To count or to catch: Do walk-in traps lead to a biased measure of wader productivity?

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Meissner W. 2007. To count or to catch: Do walk-in traps lead to a biased measure of wader productivity? *Wader Study Group Bull.* 113: 53–56.

Keywords: productivity, juvenile proportion, autumn migration, Curlew Sandpiper, *Calidris ferruginea*, Dunlin, *Calidris alpina*, Ringed Plover, *Charadrius hiaticula*

Data on the proportion of juveniles in three wader species on autumn migration along the Baltic coast of Poland were collected in two ways: daily counts and constant trapping using walk-in traps. For each species, both methods revealed similar patterns of productivity from year to year. However, depending on local conditions, the age structure of waders caught with walk-in traps may be biased towards juveniles or adults. Therefore determining proportion of juveniles from regular counts may be the better method of assessing wader productivity at stop-over sites during autumn migration than walk-in trap catching.

INTRODUCTION

The proportion of waders that are juveniles is often considered a good indicator of breeding success (e.g. Gunnarsson 2006, Meissner 2006, Minton *et al.* 2003). Such data are gathered mainly on wintering grounds (Minton 2003), but those collected during southward migration can also give valuable results (Gunnarsson 2006, Meissner 2005, 2006). In the latter case, the proportion of juveniles may not be an accurate reflection of that in the population as a whole, but year to year differences may provide a good index of changing productivity. Two methods can be used to obtain such data: counting or catching. However, catching methods may be particularly prone to bias, mainly toward juveniles due to their lower awareness and greater naivety (Goss-Custard *et al.* 1981, Minton 2003, Pienkowski & Dick 1976). Many ringing stations working in non-tidal areas use walk-in traps to catch waders (e.g. Blomqvist *et al.* 2002, Brenning 1987, Meissner *et al.* 2006, Pinchuk *et al.* 2005). Walk-in traps may catch proportionately more birds of the smaller sex, especially if small or medium size traps are used (Meissner & Sciborski 2002). However, little is known about whether there are age biases among waders caught in walk-in traps. To address this issue, I compare the proportion of juveniles of three wader species during autumn migration stopover on the Baltic coast of Poland as determined by daily counts and through the use of walk-in traps.

METHODS

Daily counts and trapping with walk-in traps (Meissner 1998) took place every day from 17 July to 27 September 1996–2000 (73 days per year) at the mouth of the Reda River, Puck Bay on the Baltic coast of Poland. There, it is possible to count waders at close range so it can be done accurately and it is easy to determine the age of each bird from plumage characteristics. An array of 30–40 medium-size walk-in traps spread across the foraging area was maintained every day from dawn to dusk and visited every two hours.

The proportion of juveniles in each year was calculated in two ways: according to the aggregate total of adults and juveniles counted and according to the total number of adults and juveniles trapped over the 73 days. Short-term retraps were excluded, thus each caught bird was taken into account only once. However, in the counts individuals would have been recounted an unknown number of times. The aggregate count of juveniles for each year is presented as an alternative measure of changes in wader productivity.

Three species that differ in abundance at the study site were selected for the analysis: Dunlin *Calidris alpina*, Curlew Sandpiper *Calidris ferruginea* and Ringed Plover *Charadrius hiaticula*.

During autumn migration, the Dunlin is one of the most numerous waders around Puck Bay where they commonly forage in flocks of over 100 (Meissner & Sikora 1995, Wlodarczak-Komosinska 2004). Most adults pass between mid-July and the beginning of September, whereas the main passage of juveniles does not start until the last ten days of August (Meissner & Strzalkowska 2006). Generally, year to year changes in the proportion of juveniles are not very large, probably because passage birds at Puck Bay breed across such a vast area that low breeding success in one region is buffered by other populations (Meissner & Sikora 1995).

The first adult Curlew Sandpipers arrive at Puck Bay during the first ten days of July, reach a peak in mid July and occur in small numbers until the first week of September. Juveniles arrive in mid August and peak in the first week of September; small numbers, often single birds, occur until the end of that month. The maximum number of adults or juveniles in a day does not normally exceed 50 (Meissner 2006). The proportion of Curlew Sandpipers that are juveniles fluctuates considerably from year to year, due mainly to variation in predation pressure on the breeding grounds in Central Siberia (Meissner 2006).

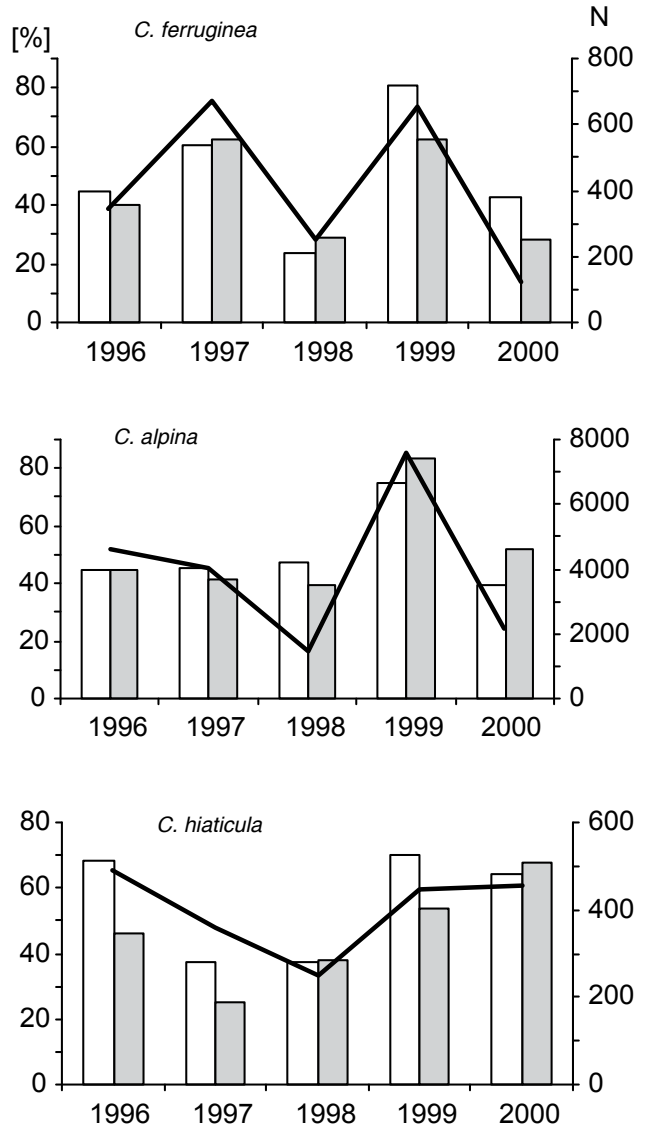

Fig. 1. Annual variation in the percentage of Curlew Sandpipers, Dunlins and Ringed Plovers that were juveniles according to trapping (white bars) and counting (grey bars) at the mouth of the Reda river on the Baltic coast of Poland during 17 July to 27 September 1996–2000 (left axis). The line shows the aggregate number of juveniles counted each year (right axis).

The first adult Ringed Plovers arrive during the first ten days of July with the proportion of juveniles increasing rapidly in late August; small numbers occur until the end of September. Peak numbers in the study area are usually 20–30 (exceptionally up to 100), but usually there are fewer and on many days the species is absent (Meissner & Huzarski 2006).

RESULTS

All three methods of measuring productivity indicate that Curlew Sandpipers had remarkably successful breeding seasons in 1997 and 1999 (Fig. 1). During 1996–1998, the percentage of juveniles derived from counts and trapping was very similar and differences were only 2.5–5.1%; but in 1999 and 2000 trapping suggested higher productivity than counts (by 18.2 and 14.7% respectively) (Fig. 2).

For Dunlin in all years except 1999, the percentage of juveniles among both counts and catches fluctuated within the remarkably narrow range of 40–51%. In 1999 productivity appears to have been much higher than usual with 83% juveniles according to counts and 75% according to trapping (Fig. 1). Generally, the aggregate juvenile counts follow the same pattern except in 1998 when they dropped (Fig. 1). The absolute difference between the percentage of juveniles obtained from counts and trapping ranged from 0.1% (in 1996) to 12.1% (in 2000) (Fig. 2). In 1999 and 2000, counts suggested higher productivity than trapping, whereas in 1997 and 1998 the results were opposite (Fig. 2).

For Ringed Plover, all three methods indicated that a decline in productivity occurred between 1996 and 1998 followed by an increase (Fig. 1). However, the percentage of juveniles according to counts and trapping showed greater discrepancies than in the case of the two *Calidris* species (Fig. 2). In three of the five seasons, trapping suggested substantially higher productivity than counts (by 12.6–22.2%), whereas in the other two years the results were opposite, but only by 1.0 and 3.7% (Fig. 2).

DISCUSSION

The results of this study support the viability of all three methods of measuring wader productivity because generally they all show the same trends and therefore corroborate one another. Nevertheless, at an autumn stopover site like Puck Bay, each may produce biased results. Turnover rates are unknown so neither the total number of birds counted on a single day nor the aggregate counted over the whole study period is likely to be a true reflection of actual numbers passing. However, although turnover rates must vary from year to year at Puck Bay, depending on such factors as weather and the availability of food, it is probable that they do not vary enough to have a major influence on the proportion of juveniles recorded. Therefore most year to year variation is likely to reflect differences in breeding productivity.

One indication that turnover rates in Puck Bay are probably similar between years and relatively fast is that in all three species median retrapping intervals were only 1–4 days with little variation between years (Meissner & Górecki 2006, author's unpublished data). However at other sites, where feeding conditions may change significantly from year to year, length of stay may differ between seasons (e.g. Meissner 2003) and estimates of productivity may therefore be biased.

Despite some differences in the proportion of juveniles derived from counts and trapping, all three methods indicate similar patterns of variation in productivity in all three species from year to year. It is possible that the main reason for the substantially higher proportion of juvenile Ringed Plovers trapped as opposed to counted in three of the five years is that juveniles of this species appear to be more prone to enter walk-in traps than adults (Meissner & Huzarski 2006). This may be a characteristic of visual foragers.

In 1998, both adult and juvenile Dunlin arrived in low numbers (Meissner & Strzalkowska 2006) and this is why trapping and counts both suggest similar productivity to previous years, whereas absolute numbers of juveniles indicate a major decrease. The reasons for these changes are unknown, but this demonstrates that there must be bias in at least one method. In some staging areas (called emergency stopover sites) the number of adults may vary irregularly, mainly as a result of weather conditions (Meissner 2005, Piersma *et al.*

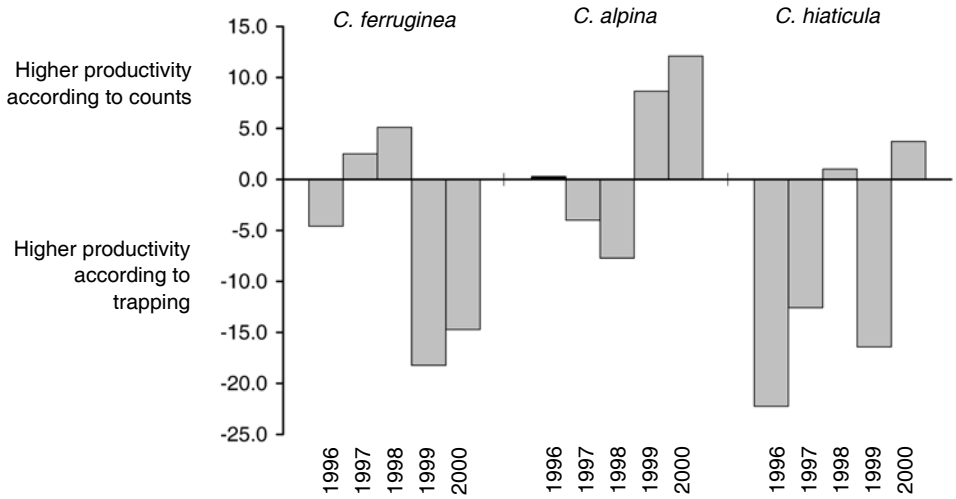

Fig. 2. Annual differences between the percentage of juvenile Curlew Sandpipers, Dunlins and Ringed Plovers caught during 17 July to 27 September 1996–2000 at the mouth of the Reda river on the Baltic coast of Poland as shown by counts and by trapping.

1992). In such cases juvenile counts may be a better index of productivity than the ratio of adults to juveniles (Meissner 2005).

It is notable that the high proportion of juvenile Dunlin recorded at Puck Bay in the autumn of 1999 is not reflected in comparable data for Britain during the subsequent winter (Clark *et al.* 2004). However, although some British wintering Dunlin migrate via Poland, many others, especially juveniles, take a route from the Arctic along the west coast of Norway (Tjørve & Tjørve 2007). Therefore many British winterers probably come from different breeding grounds to those that take the Baltic route.

It is worth noting that trapping showed a higher proportion of juvenile Curlew Sandpipers in 1999 and 2000 than counts but the reverse in 1997 and 1998. This is opposite to Dunlin (Fig. 2). Both species forage in a similar way, but Curlew Sandpipers tend to feed in deeper water than Dunlins (Stawarczyk 1984, author's own observations). It is possible therefore that this difference results from changes in the layout of the traps because in 1999 and 2000 they were placed in deeper water to catch more juvenile Curlew Sandpipers for diet analysis.

At the Reda River ringing site, as at other places where walk-in traps are used, the position of the traps is often changed to increase trapping effectiveness. Hence catching conditions were not constant. It is therefore possible that, depending on the trap layout and other local conditions, there may be biases that vary the chances of catching adults or juveniles. This indicates the value of monitoring age ratios at a number of different sites in the same flyway so that real trends can be corroborated and biases identified.

In conclusion is would seem that, in autumn, it is better to estimate productivity in Dunlin, Curlew Sandpiper and Ringer Plover (and similar species) using counts than by trapping. Counts should be conducted regularly in a standardised way and cover a large enough area so that bias arising from systematic differences in the distribution of adults and juveniles is minimised (Harrington 2004). Trapping data for the same site and period may provide information on any changes in turnover rate from year to year; and this may be helpful in assessing the effect of such changes on the count data. Trapping remains the main method for recording productivity in most species in winter when the differences between adult and juvenile plumage become difficult to discern in the field. Similarly trapping must be used in autumn in the case of species with only slight age-related differences in plumage.

ACKNOWLEDGEMENTS

I thank all volunteers and members of WRG KULING ringing team who participated in the research at the Reda River mouth. Fieldwork was funded mainly by internal grants by Gdansk University BW 1140-5-0258-7, BW 1140-5-0151-9 and BW 1140-5-0130-0. This study was undertaken by the Waterbird Research Group KULING (Publication no. 129). I am grateful to Nigel Clark for comments on an earlier version of the paper.

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