

A third report on the biology of the Great Knot *Calidris tenuirostris* on the breeding grounds

Pavel Tomkovich

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The results of further studies of Great Knots *Calidris tenuirostris* on the breeding grounds are reported. Males displayed a high site fidelity between years. Although the sample size was small, females displayed comparatively low site fidelity. A bird leg-flagged in north western Australia was collected, the first recovery of a Great Knot banded in the non-breeding quarters and recovered in the breeding season. Information on breeding density and success, and food preference are presented.

Pavel S. Tomkovich, Ornithological Department, Zoological Museum of Moscow University, Bolshaya Nikitskaya Str. 6, Moscow 103009, Russia.

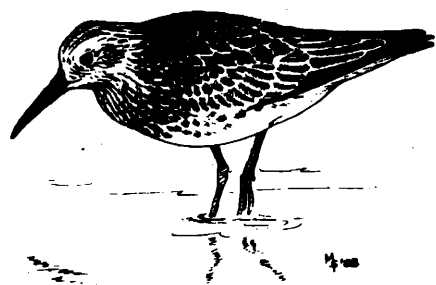
INTRODUCTION

A comprehensive review of the literature (published in English) on the Great Knot *Calidris tenuirostris* is presented in Driscoll (1993). This is the third report of research into the breeding biology of the species. For previous reports see Tomkovich (1994, 1995a), and for some other summaries see Tomkovich (1995b,c).

The study area was reached by helicopter from the village of Markovo. In 1995, arrival in the study area was comparatively early (16 May), well before the arrival of the waders. For the first time, this allowed an examination of waders during the prebreeding period. The expedition ended with the return to the village of Markovo (by boat) on 31 July. This report details the results of the 1995 season, and compares the findings with those from the 1993 and 1994 field seasons.

Study area

The study area was the same as that in the 1993 and 1994 field seasons. This was on the eastern spur of the Shchuchy Mountain Range, north east Siberia (64°55'N, 168°35'E).



RESULTS AND DISCUSSION

Site faithfulness and mate fidelity

Individual colour-marking of Great Knots in the study area in 1993 and 1994 made it possible to record their degree of site faithfulness on the breeding grounds. Twenty-four of the 25 individually marked adult males that were recorded or marked in 1994 were found back in the study area in 1995. In addition, one male marked in 1993 and not seen (probably missed) in 1994 was present in the study area in 1995, giving 92% for the total adult male return rate. The distribution of all males was very similar between years. They defended prenesting territories, nests and broods on the same mountain tops between years. Broods can move several kilometres so males are not always attached to the same parts of particular mountain tops. Consequently, in 1995 all adult males survived to return to places where they had bred in previous years.

Only two of four marked females were recorded in the study area in 1995. Moreover, one of these was located only in a post-breeding flock. The other marked female that bred in the area did so with the same male for the third consecutive season, probably indicating an individual pattern of strong site fidelity. One more female with distinctive plumage which bred in the study area in 1994, was absent in 1995. These rather poor data indicate more opportunistic territorial behaviour of adult females, when compared to that of adult males.

As a result of the comparatively low site fidelity of

females, only one pair reunited in 1995, while most males were competing for new mates. This may explain the fairly large proportion of males left unmated (two of eight males on the study plot, both of which had bred successfully in 1993 and 1994).

Observations from the winter quarters suggest Great Knots start to breed around the age of two years. None of the 29 chicks banded in 1993 were found in the study area in 1994 or 1995. This means either the sample of chicks banded in 1993 was too small, or that young birds disperse widely from their natal site to the site of first breeding. The latter possibility is confirmed indirectly by the absence of geographic variation in the Great Knot.

Other recoveries

A yellow leg-flagged Great Knot was seen on the study area on 12 July. It was one of two non-local post-breeding migrants. This bird was collected, and proved to be an adult female with inactive brood patches. This record is also the latest known date of a female on the breeding grounds. The bird (band 061-90273) was banded by the AWSG on 7 October 1992 on Eighty Mile Beach, north west Australia. The distance between sites of banding and recovery was 10 170 km (see Dettmann 1995). It is the first recovery of a Great Knot with an Australian band from the breeding grounds. Sightings of a bird leg-flagged in the study area and sighted in the non-breeding quarters are summarised by Minton (1995). Recently, an adult marked on the nest in the study area on 18 June 1995 was sighted at the Burdekin River mouth near Bowen, Queensland, Australia, on 17 December 1995.

Breeding density

The same area of 9.5-10.0 square kilometres of montane lichen tundra on mountain tops was used for density calculations. In 1993 the area was occupied by 13 broods, in 1994 24 broods were found and we also knew of two unsuccessful nests. In 1995, 23 broods plus a further five breeding pairs occupied the area.

The plateau where observations were most regular was c. 1 square kilometre in size. In 1993, this area held three broods, in 1994 six pairs and three unpaired territorial males inhabited this area, and in 1995 the area was inhabited by five pairs and two unmated males. Thus, the density of breeding Great Knot was similar to that in 1994, but twice that of 1993. The increase in density in 1994 can be explained by locally favourable snow conditions early in that season, while the high density in 1995 was probably the result of the strong site faithfulness of males. Not all of these males were able to mate, in particular at least two marked old males who raised chicks in 1993 and 1994 were left unmated in 1995.

Phenology

The early start of observations in 1995 made it possible to gather unique information on the arrival of Great Knots at the breeding grounds. No flock of migratory Knots were

noticed in the northern spring. Males simply appeared on their former territories, and later they were joined by females. Eight individually recognisable males appeared at their territories between 22 and 26 May; two of these males (which arrived on 26 May) remained unmated for the whole breeding season. Females were observed to be paired to the recognisable males on the same day as arrival (one case) or up to five days later (23 to 29 May). Pairs took six to seven days to begin egg laying, and four to five days to lay four eggs. The first egg was found on 30 May, but there were pairs which formed earlier and probably had started egg laying before this date; this was confirmed by the discovery of several early broods. One replacement clutch was recorded after the first clutch was destroyed by a predator at the end of laying. The latest heavy female was recorded on 15 June.

Hatching took place from 25 June and continued until 6 July, but most hatched before July. Consequently, on average, nesting in 1995 was slightly earlier compared with the previous two seasons.

Six nests were found with incomplete clutches, but only three of these survived to hatching. The incubation period of these clutches (from the last egg laid), was 22.5-23 days. Repeated measurements of chicks showed a rapid development of most broods in 1995. Young of three broods first flew at the age of 17, 19.5 and 19.5 days, but a single chick from a fourth brood under constant observation fledged at the age of 24 days. In comparison, the age of fledging was 20-21 days in 1993, and 25 days in 1994.

Formation of rather large feeding or resting flocks of local Great Knots started in mid-June 1995. Within the area of intensive study, non-local birds appeared in the flock on 27 June. Within two days most of these birds had disappeared, along with local unmated males, failed breeders, and females who deserted their mates (to attend the hatched young). This means the first wave of migration of Great Knots started four days earlier in 1995 compared with 1994. Males that had successfully bred in 1995, departed mainly in the last third of June, after accompanying their chicks for 23-29 days (24-30 days in 1994).

Departure of young birds in 1995 took place from 25 July at an age between 29 to 32 days (the oldest recorded departure age of young birds was 30 days in 1993, and 33 days in 1994). Most young started their migration separately from their parents, and several days later.

Breeding success

In 1995, hatching occurred in four of the seven known nests. The three other nests were depredated. There were also other breeding pairs recorded in early June. But did not appear with broods in July. Consequently, the rate of nest predation was higher in 1995 in comparison with 1993 and 1994. Nevertheless, predation rate was lower than could be expected on the basis of increasing numbers of rodents and mammalian predators in 1993-95. Thus, we had only a single sighting of *Mustella*

erminea, probably the main egg predator of Great Knots, in 1993, four records from 1994, and at least 20 records in 1995 including many family parties. Thus, it is expected that in 1996, after a population crash in rodents, Great Knots will experience heavy nest predation pressure and will have poor breeding success in the mountains in the upper Anadyr River region.

Two of 13 broods under more or less regular observation disappeared, and most probably these chicks died. Partial loss of broods was also recorded. At fledging, or a few days later, broods consisted on average of 2.8 young ($n = 13$) in 1995. This was higher than that recorded in the previous seasons; 2.5 young per brood in 1993 ($n = 8$) and 2.3 in 1994 ($n = 12$). In total, at least 39 juveniles have fledged from 68 chicks banded in 1995 (57%), while the comparable figure for 1994 was 47%. Consequently, higher egg-loss in 1995 was compensated by a higher chick survival rate due to favourable weather conditions in summer. In summary, the general results of Great Knot breeding in 1995 means the season was a rather successful one.

Food and food resources

Preliminary analysis of faecal samples and stomach contents (from casualties) of chicks have shown that berries (*Arctous alpina*, *Empetrum nigrum*, *Vaccinium uliginosum*) were the principle food after the first days of life (from c. 5 days old). Chicks mainly eat Carabid beetles during the first days of life, and these are eaten to an lesser extent as chicks grow. In 1995 invertebrates were eaten in apparently greater amounts than in 1994. The greater use of higher protein food may explain the quicker development of chicks in 1995.

Adults and fledged young consume both berries and invertebrates, except during the egg laying period when adults forage mainly by deep probing for invertebrates in moist habitats. The latter behaviour may be explained by the need for high protein ingestion rates required for egg formation. Hard-shelled nuts of the Dwarf Pine Tree *Pinus pumila* were found in the stomachs of two adult post-breeding migrants (collected with permission of the relevant Russian authorities). This food was known for Great Knots in the Koryak Highlands (Kistchinski 1980), but not for other species of wader.

Pitfall traps were used in 1994 and 1995 to evaluate arthropod numbers and their intraseasonal abundance. An analysis of these data will hopefully aid the understanding of how hatching dates (and breeding phenology in general) is timed to invertebrate abundance. Counts of berries in late July 1995 in different habitats revealed clear preferences of broods to remain in areas where berries were common. Indeed, some areas used by broods in 1994 were avoided in 1995, and these were found to contain poor crops of berries.

Results from this study of the feeding ecology of Great Knot give us an opportunity to determine the habitat requirements of the species on the breeding grounds. It is now clear that the requirements are complex, and

dependent on the stage of breeding. Habitat requirements will influence bird distribution in both the breeding range and local scale, as well as the rate of chick development, and possibly even breeding success.

Breeding behaviour

Breeding behaviour of the Great Knot has not been previously described. The early arrival to the study area meant that the researchers were able to make sound recordings and drawings of different postures used in this period. Our general impression is that the behaviour of Great Knot is different in many respects from that of the Red Knot *C. canutus*, the closest relative species, but is nevertheless it has similar features with the behaviour of many other members of the genus *Calidris*.

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