Impact and extent of recreational disturbance to wader roosts on the Dee estuary: some preliminary results

J.S. Kirby, C. Clee & V. Seager

Kirby, J.S., Clee, C. & Seager, V. 1993. Impact and extent of recreational disturbance to wader roosts on the Dee estuary: some preliminary results. *Wader Study Group Bull.* 68: 53-58.

During the 1986/87 to 1990/91 period, 3-5 voluntary wardens patrolled the West Kirby beach on 339 occasions in an attempt to reduce the level of disturbance to roosting waders. Whilst doing so, the types and frequency of potential disturbances, details of actual disturbances and the numbers of each wader species using the beach have been recorded. Walkers and dogs were the main sources of disturbance, the potential for disturbance having increased and diversified during the period. Potential disturbance rates were significantly greater on weekend visits. Dogs and walkers were responsible for most of the actual disturbances recorded, though there was no evidence that the frequency of actual disturbances had increased. Most types of disturbances resulted in waders leaving the West Kirby beach on occasions, and Grey Plover, Knot, Dunlin and Bar-tailed Godwit most commonly left the estuary altogether when disturbed. The majority of wader species have increased at West Kirby during the period despite the potential for disturbance having increased. This may be due to a successful programme of intervention and education by the voluntary wardens.

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INTRODUCTION

The Dee Estuary lies between the North Wales coast and the Wirral Peninsula. It is designated as a wetland of international importance for waterfowl under the Ramsar Convention and as a Special Protection Area under the European Commission Directive on the Conservation of Wild Birds. It is close to the Mersey and Alt estuaries, which lie approximately 20 km to the east and 20 km to the north-east, respectively. These sites are close to major urban conurbations, such as Birkenhead, Liverpool and Southport, and consequently their wide, sandy beaches are heavily used for recreational purposes.

The British Trust for Ornithology's Birds of Estuaries Enquiry (BoEE) has monitored the numbers of roosting waders using British estuaries since 1969/70. Mitchell *et al.* (1988) analysed BoEE counts from the Dee and showed that numbers of several wader species had declined dramatically during the late 1970s: Bar-tailed Godwits had decreased by 99% from a peak count of 11,149 in 1976/77 to 25 birds in 1984/85; Knots by 79% from a peak of 48,000 in 1979/80 to 10,050 in 1985/86; and Dunlins by 81% from a peak of 46,826 in 1975/76 to 8,800 in 1985/86. Counts from adjacent estuaries, supported by observations of flock movements, revealed that the Bar-tailed Godwits and Knots that formerly roosted on the Dee had switched to roosting on the Alt Estuary (Mitchell *et al.* 1988). In contrast, the Dunlin lost from the Dee had not relocated elsewhere in the region but had declined nationally (Goss-Custard & Moser 1988). Mitchell *et al.* (1988) attributed the change in roosting behaviour of Bar-tailed Godwits and Knots to increased levels of disturbance on the outer Dee roost sites, particularly in the West Kirby/Red Rocks area (Figure 1), caused mainly by dogs, horseriders and walkers. Subsequent BoEE counts have revealed that the numbers of Bar-tailed Godwits and Knots on the Dee may be slowly increasing, with average peak winter maxima (1986/87 to 1989/90) reaching 267 Bar-tailed Godwits and 20,800 Knots (R. Prŷs-Jones, pers. comm.).

If there was to be any large scale return of Bar-tailed Godwits and Knots to the Dee, there was an obvious need to reduce the levels of disturbance on the West Kirby beach. Thus, interested ornithologists living close to the estuary established a voluntary wardening scheme in October 1986, which has received both logistical and financial contributions from Wirral Borough Council, The Nature Conservancy Council (as it then was) and The Royal Society for the Protection of Birds. The scheme continues, and whilst the primary aim is to improve local understanding of the problems that the birds are facing, the wardens have taken the opportunity

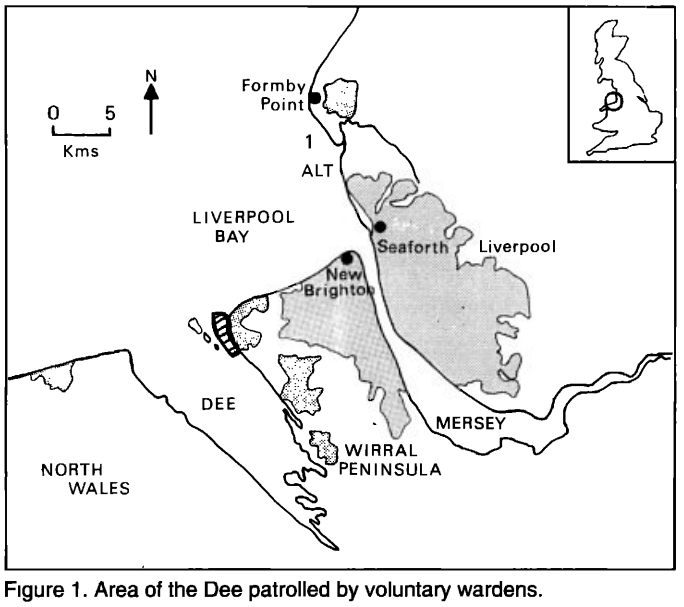

Figure 1. Area of the Dee patrolled by voluntary wardens.

to quantify the true extent of disturbances to birds and describe their impacts. Here we present some preliminary analyses of data collected during the 1986/87 to 1990/91 period.

MATERIAL AND METHODS

The area of the Dee patrolled by the voluntary wardens is shown in Figure 1. Visits were confined to October to March and to the high tide period. They occurred on both week and weekend dates on all tides of 8.4 m or above, thus at times when a relatively narrow stretch of the beach was available to the birds. The total number of visits made during the five winters was 339 and involved around 1,007 hours of observations. The number of visits has varied between years, but has generally been increasing, with 83 visits taking place in 1990/91. The average duration of a visit was approximately 3 hours. A minimum of three, and up to five, wardens were 'on duty' during each visit. They intercept and talk to people who are about to disturb the birds. They distribute leaflets, show the birds to the people and organise high tide birdwatching events. They have placed permanent notices outlining the problems at access points to the beach. On the very highest tides (9.4 m), the wardens attempt to 'close' the beach, and ask walkers to use pathways which lie behind the adjacent sand-dunes, out of sight of roosting birds on the beach.

During most wardening visits the following information is recorded: the numbers of 'potential disturbance agents' (walkers, dogs, horseriders, birds of prey, etc.); details of any actual disturbances observed; the maximum number of each wader species attempting to feed or roost on the beach during the observation period; and details of bird movements within and outside the study area. A 'potential disturbance agent' comprised every walker, dog, bird of prey, etc. that was recorded within the study area, and is thus a measure of the intensity of beach usage on any particular day.

For actual disturbances, the information recorded was descriptive for the first four winters, but a coding system was adopted in 1990/91 to summarise the responses of waders to disturbances: response type 1 involved rapid movement to a new location within the study area; type 2 involved flights away from the study area but a return movement within a five-minute period; type 3 involved 'permanent' movement to alternative roosts within the Dee (*e.g.* Heswall, Hilbre Islands); and, type 4 involved 'permanent' movements out of the estuary. Thus, type 3 and 4 responses involved loss of waders from the West Kirby beach due to disturbances.

RESULTS

Potential disturbances

The vast majority of the potential disturbance agents recorded over the 1986/87 to 1990/91 period (Table 1) were walkers (over 50% of the total in all years) or dogs (26-41% of the total), whilst birdwatchers, windsurfers and horseriders were also relatively abundant. Cyclists, boats, helicopters and personal watercraft (jet-skis) have only been recorded in recent years, indicative of a diversification of beach activities.

During the five-year period, there appears to have been a marked increase in usage of the beach by particularly birdwatchers, windsurfers, horseriders and birds of prey (mainly Peregrines *Falco peregrinus*). There has also been a marked surge in usage of the beach by walkers in 1990/91. Figure 2 shows potential disturbance rates (all agents combined) for each visit during the five-year

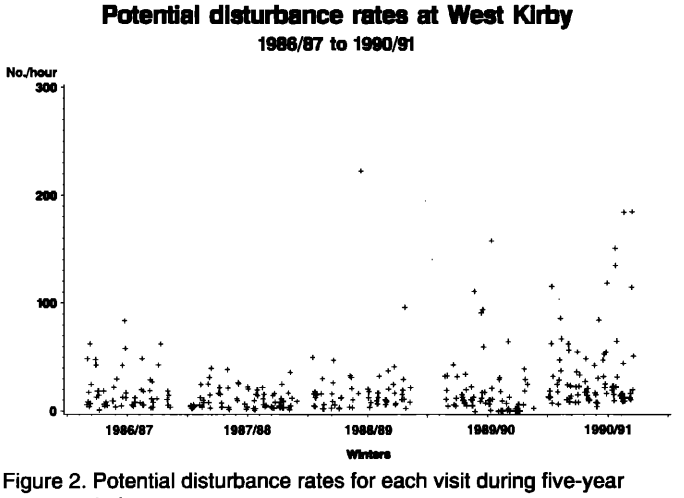

Figure 2. Potential disturbance rates for each visit during five-year period.

Table 1. Numbers and frequency (numbers/hours) of potential sources of disturbance to waders on the West Kirby beach, 1986/7 to 1990/91

Disturbance Source	1986/87	1987/88	1988/89	1989/90	1990/91
Walkers	1,936 (10.8)	1,280 (6.3)	2,072 (11.9)	2,545 (12.1)	5,307 (22.1)
Dogs	1,373 (7.6)	948 (4.7)	1,484 (8.5)	1,262 (6.0)	2,440 (10.2)
Birdwatchers	145 (0.8)	104 (0.5)	40 (0.2)	2 (–)	689 (2.9)
Windsurfers	3 (–)	30 (0.2)	28 (0.2)	395 (1.9)	573 (2.4)
Horseriders	43 (0.2)	12 (–)	23 (0.1)	30 (0.1)	124 (0.5)
Birds of prey	1 (–)	3 (–)	13 (0.1)	6 (–)	61 (0.3)
Vehicles	4 (–)	1 (–)	0 (0)	1 (–)	32 (0.1)
Cyclists	0 (0)	0 (0)	0 (0)	5 (–)	23 (0.1)
Boats	0 (0)	0 (0)	0 (0)	0 (0)	3 (–)
Helicopters	0 (0)	0 (0)	0 (0)	0 (0)	3 (–)
Jet-skis	0 (0)	0 (0)	0 (0)	0 (0)	2 (–)
Totals	3,505 (19.5)	2,378 (11.8)	3,660 (20.9)	4,246 (20.1)	9,257 (38.5)

Note: (–) denotes a potential disturbance rate of less than 0.1

period. There was considerable day-to-day variation in usage of the beach. The level of usage was sometimes as high as 200 agents/hour, but was more usually less than 50 agents/hour. We tested these data to see whether there were significant differences between winters, months or week vs weekend visits using a general linear models procedure (Table 2). The results indicated that potential disturbance rates have increased significantly over the years.The winter by month interaction was such that the pattern of increase in potential disturbance rates across winters was not the same in all months. Overall then, the intensity of usage of the West Kirby beach, and the potential for disturbance to waders, has both increased and diversified.

Actual disturbances

Figure 3 shows the proportions of actual disturbances to waders that were attributable to particular disturbance agents. Dogs (27-72% of the total) and walkers (20-34%) were responsible for the majority of the disturbances recorded in all years. There was an increase in the proportion of disturbances attributable to birds of prey, and to other factors such as windsurfers and birdwatchers over the five-year period.

Table 2. F-values and estimates of effects from an analysis of covariance using the general linear models procedure to examine the effects of week vs weekend visits, season and season x month on potential disturbance rates (numbers/hour).

Source	D.f.	Sum of Squares	Mean Square	F value	P
Model	13	11.28	0.87	6.33	0.0001
week vs weekend	1	4.61	4.61	33.61	0.0001
winter	1	4.32	4.32	31.50	0.0001
winter x month	5	1.63	0.33	2.38	0.0384

Parameter	Estimate	SE of estimate	T	P
intercept	–0.02	0.049	–0.04	0.9661
week vs weekend	0.29	0.05	6.03	0.0001
winter	0.20	0.05	4.38	0.0001

D.f.=Degrees of freedom; P=Probability; SE=Standard error; T=t statistic (as in student's t test)

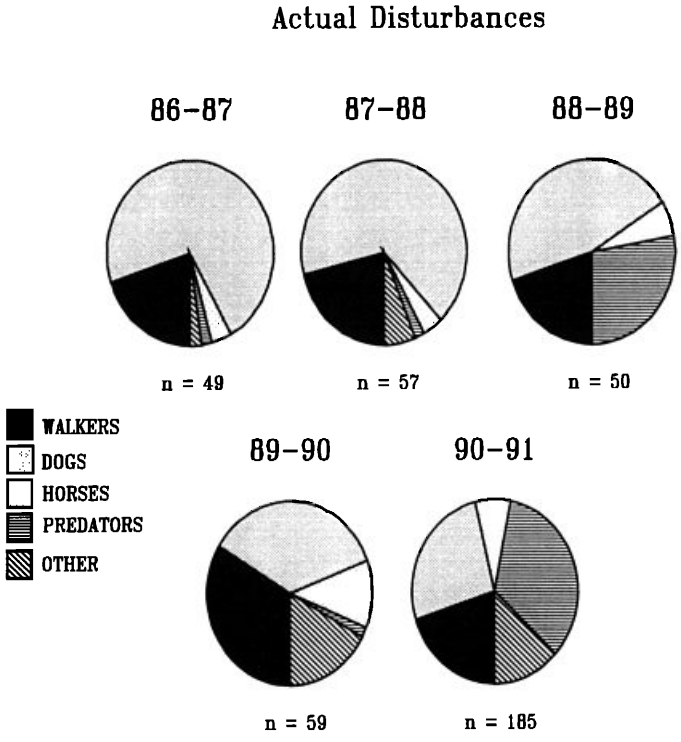

Figure 3. Proportions of actual disturbances to waders attributable to particular disturbance agents.

Overall actual disturbance rates (combining all agents) varied between 0-3 incidents/hour, with less than 1 incident/hour on the vast majority of occasions. Further analyses indicated that actual disturbance rates have not varied significantly between winters, months or according to whether the records came from week or weekend visits (Modelled F-value=1.19, N.S.).

Reactions of waders to disturbances

The overall reactions of waders (all species combined) to the main types of disturbances recorded are shown in Table 3. All types of disturbance, except for incidents involving birdwatchers, could result in waders leaving the study area altogether (type 3 or 4 reaction), but in most cases the birds either moved directly to a new location within the study area (type 1) or took flight but soon returned (type 2). The latter was easily the most frequently recorded reaction to disturbance from dogs, horseriders and windsurfers.

The reactions of waders to disturbances (all types combined) varied according to species (Table 4). Grey Plover, Knot, Dunlin and Bar-tailed Godwit were the species most likely to leave the estuary altogether (type

Table 3. Reactions of waders (all species combined) to the commonest sources of disturbance. The reactions are classified into one of four types: type 1 involved waders flying directly to a new location with the study area; type 2 involved flights away from the study area but a return movement within a five-minute period; type 3 involved movements to alternative roosts within the Dee; and, type 4 involved movements out of the estuary.

Source of disturbance	Type 1		Type 2		Type 3		Type 4	
	n	%	n	%	n	%	n	%
Walkers	52	(45)	31	(27)	24	(21)	9	(7)
Dogs	35	(20)	107	(61)	19	(11)	15	(8)
Horseriders	11	(27)	20	(49)	4	(10)	6	(14)
Windsurfers	4	(10)	26	(67)	5	(13)	4	(10)
Birdwatchers	14	(67)	7	(33)	0	(0)	0	(0)
Birds of prey	154	(47)	73	(22)	44	(14)	54	(17)

Table 4. Reactions of wader species to beach disturbances (all disturbance types combined). Four types of reaction are distinguished (see table 3 and methods section for details).

Species	Type 1		Type 2		Type 3		Type 4	
	n	%	n	%	n	%	n	%
Oystercatcher	10	(25)	16	(40)	12	(30)	2	(5)
Ringed Plover	26	(43)	29	(48)	5	(9)	0	(0)
Grey Plover	41	(36)	40	(35)	13	(12)	19	(17)
Knot	40	(36)	33	(30)	15	(14)	22	(20)
Sanderling	33	(45)	30	(41)	5	(7)	5	(7)
Dunlin	43	(31)	55	(40)	17	(12)	22	(17)
Bar-tailed Godwit	34	(43)	27	(34)	9	(11)	10	(12)
Curlew	12	(32)	14	(37)	9	(24)	3	(7)
Redshank	33	(44)	33	(44)	6	(8)	3	(4)

Table 5. Winter average and peak counts of waders using the West Kirby beach during the 1986/87 to 1990/91 period.

Species		1986/87	1987/88	1988/89	1989/90	1990/91
Oystercatcher	Mean	1,063	993	1,840	1,038	1,211
	Max.	4,000	4,000	8,000	7,000	6,400
Ringed Plover	Mean	20	22	30	36	53
	Max.	100	200	500	700	300
Grey Plover	Mean	101	91	122	152	503
	Max.	1,000	1,000	1,000	1,500	3,000
Knot	Mean	772	366	1,671	3,382	3,719
	Max.	9,000	5,000	12,000	30,000	14,000
Sanderling	Mean	8	42	30	63	29
	Max.	200	1,200	1,000	1,200	210
Dunlin	Mean	577	611	1,649	2,040	5,007
	Max.	3,000	10,000	7,000	30,000	15,000
Bar-tailed Godwit	Mean	3	1	22	115	70
	Max.	500	50	320	2,560	1,500
Curlew	Mean	33	53	30	35	112
	Max.	500	400	226	560	410
Redshank	Mean	62	190	152	142	182
	Max.	700	6,000	1,000	1,000	1,260

4 reaction), whilst these plus Oystercatcher and Curlew would often move to other roosts within the estuary (type 3). For most species, however, the commonest reaction was either to move directly to an alternative site within the study area, or to take flight and then return to the study area once the disturbance had passed.

Numbers of waders

Examination of the numbers of each wader species in the study area revealed that most species appeared to have increased over the 1986/87 to 1990/91 period (Table 5). This was especially true for Grey Plover, Knot, Dunlin and Bar-tailed Godwit. We consider that several factors may influence the numbers of waders recorded in the study area at any one time: the winter and month in which the count was made; the height of the tide and thus the amount of beach exposed; whether the count was made during the week or at the weekend (as disturbance levels were higher at weekends - see above); and, the level of potential disturbance recorded. A general linear models procedure was used to investigate the influence of such factors on the numbers of each species (Table 6). All nine species showed significant differences between winters and significantly different monthly patterns. For the majority of species (all except Oystercatcher,

Table 6. F-values from an analysis of covariance using the general linear models procedure to examine the effects of several variables on the numbers of each species recorded on the West Kirby beach.

Species	Season	Month	Season x Month	Tide Height	Week vs Weekend	Potential Disturbance Rate
Oystercatcher	7.48 **	11.26 ***	2.20 NS	0.50 NS	3.75 NS	0.30 NS
Ringed Plover	11.66 ***	16.61 ***	2.34 *	10.02 *	0.06 NS	25.50 ***
Grey Plover	37.42 ***	6.28 ****	2.45 *	1.25 NS	0.64 NS	24.60 ***
Knot	77.62 ***	9.36 ***	4.35 **	2.17 NS	9.43 **	65.48 ***
Sanderling	29.52 ***	4.58 ***	1.10 NS	0.14 NS	0.51 NS	10.81 **
Dunlin	47.98 ***	13.57 ***	2.69 *	1.52 NS	1.38 NS	41.74 ***
Bar-tailed Godwit	59.24 ***	4.64 ***	2.61 *	0.13 NS	0.67 NS	5.91 *
Curlew	30.39 ***	3.03 ***	1.91 NS	5.92 *	1.73 NS	4.26 *
Redshank	31.57 ***	7.37 ***	2.56 *	3.77 NS	2.62 NS	3.09 NS

NS=not significant; * P=0.05; ** P=0.01; *** P=0.001

Sanderling and Curlew) there was a significant interaction between winter and month, indicating that the trend across winters varied between months. There was generally little in the way of a tidal effect, perhaps due to the limited tidal range over which these visits were made. Significantly fewer Knots were recorded on weekend compared with weekday visits. The abundance of many species seemed to be affected by potential disturbance rates (all except Oystercatcher and Redshank), with the numbers of most being greater when potential disturbance rates were high.

DISCUSSION

It is clear from these preliminary results that the numbers of several wader species at West Kirby, including species which had declined on the estuary as a whole in recent years (Knot, Dunlin and Bar-tailed Godwit), are now increasing. Yet the level of beach disturbance has increased significantly, and has also diversified, over recent years. There is no evidence, however, that the number of actual disturbances to waders has increased, perhaps indicative of a successful programme of intervention and education by the voluntary wardens. Whether this is responsible for the increased usage of the West Kirby beach by waders is unclear. Alternatively, the increases at West Kirby may be part of a wider return movement to the Dee, brought about by some other factor. This would need to be disproved if the wardening scheme was to be shown to be attracting birds back to the Dee.

Interestingly, both Knot and Bar-tailed Godwit were amongst the species most likely to leave the estuary when disturbed, and significantly fewer Knots were recorded on weekend visits (when the potential for disturbance was the greatest). These findings confirm that these species are particularly susceptible to roost disturbance and provide further evidence that disturbance on the West Kirby beach may be particularly important in determining just how many Knots and Bar-tailed Godwits utilise the estuary. Further analyses will be undertaken to examine more closely the relationships of potential disturbance rates and usage of the beach by birds.

ACKNOWLEDGEMENTS

We are indebted to the following voluntary wardens who have patrolled the West Kirby beach in all weathers and collected much of the data we have analysed here: C. Bower, J. Bradshaw, D. Brooks, C. Butterworth, A. Carbury, I. Chase, P. Collins, S. Ducker, C. Farnell, A. Gately, C. Gilmour, J. Gittins, T. Green, A. Gretton, J. Harvey, R. Henshilwood, R. Hoffman, R. Hose, G. Jakeman, E. Jones, W. Jones, D. Jowitt, N. Kemp, M. King, C. Kirkham, R. Lindsay, G. Lister, P. McNamara, V. Mcfarland, I. Mitchell, S. Morris, G. Oddie, K. Peacock, A. Peters, C. Quinn, S. Robarts, E. Robinson, P. Robinson, P. Rowlands, M. Seager, C. Taylor, R. Thompson, C. Williams, S. Woolfall and A. Wraithmell.

Thanks also to Wirral Borough Council, the Nature Conservancy Council and The Royal Society for the Protection of Birds who have made financial contributions to the wardening scheme, and to Myrfyn Owen for helpful comments on a draft of this paper. JSK's post is part funded by the Joint Nature Conservation Committee (part of the late Nature Conservancy Council), The Royal Society for the Protection of Birds and the Department of the Environment for Northern Ireland.

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