NUMBERS, PASSAGE AND LOCAL MOVEMENTS OF REDSHANKS Tringa totanus ON THE CLYDE ESTUARY AS SHOWN BY DYE-MARKING

by Robert W. Furness and Hector Galbraith

The inner Clyde estuary is an internationally important winter feeding ground for ducks and waders. It ranks third in Scotland for peak winter wader numbers (Standring 1978). Its most important asset is a flock of Redshanks Tringa totanus of up to 10,000 birds, or roughly 8% of the west European population in most recent winters (Gibson 1978), with smaller flocks of Oystercatchers Haematopus ostralegus, Lapwings Vanellus vanellus, Dunlins Calidris alpina, Curlews Numenius arquata and Greenshanks Tringa nebularia. The waders achieve a density per square kilometre of mudflat which is exceeded in Scotland only on the Ythan estuary (calculated from Birds of Estuaries Enquiry data). Much of the inner estuary has already been reclaimed. Nearly 50% of the high water line is delimited by retaining sea walls with motorways, housing or industrial developments immediately behind. Further reclamation is in progress although at present on a small scale. As in the Forth (Furness 1973 a, b; Pienkowski & Clark 1979) waders on the inner Clyde estuary have a limited number of roost sites, mainly on 'unnatural' constructions, and are subject to considerable disturbance from aircraft, ships, trains, lorries and people (Goudie 1980).

Numbers of Redshanks on the estuary in winter 1978 - 79 were unusually low, even before the onset of cold weather. Limited sampling of intertidal invertebrate densities (Broadway 1979) suggested that while numbers of Nereis diversicolor were the same as in previous winters, densities of Corophium volutator were an order of magnitude below normal. Corophium forms the bulk of Redshanks' diet on the Clyde, and is the preferred food in many other estuaries (Goss-Custard 1977). It is also noteworthy that Dunlin numbers on the estuary were only 20% of normal in 1978-79 - they are thought to feed largely on Corophium on the Clyde (I.Gibson pers. comm.). The disappearance of about 5000 Redshanks gave cause for concern as it represents 4% of the west European population. The situation was particularly interesting because of the previous high fidelity of local ringed Redshanks to the Clyde (Mackie 1976). The 21 recoveries in winters up to 1978-79 of Redshanks ringed in winter on the Clyde estuary had all been on the Clyde Estuary. In winter 1978-79 there were four recoveries of birds ringed in previous winters; two on the Clyde, one in Holy Loch, Argyll and the other at Culmore, Londonderry, Northern Ireland giving a clue to the new wintering area of birds deserting the Clyde.

For obvious reasons Redshanks became the target species for cannon-netting in 1979-80. The questions we wished to examine included: is the Clyde population homogenous, with all the birds using all parts of the estuary? Is there any turnover through the area in winter (eg. Evans 1979)? How much passage occurs in autumn and spring? These questions are very similar to those posed by Pienkowski and Clark (1979) and as in their study we aimed to use dye-marking to provide answers.

Results and discussion

Throughout most of the winter nearly all the Clyde estuary Redshanks roost in a single-species flock on a motorway wall at Langbank (Fig.1). From there they can be moved to West Ferry shingle spit without difficulty. A catch of 1057 unringed birds, 64 retraps and 3 controls was taken on 20 October 1979. It was already clear by this date that Redshank numbers were below the normal in 1979-80. Only half the expected number were present. Three features of the catch were of particular interest: it contained very few first year birds (14 out of 521 aged were 1st year; i.e. 2.7%). Subsequent onbservations at roosts confirmed this was representative of the whole flock. Smaller catches in 1979-80 at Ardrossan, Ayrshire and on the Ythan and Forth estuaries (S.R.Baillie, M.W.Pienkowski pers. comm.) contained much larger proportions of young birds. Mist net catches on the Clyde estuary between 1973 and 1976 contained 15% juveniles in August, 18% in September and 49% in October (samples of 76,22 and 71; Mackie 1976). While mist net catches may be biased in favour of juveniles (Pienkowski and Dick 1976), they are comparable to the proportions found in cannon net catches in other estuaries. Swann (1979) concluded from samples cannon-netted in the Moray Firth basin that the median Redshank completed moult by 10 October. Mackie (1976) found an almost identical pattern in the Clyde. Moult scores were recorded from a random sample of 136 birds in our catch. Less than half had completed moult on 20 October (Fig.2) suggesting that our birds were at least 10 days later than normal in their moult. Weights of 184 birds chosen at random averaged 149.8g (s.d. 11.9, s.e. 0.88). Contrary to the pattern described by Davidson (1979a) for other areas live weights of Redshanks on the Clyde estuary (Mackie 1976) show little clear change between September and February, with a suggestion of a winter peak in January. The mean of a sample of 215 birds from a cannon net catch on 11 November 1973 was 155.0g (s.d. 11.8, s.e. 0.80). The sample caught on 20 October 1979 was significantly lighter by over 5g. Measurements of the protein reserve of 112 individuals using the method described by Davidson (1979b) showed that all the birds were in poor condition, most having a muscle condition index in the upper range of those which were found starved to death on the Ythan in January-February 1979 (Baillie 1980), and well below that of 'normal' birds (Davidson pers.comm.). Lipid levels were also estimated to be below normal (ca 6.7% compared to ca 8% Davidson pers. comm. and 1979a). The poor body condition, late moult, low proportion of juveniles and low numbers all suggest that conditions on the Clyde estuary are not now as suitable for wintering Redshanks as they once were.

Before releasing the birds we dyed 333 individuals with picric acid on the breast and underparts. Counts at Redshank roosts of the numbers present and the proportion of dye-marked individuals in samples were made as often as possible. We also visited most of the Redshank roosts between Helensburgh (north) and Troon (south) to look for marked Redshanks leaving the Clyde estuary. No counts were made at low tide but dye-marked birds were seen feeding over all the mudflats of the inner estuary.

Redshank roosts in the Clyde estuary are shown in Figure 1. In September and in October before the cannon net catch, 4000-5000 Redshanks roosted on the wall at Langbank. Flocks of less than 100-300 birds were found in Holy Loch, Hunterston Bay and Bogside Flats. Counts of Redshanks at the main inner Clyde roosts (Erskine to Dumbarton and to Langbank but not extending to Woodhall or Ardmore) after the catch are given in Table 1, together with numbers of dye-marked birds in sample counts. Proportions of dye-marked birds did not differ significantly between these roosts.

Immediately after the catch a small number moved to roost to Ardmore or Woodhall. Half the flock moved to East Ferry or the Esso wall. Counts of dye-marked birds at Woodhall and Ardmore (Table 2) show that there are distinct local Redshank populations at these two sites. Small numbers joined these because of the disturbance of cannon-netting but the proportion of marked birds fell back to zero by December. These birds clearly returned to Langbank leaving only the local populations at Woodhall and Ardmore. No dye-marked Redshanks were found at any of the other roosts between Helensburgh and Troon (Table 3). The seasonal pattern in the inner Clyde estuary showed a constant proportion of dye-marked birds at these roosts until 5 March 1980. Clearly there was no significant movement of Redshanks to the Clyde between 20 October 1979 and 5 March 1980 otherwise the proportion dye-marked would have decreased. This agrees with the high site-fidelity in winter indicated by ringing data. As the proportion dye-marked remained constant we can estimate the population size at capture by simple Lincoln index. Between 22 October 1979 and 5 March 1980, 338 observations of dye-marked birds were made in samples totalling 4482. As 333 birds were dye-marked we estimate a flock

Table 1. Counts of Redshanks and proportions of dye-marked birds in samples observed at the main roosts on the inner Clyde estuary.

Date	Observer	Roost	Count	Dye-marked in sample	total flock
20-10-79	RWF	Langbank	4500		4500
22-10-79	RWF	Langbank	2500	57/728=7.8%	
		East Ferry	2200	9/145=6.2%	4700
23-10-79	RWF	Langbank	2500	15/214=7.0%	
		East Ferry	1500	13/200=6.5%	
		Esso Wall	520		4520
5-11-79	RWF	Langbank	3800		
		East Ferry	650	5/80 =6.3%	4450
15-11-79	RWF	Langbank	3000		
		East Ferry	500	29/423=6.9%	3500
20-11-79	HG	Langbank	3000	21/268=7.8%	3000
29-11-79	HG	Langbank		17/249=6.8%	
3-12-79	HG	Langbank		16/203=7.9%	
10-12-79	HG	Langbank		16/200=8.0%	
30-12-79	HG	Langbank		14/197=7.1%	
5-1 -80	HG	Langbank	3000	15/148=10.1%	3000
16-1 -80	HG	Langbank		11/113=9.7%	
		East Ferry		0/31 =0%	
3-2 -80	HG	Langbank		9/87 =10.3%	
15-2 -80	RWF	Langbank	3100	52/636=8.2%	3100
5-3 -80	RWF	Langbank	2200	26/320=8.1%	
		Milton	750		2950
15-3 -80	RWF	Milton	4200	42/800=5.2%	
		Longhaugh	1100		5300
16-3 -80	HG	Langbank		9/200=4.5%	
18-3 -80	HG	Milton	3500		
		Langbank	2500	9/160=5.6%	6000
23-3 -80	RWF	Langbank	3500		
		Milton	2500	19/400=4.8%	6000
28-3 -80	RWF	Milton	4000	9/300=3.0%	
		Langbank	2600		
		East Ferry	50		6650
30-3 -80	RWF	Esso Wall	2300		
		Milton	650		
		Langbank	150	5/100=5.0%	3100
5-4 -80	RWF	Milton	900		
		Esso Wall	700		
		Langbank	250		
		East Ferry	100		1950
13-4 -80	RWF	Longhaugh	100		
		Langbank	32		
		East Ferry	11		143
4-5 -80	RWF	Langbank	7		
		Milton	10		17

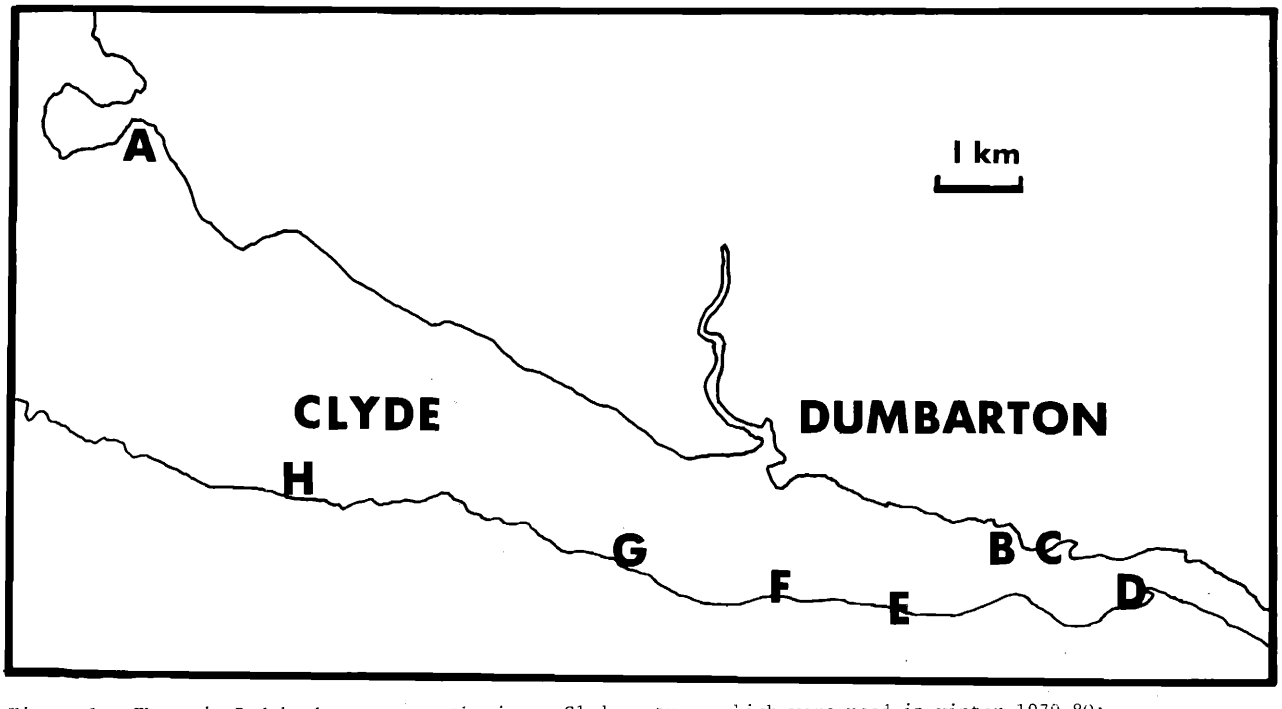

Figure 1. The main Redshank roosts on the inner Clyde estuary which were used in winter 1979-80: A, Ardmore; B, Milton; C, Esso Wall; D, Longhaugh; E, East Ferry; F, West Ferry; G, Langbank Wall; H, Woodhall.

Table 2. Counts of Redshanks and proportions dye-marked at Woodhall and Ardmore on the lower part of the Clyde estuary.

Roost	Date	Observer	Count	Dye-marked
Ardmore	26-10-79	RWF	140	3/140=2.1%
	20-12-79	HG	34	0/34 =0.0%
	17-2-80	RWF	38	0/38 =0.0%
Woodhall	23-10-79	RWF	171	8/171=4.7%
	27-10-79	RWF	24	0/24 =0.0%
	5-11-79	RWF	12	0/12 =0.0%
	20-11-79	HG	60	1/60 =1.7%
	29-11-79	HG	91	4/91 =4.4%
	9-12-79	HG	58	0/58 =0.0%
	15-2-80	RWF	35	0/35 =0.0%

Table 3. Counts of Redshanks and numbers dye-marked at roosts away from the inner Clyde estuary.

Date	Observer	Roost	Count	Dye-marked
27-10-79	RWF	Gourock	16	0
		Inverkip	26	0
16-1-80	RWF	Gourock	24	0
		Inverkip	37	0
		Ardrossan	29	0
		Hunterston	155	0
16-2-80	HG/RWF	Irvine	60	0
		Ardrossan	20	0
		Hunterston	220	0

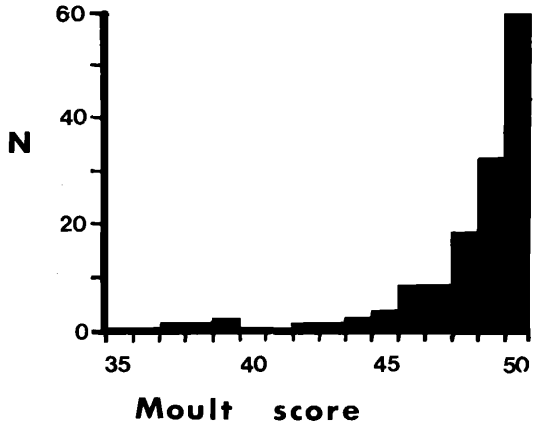

Figure 2. Distribution of moult scores in a sample of 136 Redshanks caught at West Ferry on 20 October 1979. The median moult score is 49.

size of 4350 birds. This gives us some confidence as our field counts were of 4500-4700 around the date of the catch.

Numbers of Redshanks on the inner Clyde roosts fell during the winter. This cannot be accounted for by inland feeding at high tide as Redshanks on the Clyde do not move to the fields. Clearly some birds left the area between early November and mid-February. We have little idea where these went. They do not seem to have joined the small Redshank populations of the nearby coast. Three sightings of dye-marked, not necessarily different, individuals were reported from the Firth of Forth where there were intensive observations of waders, including Redshanks, dyed with a different colour. Many could have moved to the Solway or Ireland where observer cover is low, but no dye-marked individuals were reported from other estuaries (but none were reported on the Clyde except by Clyde Ringing Group members!).

The dye began to be lost in March as birds moulted body feathers, but we were able to approach close to roosting flocks to count dye-marked individuals and we were certain that fading was not severe enough to be a problem until April when counting was abandoned. The arrival of spring passage Redshanks was coupled with a decrease in the percentage dye-marked from 7.7% (winter average) to 3.5% (average for 28 and 30 March). The proportion dye-marked is close to that predicted by an arrival of 3600 new birds with no loss of the winter residents (3.4%) suggesting that this is what happened. Most birds left between 28 March and 13 April, so the spring passage birds were probably on the estuary for no more than 15 days.

We feel that the movement of Redshanks out of the estuary in mid-winter is unusual and may reflect poor local conditions in winters 1978-79 and 1979-80. Densities of Corophium appear to have been similar in both winters (Goudie 1980) but reasons for these abnormally low levels are obscure. We wait to see whether Corophium recovers by winter 1980-81 and how the Redshanks will respond. Our aim for 1980-81 will be to obtain more information on the ages and racial origin of Redshanks passing through the Clyde in autumn and spring, and to look at the survival body condition and feeding behaviour of our winter flock.

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NON-RANDOM DISTRIBUTION IN ROOSTING FLOCKS OF WADERS MARKED IN A CANNON NET CATCH.

by Robert W. Furness and Hector Galbraith

In autumn 1979 some 4500-4700 Redshanks Tringa totanus roosted in a single compact flock on the inner Clyde estuary, Scotland. On 20 October 1979 we caught 1124 (24%) of these in a cannon net. The catch represented a complete section of the roosting flock from high on the shore to the water's edge. Almost all were adults (507 of 521 which were aged = 97%). During ringing 333 birds were chosen at random and dye-marked with picric acid. Subsequent observations showed that most of the flock remained on the estuary until late March and no other Redshanks moved into the area until spring passage in mid-March (Furness and Galbraith 1980).

The flock used a number of roosts in the area, probably depending on the extent and nature of disturbance factors in this highly developed estuary. Usually more than 95% of the flock was to be found on only one roost. On three occasions (22 October, 15 November 1979 and 15 February 1980) ideal weather conditions, combined with luck, enabled very close observation of a large flock at the main roost.

Observations were made using 10x40 Leitz binoculars from a vehicle parked behind a motorway crash barrier less than 10m from the roosting birds at Langbank, Renfrewshire. As a result it was possible to count samples of the flock and record the number of dyed individuals in each group. Counts were made starting at one end of the flock. The first ten birds were counted and the number of dye marked individuals recorded. The next ten were counted and so on. On each occasion the count terminated long before reaching the end of the flock because more birds arrived or the flock was disturbed and some took off.

Results

A null hypothesis that the proportion of dyed birds in the three counts was the same gave expected counts of 56, 33 and 49 dyed individuals. Actual counts were 57, 29 and 52 respectively. The results do not differ significantly ($\chi^2 = 0.7$) so can be combined to give a single sample. Overall, 138 of 1787 observations were of dye marked birds so the probability of any one bird being dye-marked was 0.0772. Groups of ten birds should contain an average of 0.772 dyed individuals. The expected number of groups with 0, 1, 2.....10 dyed individuals can be calculated from the Poisson distribution. If the dyed birds are randomly distributed our observed counts should match this series. Actual counts and the expected number (under the hypothesis of random distribution) are shown in Table 1. The hypothesis is clearly rejected ($\chi^2 = 15.7$, $p < 0.01$), showing that dyed birds were not randomly distributed through the roosting flocks. Instead they tended to occur in clumps more often than expected by chance.

Table 1. Observed and expected frequencies of dye-marked birds per group of ten in Redshank roosts at Langbank.

Number dye-marked in group of ten	Expected frequency if randomly distributed	Observed frequency	χ^2
0	81.8	97	2.8
1	63.1	40	8.5
2	24.4	28	0.5
3	6.3	9	1.2
4 or more	1.2	3	2.7
	177	177	15.7

Discussion

It is difficult to understand what these results mean. The discrepancy arises because there were more groups with no dye-marked birds or with several dye-marked birds and fewer than expected with only one. Pienkowski and Dick (1976) pointed out that cannon net catches may be biased because roosting waders often segregate into age and moult groups. In this study segregation must be within-flock as only one flock is involved. The birds continued to be non-randomly distributed within the roosting flock even four months after dye-marking so the behaviour is clearly stable over long periods of time.