waterbird populations (Britton & Britton 1976, Pearson & Britton 1980) and assessed the variations in waterbird numbers from December 1994 to February 1995.

Study area and methods

Three wader roosts were found in the 16-km Tiwi–Diani–Galu stretch of seashore, south of Mombasa. The Tiwi roost was the northernmost one and was occupied daily. The birds started to form small conspecific flocks 2–3 hours before high tide, gradually congregated into a single roost, then left again approximately 2–3 hours after high tide, reaching the sandy shores and banks in small heterospecific parties and beginning to feed. The precise arrival and departure times depended on the amount of exposed shores and banks, which in turn depended on the type of tide (spring, neap or intermediate). Roosts were formed twice per 24 hours, usually once in daylight and once at night.

The study was carried out on the northern end of Diani Beach, at a roosting site on the mouth of the Tiwi River. The estuary was less than 100 m wide; its water level fluctuated daily with the tides and decreased from December to February owing to the dry season. A wader roost was constantly present on the small muddy islands and sandy bars, 300 m from the shore. From 23 December 1994 to 15 February 1995 we repeated 14 counts (including two re-counts within the same day) from a fixed position and using a 30 x 60 telescope, within 1 hour from high tide. All the birds were identified to species except for Greater and Lesser Sandplovers (*Charadrius leschenaultii* and *C. mongolus*). These species were lumped because they were not identifiable when the birds were resting or sleeping in compact groups. The total number of Common Sandpiper *Actitis hypoleucos* was probably underestimated, as the species also scatters along the river banks during the high tide, but our figures reflect the presence at the roost.

Results

Fourteen wader species were recorded at the roost during the study period (see Fig. 1), on average 11.5 ± 1.16 SD (range 9–13 species) per count. Two additional species of waders (White-fronted Sandplover *Charadrius marginatus* and Spotted Redshank *Tringa erythropus*) were observed within 100 m of the roosting site and another (European Oystercatcher *Haematopus ostralegus*) in the surrounding beaches. The changes in number of the 14 wader species at the roost are shown in Fig. 1. Fluctuations occurred in all the species. The mean number of waders at the roost was 666.2 ± 108.1 (range 445–848). No clear seasonal pattern was apparent and there was no correlation between date and the number of roosting birds (Spearman rank correlation, $r_s = 0.15$, $n = 12$, ns). No correlations were found among the number of the four most abundant species (Greater and Lesser Sandplovers lumped together).

The wintering community of waders can be divided into four main categories:

1. Five species were observed during every census, with on average more than 100 individuals: Grey Plover *Pluvialis squatarola*, Greater/Lesser Sandplovers, Sanderling *Calidris alba* and Curlew Sandpiper *Calidris ferruginea* (Fig. 1a).
2. Four species were observed during every census, with on average less than 30 birds: Ringed Plover *Charadrius hiaticula*, Greenshank *Tringa nebularia*, Ruddy Turnstone *Arenaria interpres*, Terek Sandpiper *Xenus cinereus* (Fig. 1b).
3. One species was observed in more than 50% of the censuses, but with few (<10) individuals: Common Sandpiper *Actitis hypoleucos* (Fig. 1c).
4. Four species were observed in less than 50% of the censuses, with few (usually <10) individuals: Crab Plover *Dromas ardeola*, Caspian Plover *Charadrius asiaticus*, Whimbrel *Numenius phaeopus* and Little Stint *Calidris minuta* (Fig. 1c).

Overall, single counts provided estimates that deviated from the mean by an average of 42%, for the combined set of species in Fig. 1. Deviations from the mean counts were inversely correlated with the average number of birds (Fig. 2). The species in category 1 showed similar, relatively small mean deviations (19% for Greater/Lesser Sandplovers, 23% for Grey Plover, 25% for Curlew Sandpiper, 32% for Sanderling). These were higher for category 2 (25% for Greenshank, 40% for Ringed Plover, 50% for Terek Sandpiper, 64% for Ruddy Turnstone), and highest for those in categories 3 and 4 (16% for Caspian Plover, 28% for Whimbrel, 55% for Common Sandpiper, 60% for Crab Plover, 112% for Little Stint).

Discussion

The wader community included a relative small number of species, particularly if compared with inland water bodies in Kenya (Fasola *et al.* 1993). However, these low numbers are normal for the East African coast (Petersen *et al.* 1988). Noteworthy is the absence of Eurasian Curlew *Numenius arquata*, Marsh Sandpiper *Tringa stagnatalis* and Wood Sandpiper *T. glareola*, considered regular visitors to the coast

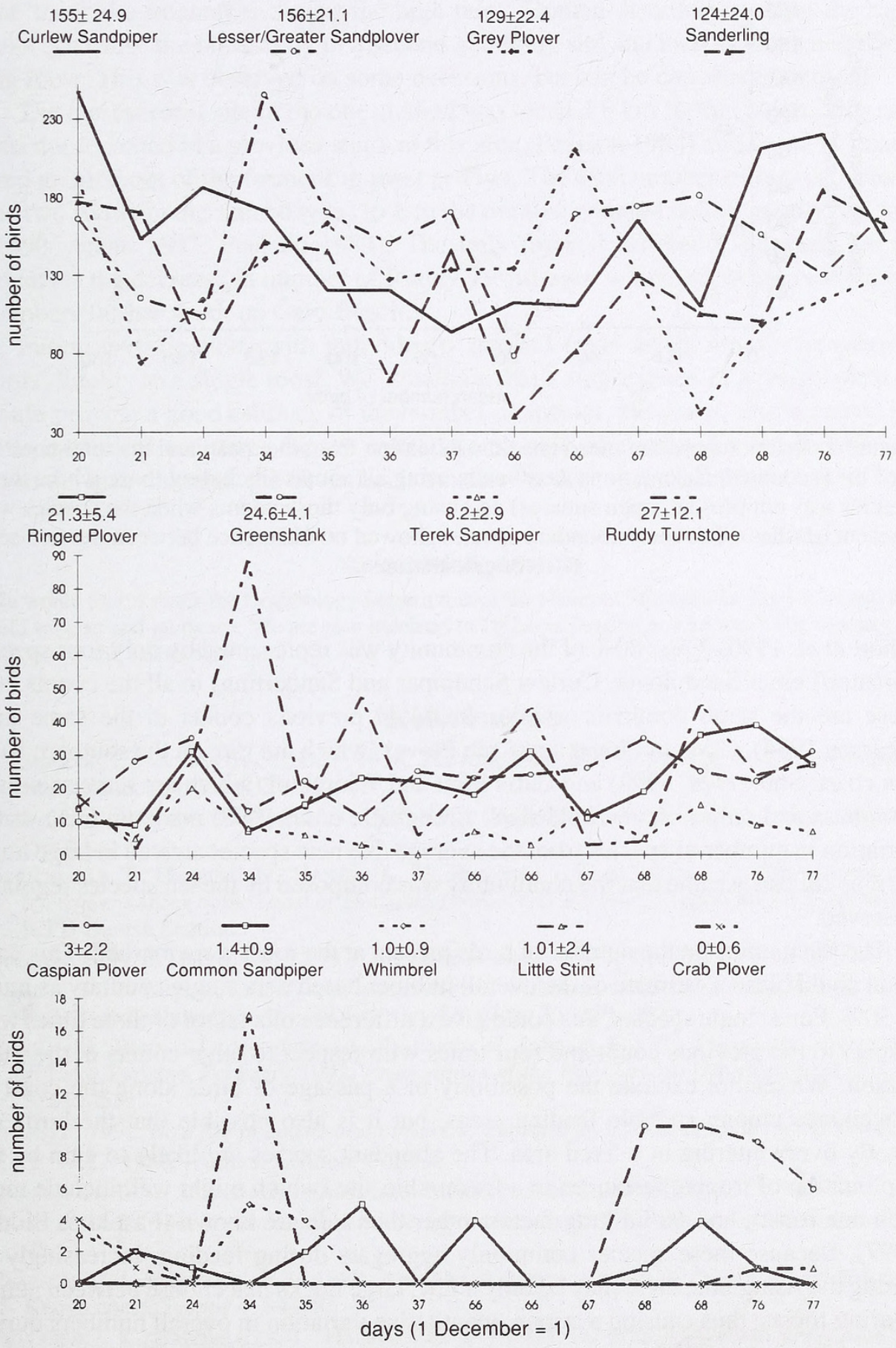

Figure 1. Changes in the number of birds during the 14 censuses. The figures for each species are the mean number for the days when the species was present, and the 95% confidence limits of the mean

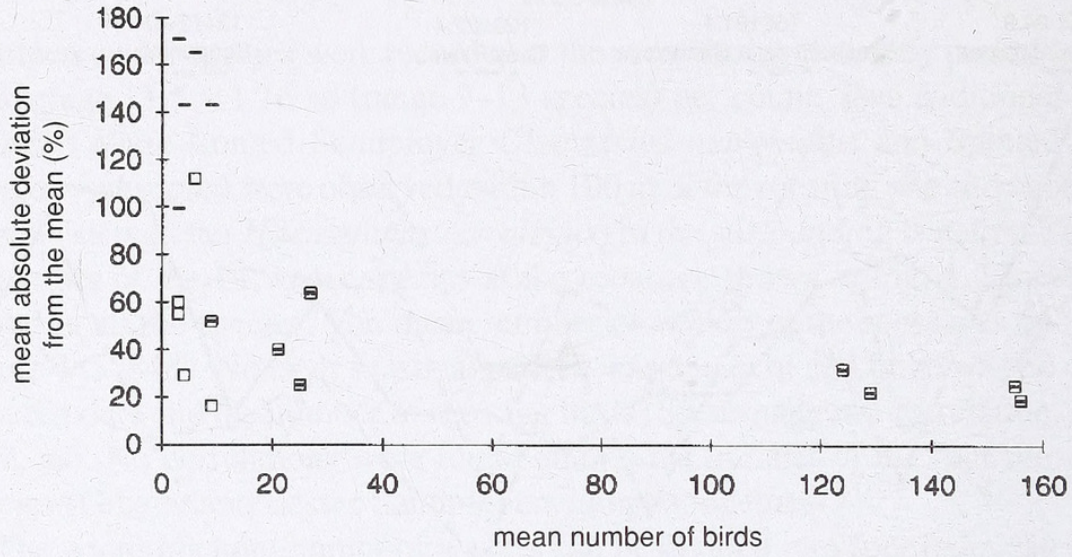

Figure 2. Relation between mean absolute deviation from the mean and the total number of birds counted. Calculations were made using all counts (including those where the species was not present, open squares) and using only those counts when the species was present (dashes). The most abundant species showed no difference between the two sets of calculations

(Short *et al.* 1990). Over 80% of the community was represented by only four species (Greater/Lesser Sandplover, Curlew Sandpiper and Sanderling) in all the counts, and these are the same dominant species found in previous counts in the same area (Pearson 1984). Caspian Plover and Crab Plover (which are rare on the southern Kenyan coast: Short *et al.* 1990) and Little Stint and Whimbrel (which are scarce south of Mombasa and only in favourable sites: Brengballe *et al.* 1990) made up most of the variation in number of species from the average. No new species arrived in large numbers, so we can assume that the community was composed by the ten species regularly observed.

The fluctuations in the number of birds present at the roost were marked. This variation could bias an estimate of the overall number based on a single count by as much as 30%. For a single species, this could give a difference of a factor of three times with respect to the previous count and four times with respect to other counts in the same season. We cannot exclude the possibility of a passage of birds along the coast or movements among suitable feeding areas, but it is also possible that the birds are mostly overwintering in a fixed area. The abundant species are likely to gain by the exploitation of trophic resources in a favourable site (which might well include more than one roost), and no limiting factors other than tide are known (Fasola & Biddau 1997). Because these species commonly aggregate during feeding, increasingly so during the rising tide, there may be only a few, large flocks that choose between neighbouring roosts, thus causing a strong quantitative variation in overall numbers during consecutive counts. We observed conspicuous movements of some species (particularly Grey Plover and Ruddy Turnstone) and sometimes small groups of Ringed Plover aggregated on the beach along the shore, but we never saw flocks moving from

one roost site to another during the high tides. Human disturbance along the sandy spits can cause the birds to fly to a second gathering site and then to join a neighbouring roost. This was observed on some occasions, but can be considered unusual.

The closest roost site to the one studied was located 6 km further south. This roost was not recorded in a previous study in this area (Pearson 1984) and could be considered an offshoot of the former big roost at Tiwi. The total number of birds counted in the two roosts in the same day is close to the number counted before in only one roost (1490 versus 1607: Pearson 1984). The only marked difference between the two counts is the decrease in number of Ruddy Turnstones, which were observed in large numbers further south on Galu Beach.

Future investigations with individually marked birds would clarify the extent of birds' fidelity to a single roost. We conclude that a single count of a wader roost site could provide a good estimate of the number of species. However, single counts provide numerical estimates for the overall community that may deviate considerably from the mean, though the deviation is smaller for the most numerous species.

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