The UK shooting disturbance project

Myrfyn Owen

Owen, M. 1993. The UK shooting disturbance project. *Wader Study Group Bull.* 68: 35-46.

M. Owen, The Wildfowl & Wetlands Trust, Slimbridge , Gloucester GL2 7BT, U.K.

INTRODUCTION

This project, which began in 1987 and was completed in 1991, was undertaken jointly by The Wildfowl & Wetlands Trust (WWT) and the British Association for Shooting and Conservation (BASC). David Bell at WWT and Peter Fox at BASC were the scientists chiefly responsible for the work. The project was supervised by an advisory committee which included staff members from the RSPB and the late Nature Conservancy Council. The work was supported financially by the Crown Estate, the Department of the Environment (Northern Ireland), the Duchy of Cornwall, the Duchy of Lancaster and the World Wide Fund for Nature as well as by the organisations already mentioned. The full report has now been completed (Bell & Fox 1991).

The project had six main aspects:

1. A review of the evidence on shooting disturbance in the literature;
2. An examination of the working of the present system;
3. An attitudes survey of wildfowlers, counters and professionals;
4. A multivariate analysis of wildfowl numbers and site characteristics;
5. Case studies on a number of key sites; and
6. Field studies on disturbance effects.

LITERATURE REVIEW

The literature review concentrated on evidence to illustrate any effects of disturbance on mortality or recruitment – the only way in which disturbance could have an impact on populations. It is very rarely possible to work on a population scale, but we can work on the basis that deprivation of feeding opportunity, for example, or other factors that might affect body condition, would have an effect on reproduction and on survival.

A key question here is whether populations are limited by wintering habitat. If they are, then movement away from favoured areas would inevitably be costly in terms of energy for further migration and in terms of lost feeding opportunity or competition for limited resources. This would inevitably have implications for survival, and possibly recruitment as well in some species where body reserves gained in winter are important for migration and breeding.

The literature review confirms what we knew already; that there was not really any conclusive evidence that populations actually suffered from disturbance. Many people have demonstrated that there are local distribution shifts but there are a number of problems with relating that to population effects. Firstly, most of the evidence is circumstantial. Hirons & Thomas (this vol.) mentioned the case of the Ouse Washes where birds on refuges were at a higher density than on non-refuges, but we also know that there are other factors such as habitat management that are altering refuges at the same time as disturbance is being reduced. For example, both the RSPB and WWT are providing water on the Ouse Washes, which we know is very important for Wigeon *Anas penelope* feeding and may be responsible for the difference in bird density (Thomas 1978). Another problem with case studies is that many have been extreme examples; sites more amenable for study or where problems are acute often more or less select themselves. Extrapolating from such problem areas to the country as a whole is not valid.

The really difficult question is whether birds can actually compensate. Even if the feeding behaviour or the energy budget of birds has been altered by disturbance, it has to be demonstrated over an extended period to counter the argument that birds can compensate in some other way. In Britain, for example, the night is 16 hours long in winter and the day only eight hours, and birds may well be able to fulfil their daily requirements by feeding exclusively at night (Owen in press). We know that many species of wildfowl do feed exclusively

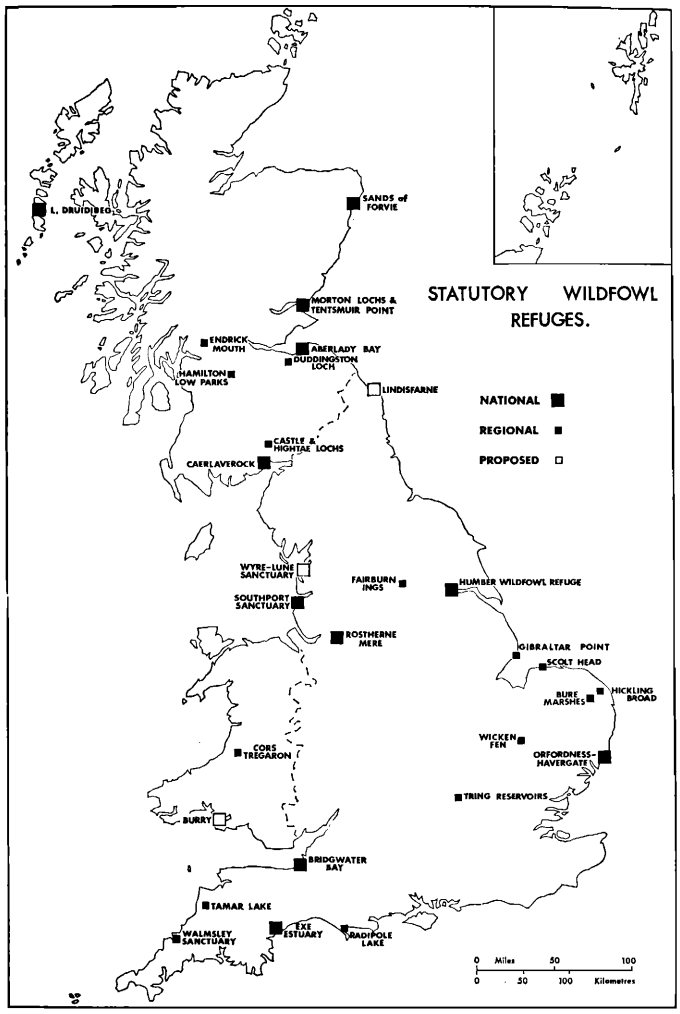


Figure 1. The distribution of wildfowl refuges in the early 1960s (from Atkinson-Willes 1963.)

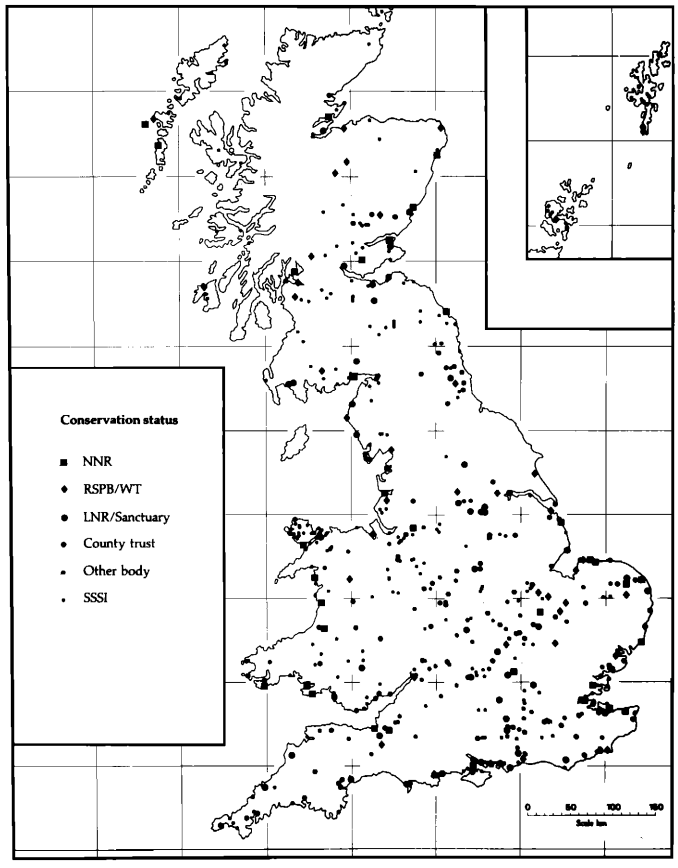


Figure 2. The distribution of sites that contained protected areas or refuges in 1982-83 (from Owen *et al.* 1986). Sites which are controlled by wildfowling clubs but do not come into any other category have been added (triangles).

at night. Another argument that Goss-Custard (pers. comm.) has put forward is that parts of an estuary may be used at times when shooting is not occurring, notably at the end of the shooting season.

Some might even argue that shooting, by keeping birds off an area in the early winter, is actually holding back a reserve of food for birds to use after the end of the shooting season so that the resource as a whole is used to the same or an even greater extent that it would be without shooting (see also Madsen, this vol). There are other complicating factors which make studies of the real impact of disturbance difficult, so there is very little conclusive information on the effect of shooting disturbance, or any other disturbance, on mortality or recruitment in populations as a whole or even on a scale as large as a country.

The weight of evidence does, however, tend to support the hypothesis that many wildfowl and waders are limited by winter habitat, at least in the more northerly parts of the range. For example, Grey Plover *Pluvialis squatarola* filled some estuaries to capacity before moving to areas farther from the breeding area or where food resources were less good (Moser 1988). This implies a cost in moving, which might be reflected in lower survival. Similarly, female Pochard *Aythya ferina* migrate farther than males and also have a lower survival rate, such that the sex ratio in the population is around 3:1 in favour of males (Owen & Dix 1986).

THE PRESENT REFUGE SYSTEM

An analysis some years ago for *Wildfowl in Great Britain* (Owen *et al.* 1986), examined the development of refuges and the effect on wildfowl distribution. Figure 1 is a map from the First Edition (Atkinson-Willes 1963). There were very few refuges at that time (29 in total).

Figure 2 shows the sites where refuges existed in 1982; a total of 318 sites. We then examined the wildfowl counts for the period 1960 to 1989 on the sites which had refuges in 1989 for trends in numbers of birds. The analysis is of the same areas but, over the period, an increasing proportion of the sites have had refuges created within them. The so-called 'refuge' sites include all those which include reserves and all the birds are attributed to them. For example, Langstone Harbour is included as a refuge site because there is an RSPB

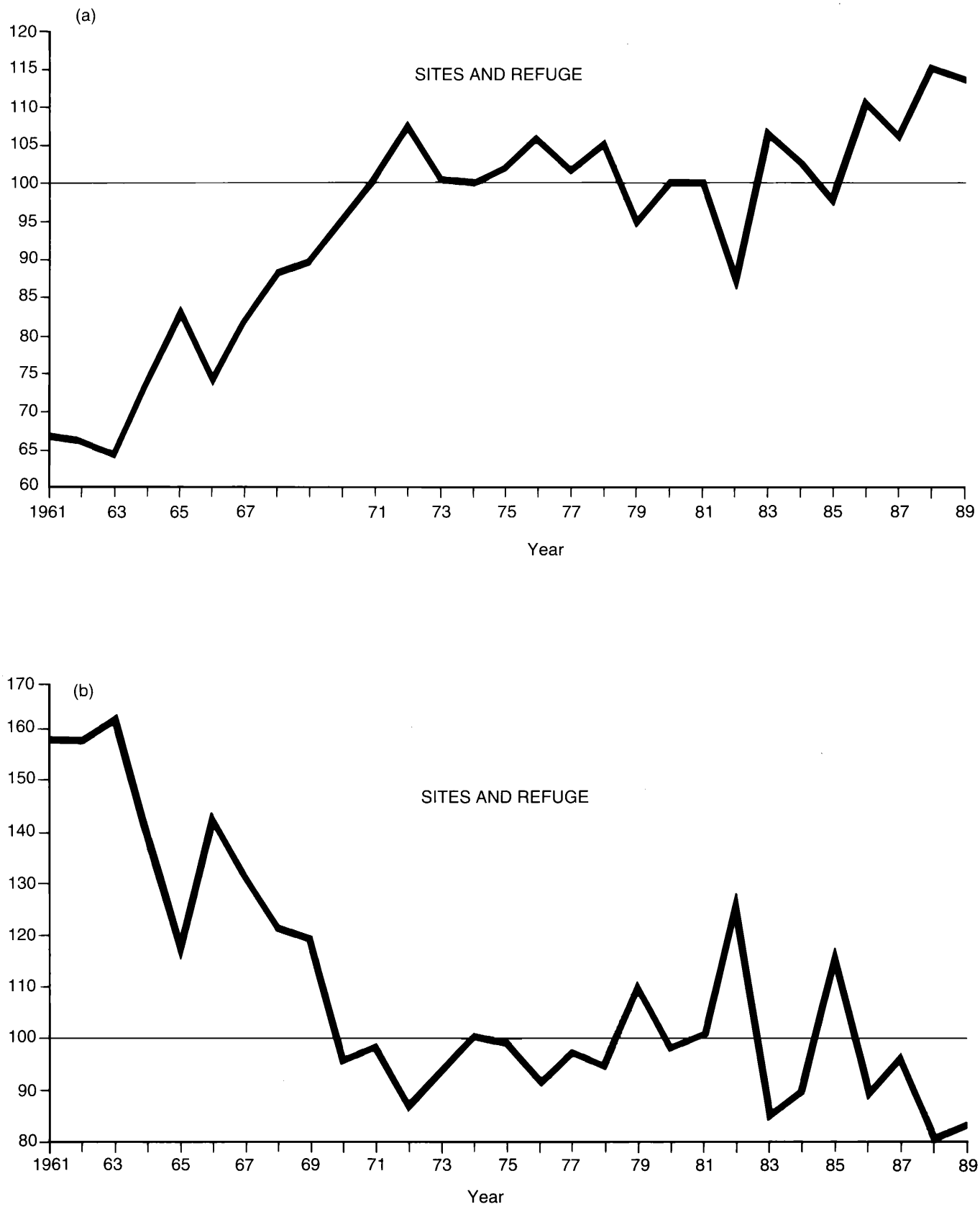
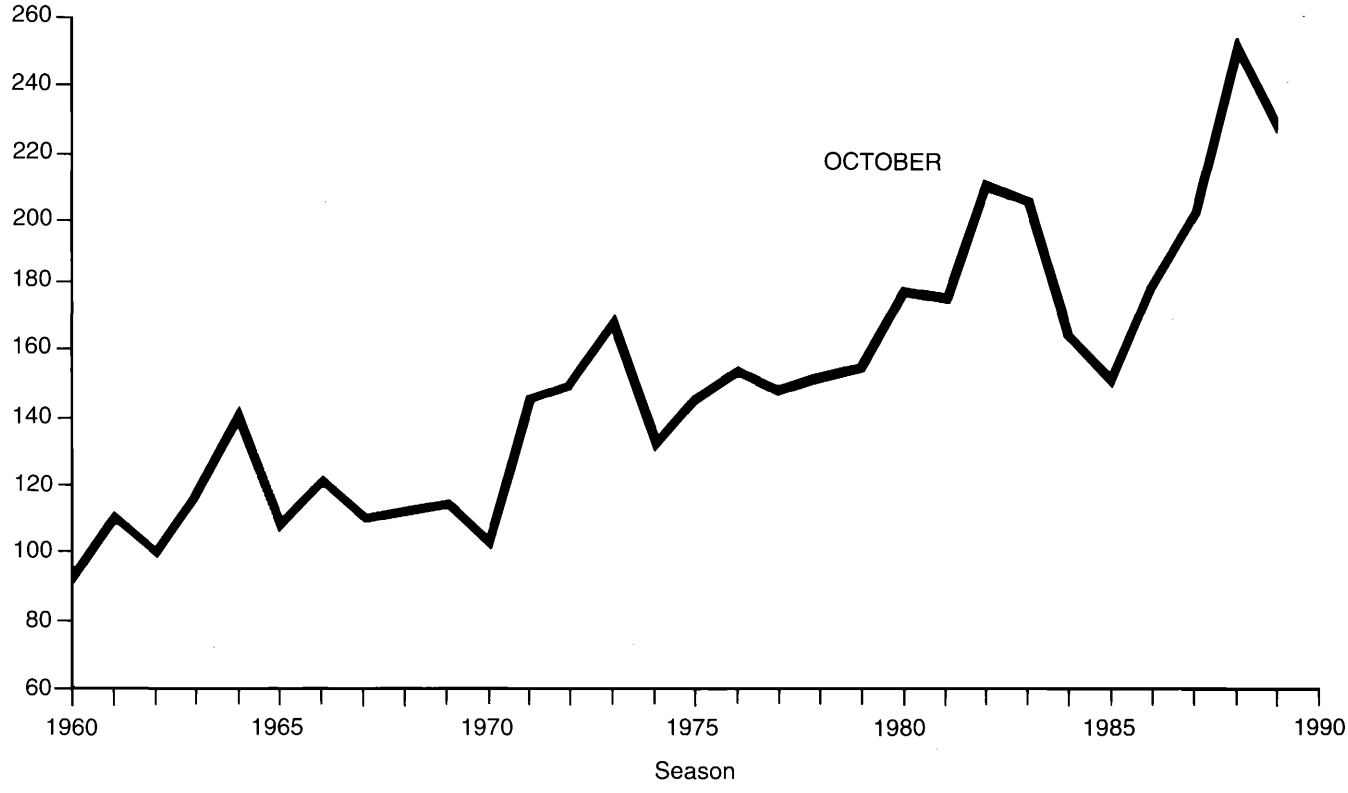


Figure 3. The trend in the number of Wigeon (for methods, see Owen *et al.* 1986). In January on sites on which (a) there is a refuge and (b) without a safe area. Note that this does not include those sites whose only control is by wildfowling clubs (see Figure 2).

reserve there. All the birds wintering there are attributed to the 'refuge' category although many of them are outside the reserve.

Figure 3 shows the results of the trend analysis (Owen *et al.* 1986) on the Wigeon which we believe is the most vulnerable species, mainly because it needs a



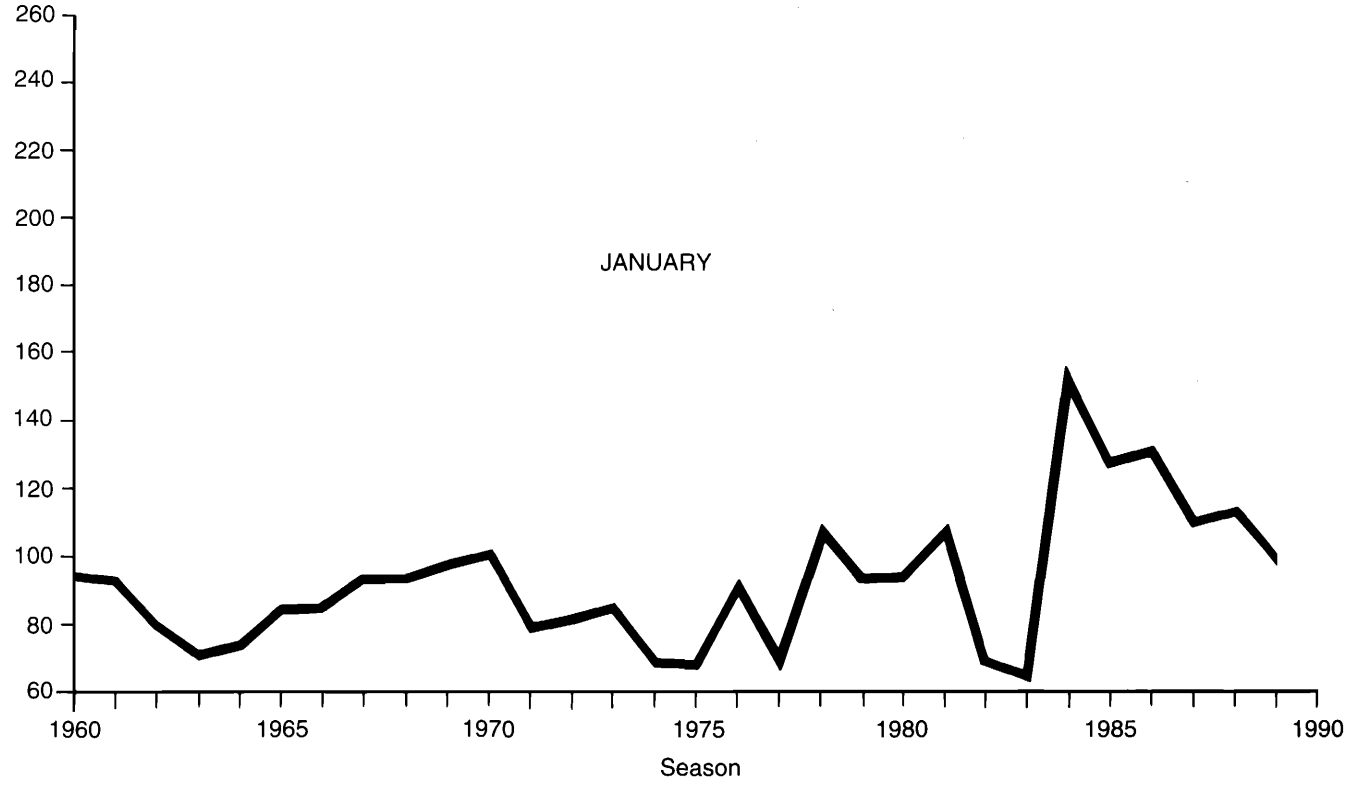


Figure 4. The trends in the number of Wigeon on all sites in Britain in October and January.

TABLE 1. Proportions of shot and unshot SSSI-designated land managed by BASC-affiliated clubs in England (from Laws & Goatar 1989).

Sites	Area Shot (ha)	Area Unshot (ha)	% Unshot	No sites with refuges
Sites held directly by clubs	39,508	9,501	19.4	26
Sites with shared management interest	11,042	10,269	48.2	15
Total	50,550	19,770	28.1	41

TABLE 2. The number of tests that showed a significant increase (+) or decrease (−) in numbers of birds (expressed as a proportion of the British population) after the establishment of a refuge at four different sites.

	Number of significant changes	
	Increase	Decrease
Eden	2+	4−
Exe	3+	4−
Montrose	6+	2−
Ribble	7+	2−

very high proportion of the day to gather its food. The figure is corrected for a slight positive trend in Britain as a whole over the period. The sites with refuges have shown great increase in Wigeon numbers and the sites without refuges have shown a decrease, suggesting that as refuges have progressively become established more and more birds have moved there from shot areas.

Notice, however, that in the three hard winters of recent years, when there were great influxes of Wigeon from the continent, the non-refuge areas assume relatively a much greater importance. This clearly indicates that refuge areas are at or nearing capacity and that non-refuge areas are the only places that are able to absorb the increased numbers.

The trend of numbers in the country as a whole in January (Figure 4), shows that there has not really been a marked trend. A Spearman correlation is significant but this is due to the three hard weather influxes in January 1979, 1982 and 1985, all of which were towards the end of the period. In general the numbers of Wigeon in Britain have not changed very much since 1960, apart from hard weather influxes, so these trends in shooting areas do really suggest that birds have actually shifted into reserves from areas which are shot. We know of some very good examples, such as the Ouse Washes and the Ribble Estuary, where such shifts have taken place.

Some circumstantial evidence in support of the idea that the birds are making a positive selection of refuges is given by Hirons & Thomas (this vol.) in relation to the Ouse Washes. We know that the peak of Wigeon numbers at the Ouse Washes has become earlier as refuges have been established and their sizes increased (Owen & Thomas 1979). When a site becomes a refuge not only are there more birds, but they stay for longer. Figure 4 shows the trend in Wigeon in October and in January in Britain. In October there is a very clear positive trend suggesting, that birds have already learnt there are refuges there and they move more quickly along the migration route. This means that the establishment of refuges in one country might impact on another, even farther along the migration route.

This analysis does not include areas that are effectively refuges controlled by wildfowling clubs. Wildfowlers manage quite a lot of land, and this has been increasing over the same period. Table 1 shows the areas of land managed by BASC clubs: about one-fifth is an area where shooting is not allowed.

The final part of this review was an examination of four sites where refuges have been established, to look at the effects of the refuge establishment by comparing numbers of birds (as a proportion of their British populations) before and after. The analysis looked at a number of species and Table 2 shows the number of tests showing significant positive (increase in numbers after refuge establishment) and negative changes. The numbers of minuses and pluses are not so different, although the two very well-known examples of Montrose Basin and Ribble have shown quite a number of significant changes. Notably on the Ribble Wigeon numbers have increased from 6,000 to 60,000.

So it does seem that the great development of refuges over recent decades by the RSPB, County Trusts, Wildfowl & Wetlands Trust and others seems to have had an effect on the distribution and perhaps the numbers of at least some of the birds in Britain as a whole.

Figure 5. The distribution of wildfowling activity and the number of visits made to each location on the Montrose Basin in 1988-89.

ATTITUDES TO DISTURBANCE

An attitudes questionnaire survey was carried out, circulating wildfowlers, wildfowl counters and professional reserve personnel. Only a brief summary is given here. Birdwatchers (counters) and wardens thought that wildfowling was very disturbing but the wildfowlers did not agree. Wildfowlers emphasised something which we know to be true, that other disturbing agents are equally or even more important. Wildfowlers tended to highlight different things like windsurfing or power boating which disturbed birds more than they did themselves.

There was a good agreement about which species were most vulnerable and that seemed to be based on some reasonable perception of what was actually happening.

About half the counters and wardens thought that more refuges were needed on estuaries, and specifically that refuges or more restrictions were needed on their sites. I could say the following in two ways: *only* about a fifth of the wildfowlers thought that more refuges were necessary; or alternatively, that *even* a fifth of the wildfowlers agreed, so one in five wildfowlers thought that refuges or more restrictions were necessary.

MULTIVARIATE ANALYSIS

The aim of this analysis was to explain the variation in bird numbers by the characteristics of sites, such as the area, the amount of habitat, geographical position, etc. Once this was done we could examine whether shooting explained any deviations from expected site values. Such an analysis would be of enormous importance, because it would allow the potential of a site to be determined, and the proportion of potential that was realised to be examined in relation to human activities that affect site use by birds.

The analysis failed because we did not have good enough information on physical characteristics of estuaries, even on their size, or – more importantly – what is significant about their size. This is very difficult at times: is it the area of intertidal mud; do you include salt-marshes in it or not? Whether this is significant or not depends on the species. We had very little information about the substrate. The NCC's estuary measurements do not yet, for example, distinguish sand and mud: that matters, and in what way depends on whether you are an Oystercatcher *Haematopus ostralegus* or a Dunlin *Calidris alpina*. We do not yet have good enough information about which characteristics of estuaries are important for birds in order to see whether disturbing influences have an effect.

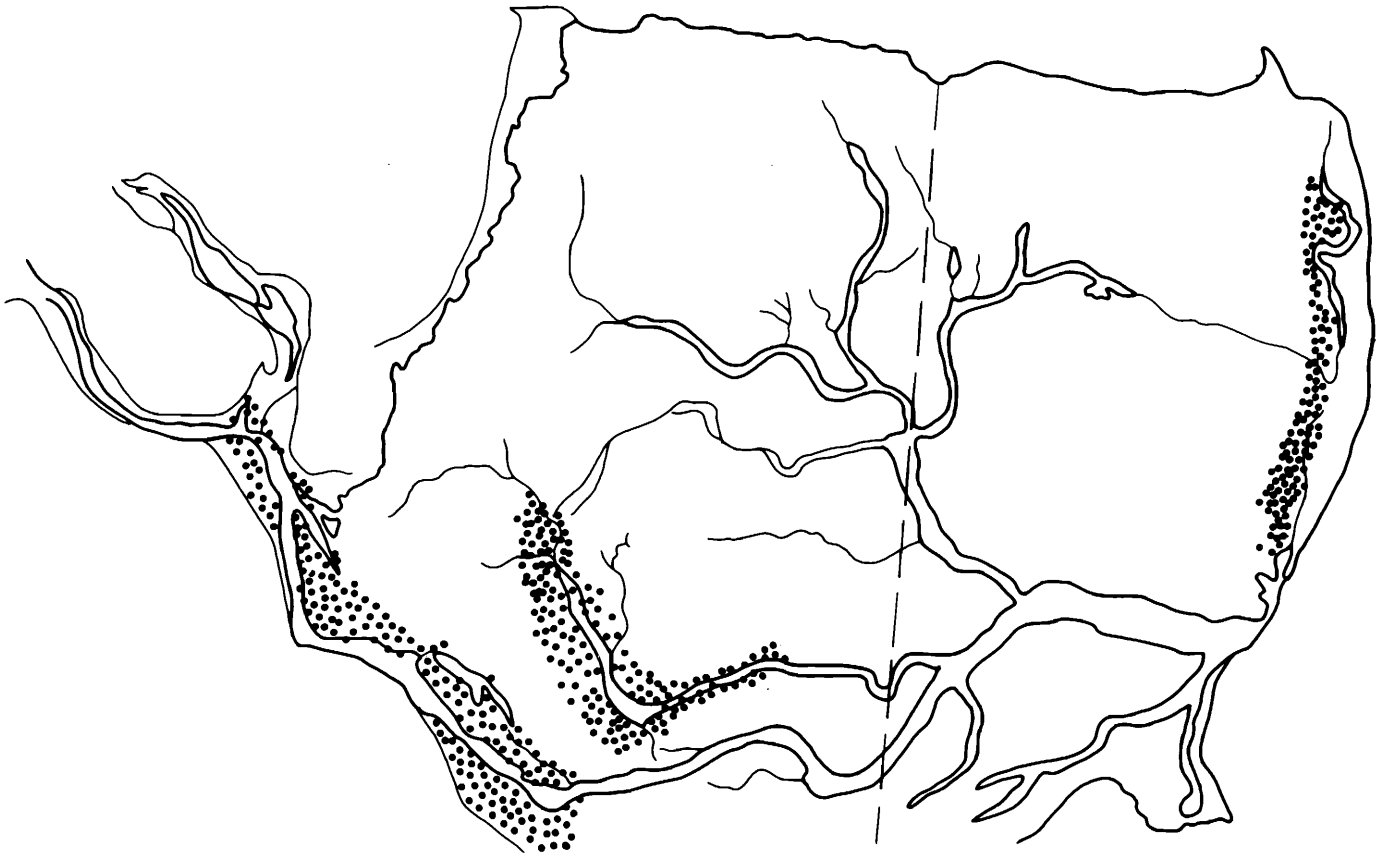


Figure 6. The low-tide distribution of Redshank in the Montrose Basin in 1988-89.

CASE STUDIES

The fifth approach was carried out by the BASC and by wildfowl counters and managers on a selection of sites. The sites picked themselves, dependent on whether it was possible to get good bird data on them and whether there were reasonable historical data but, most importantly, whether it was possible to get good information on wildfowling. They had to be areas which were fairly well controlled by wildfowling clubs who would be prepared to co-operate with this study.

The idea was to match the distribution of the birds to the activities of wildfowlers in terms of location and intensity. To give an indication that this was a large-scale operation, which involved mapping the distribution of all birds at low tide, Figures 5 and 6 show distribution of wildfowlers and the low-tide distribution of Redshank *Tringa totanus* at the same site.

We carried out a multivariate analysis to relate the density of birds on mudflats and their distribution at low tide to the distribution and activity level of shooters. Distributions in the shooting season were compared with a model from the non-shooting season (March), when there would be no effect of disturbance, at least from wildfowling.

To summarise, there was no consistent effect of disturbance on the distribution of birds, *i.e.* places with high wildfowler numbers did not have consistently low densities of birds. However, there was a problem here in that, as in the countrywide survey, the coefficient of determination of the effect of habitat and other variables that were measurable (the amount of the variation in birds' densities explained by these variables) on the distribution of birds were very low so that the predictive ability of the test was also very low.

There was also, as was found in a study that was done ten years ago, a positive relationship between the locations of birds and wildfowlers. Inevitably, because wildfowlers pursue birds they are found in the places where there are also birds. This means that if wildfowlers naturally select places where there are wildfowl, any disturbing effect that might be happening is more difficult to demonstrate. Because of the compensatory way in which it works, this selection bias always works against the hypothesis that wildfowling is disturbing, which is a basic problem with this approach.

Looking at whether there was a re-distribution of birds after the end of the shooting season, most of the results were not significant. Very few birds showed any sign of re-distributing or having a different distribution outside and inside the shooting season. Only Wigeon were

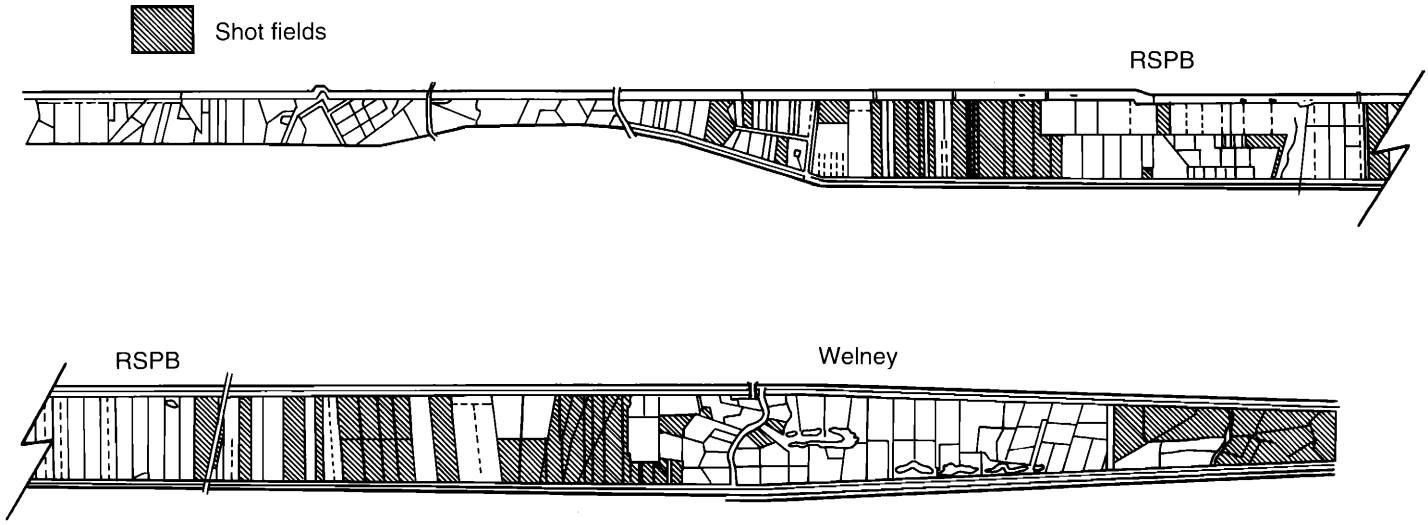


Figure 7. The Ouse Washes, showing the distribution of shot land (shaded) and the locations of the WWT refuge at Welney and the reserves of the RSPB.

found to distribute themselves out of refuge areas into shooting areas after the end of the shooting season, for example the Ouse Washes (Hirons & Thomas, this vol.).

Another aspect of this site approach was a study on the effect of individual shooting visits on bird distribution at Loch Leven. The results were that shooting did re-distribute birds but the effect of it was very short term: they came back the next day.

FIELD STUDIES

The main aim of this work was to tackle the question of whether shooting disturbance was having an effect on the energy budget of birds which might actually impact on their survival or mortality. Part of this work was done on the Ouse Washes, where there is a great deal of circumstantial evidence on the effects of refuges. When the RSPB and the Wildfowl & Wetlands Trust bought land and created refuges, the number of birds and level of usage by birds, in terms of Wigeon days particularly, increased greatly (Owen & Thomas 1979).

Figure 7, shows the shooting areas (shaded) and refuges (unshaded) of the Ouse Washes. The first aim was to look at the distribution of the birds within these areas in detail and to relate bird density to whether or not shooting was allowed. The RSPB's holding here is different from the Wildfowl & Wetlands trust land at Welney in that it does have refuges interspersed with shooting areas whereas the Trust's refuge is a complete block. The land was classified into fields that were shot over; fields adjacent to shot areas, which were, to some extent, affected by shooting; and fields within reserves and at least one field away from a shooting zone. For a simple analysis of Wigeon density in relation to shooting, the first two categories were combined and compared with refuge areas.

TABLE 3. The number of Wigeon, in ducks/ha, on refuge and shot areas (including a one field buffer zone) on the reserves of the RSPB and WWT at the Ouse Washes. Note that no account has been taken of the management differences between the various areas.

Site	Wigeon Density	
	During shooting season	After shooting season
WWT reserve		
Shot (+ near)	0.9	18.9
Refuge	11.5	49.7
RSPB reserve		
Shot	0.1	9.3
Refuge	4.6	4.9

Considering the two reserves separately in Table 3, there is clearly a very large difference between the density of birds on a refuge and a shot area, but there also seem to be differences in bird density between the RSPB and the Wildfowl & Wetlands Trust reserves. After the end of the shooting season there clearly is a much larger number of birds on the shot areas but, on WWT land, a great increase in density on refuge areas as well. One of the problems is that the peak numbers of Wigeon often occur after the end of the shooting season, and there is also probably a turnover of birds at the site, so it is impossible to tell whether there is are-distribution of birds or whether newly arrived ducks are settling differentially in the various areas.

Another part of the study on the Ouse Washes was to catch birds and mark them with radio transmitters, first

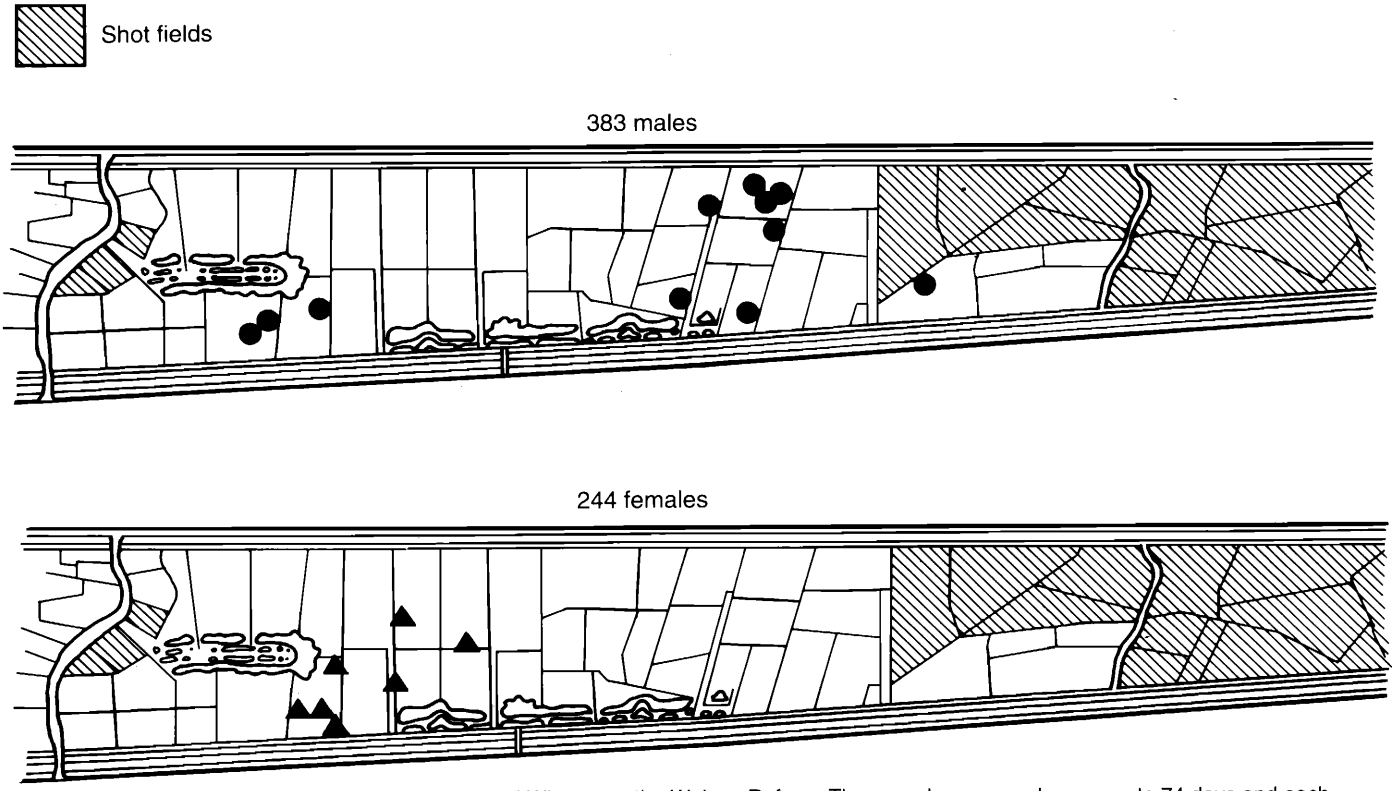


Figure 8. The locations of two individual radio-tagged Wigeon on the Welney Refuge. The records were made over up to 74 days and each location is from a different day or night.

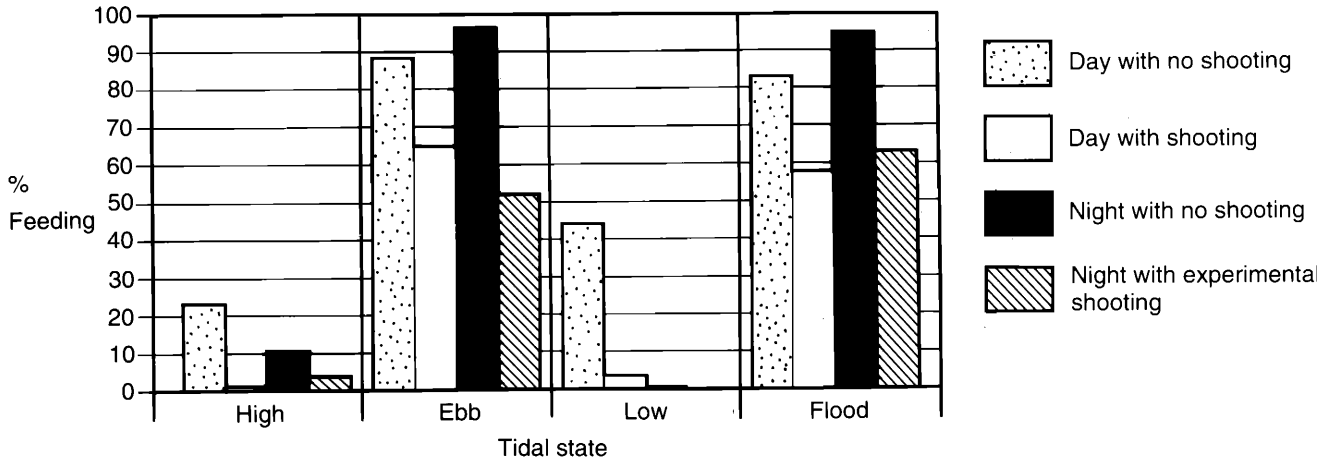


Figure 9. The mean percentage of Wigeon-hours spent feeding at Moray Firth sites in relation to tidal stage, day/night and shooting disturbance For each tidal state the columns represent, from left to right: day with no shooting, day with shooting, night with no shooting, night with experimental shooting (from Mudge 1989).

of all to establish their home ranges and whether they actually used, shooting areas for example at night or at the end of the shooting season that were not available to them when shooting was taking place. We were also interested in whether shooting disturbance was disrupting the time and energy budget of the birds by depriving them of feeding opportunity and increasing the time they spent in flight.

After a lot of difficulty we caught 11 birds on the Ouse Washes, but for practical reasons we could only catch them on the Wildfowl & Wetlands Trust's refuge. Unfortunately none of the birds moved out of that refuge for the whole time that we studied them. Figure 8 is an example of the distribution of locations of two individual birds. One of them stayed in a small area for about two weeks and then moved to another part of the refuge.

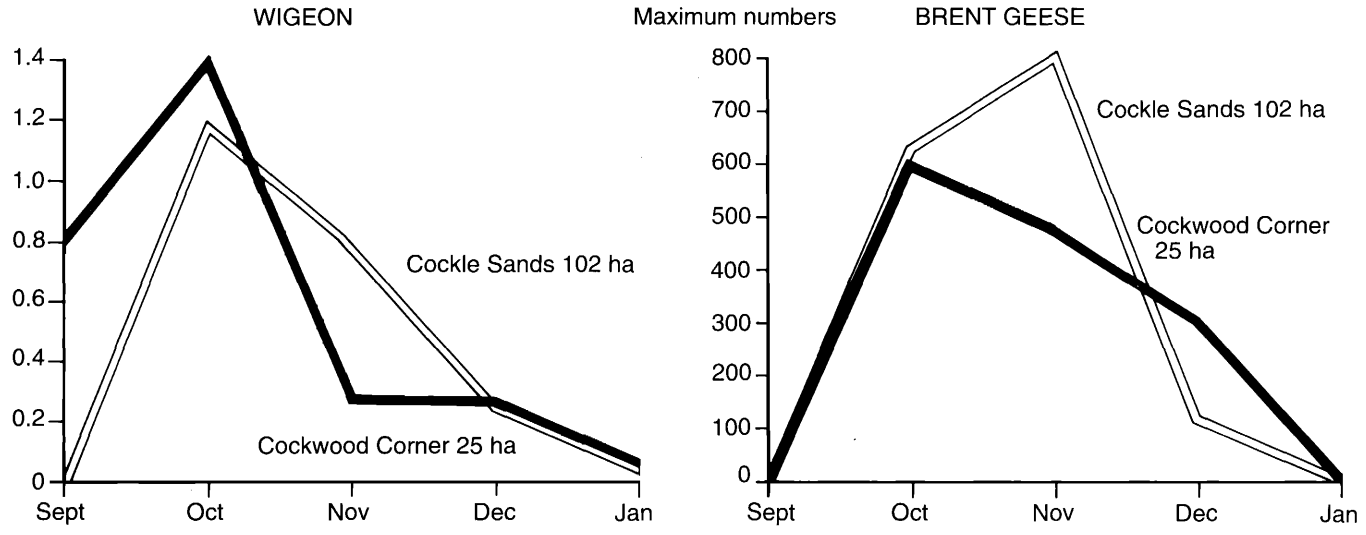


Figure 10. The number of Wigeon and Brent Geese feeding on *Zostera* in the Exe estuary on the non-refuge area at Cockle Sands (102 ha) and the Cockwood Corner refuge (25 ha).

The birds stayed by day and night in almost exactly the same spot; all the 11 birds behaved in a similar way. Different birds tended to have their own home ranges and did not move out of them. There was no evidence at all from this study of re-distribution at night. Nor did birds re-distribute themselves after the season ended or take advantage of the 'reserve' of food that was left on shooting areas. Whether this behaviour is typical of all the Wigeon on the Ouse Washes or just those that are using the WWT refuge, we have no way of knowing; it is quite possible that there are both rather sedentary and mobile birds within the wintering flocks. The sedentary birds may settle in an area and even defend it, whereas the moveable group distributes itself according to the density of the resident birds, and also to the availability of food.

Another field study was carried out on the Ribble Estuary. This related the usage of shooting and non-shooting areas on the marsh by counting droppings, a sensitive and accurate technique of assessing the amount of time birds spent in an area. The study species was again Wigeon. A transect was set up across the refuge and shooting zone and droppings were counted at regular intervals along the transect. Early in the season birds were using the non-shooting zone preferentially but over the whole season there was no apparent effect of whether an area was a refuge on the intensity of its use by Wigeon. Of course The Ribble is very well controlled; there is no night shooting allowed and most of the Wigeon's feeding takes place at night.

At the same time, the WWT was working on an NCC project to investigate night shooting (Mudge 1989). Figure 9 comes from this study and shows the amount of feeding done by Wigeon in the Moray Firth in conditions with and without shooting. In this case the shooting was experimental, carried out by the researcher. In all cases there was a very large drop in feeding activity at times when shooting was taking place. However, we did not have any data over long enough periods to know whether the birds could compensate by feeding in another area; certainly these birds did not move out of the whole region, they just re-distributed within the Moray complex.

Finally, a study was done on the Exe Estuary with the aim of seeing whether disturbance, including wildfowling, was restricting the use of *Zostera* on the estuary by Wigeon and Brent Geese *Branta bernicla* (see also Fox *et al.* this volume). Table 4 illustrates the kinds of disturbance that takes place on the estuary. Cockle Sands is a non-refuge area where wildfowling is allowed, the Cockwood Corner is a rather smaller refuge area. Clearly one of the main differences between the refuge and non-refuge is the presence or absence of wildfowlers, which represent quantitatively the most important source of disturbance on Cockle Sands.

The quantity of *Zostera* on each bed was assessed by periodical aerial photography to estimate the size of the beds and by checking the standing crop per unit area from ground information. Figure 10 shows the usage of *Zostera* beds by Wigeon and Brent Geese; there seems to be quite similar numbers and similar patterns on the two beds, but note that the *Zostera* bed in the non-refuge area was 102 ha and in the refuge area was only 25 ha. So the refuge area carried a much high density of Wigeon and Brent Geese.

Figure 11 shows this usage of the two beds expressed as a proportion per unit biomass of *Zostera,* which highlights the disparity in the holding capacity of the refuge and non-refuge area. Figure 11 also shows that there is not a reserve of food left after shooting ceases, because whether or not there is a refuge the

TABLE 4. The factors causing disturbance and the time the birds' budget was affected in two areas of the Exe Estuary (a) Cockle Sands, a non-refuge and (b) the small refuge area at Cockwood Corner

(a) Cockle Sands

Cause	n	Duration (min) Mean (SD)	Total
Wildfowlers	5	29.1 (21.8)	145.5
Light aircraft	7	17.5 (12.5)	122.5
Windsurfers	10	3.9 (2.8)	39.0
Dogs	20	1.8 (1.2)	36.0
Bait diggers	17	1.7 (0.8)	28.9
Walkers	9	1.2 (0.4)	10.9
Powered boats	1	5.0	5.0
Herons	2	2.0 (0.0)	4.0
Unpowered boats	1	3.0	3.0
Miscellaneous	4	1.4 (1.0)	5.6
Total	76	–	400.3

Feeding periods: 12. Hours of observation: 48
Disturbance time (Mins/hr 8.3)

(b) Cockwood Corner

Cause	n	Duration (min) Mean (SD)	Total
Bait diggers	5	19.2 (20.0)	96 0
Birds of prey	7	3.4 (5.8)	23.8
British Rail activities	11	2.1 (1.5)	23.1
Trains	6	1.7 (1.1)	10.2
Light aircraft	6	1.4 (0.8)	7.0
Powered boats	1	6.0	6.0
Herons	1	2.0	2.0
Total	37	–	168.1

Feeding periods: 10. Hours of observation: 36.6
Disturbance time (Mins/hr 4.6)

Zostera stock disappears, eroded by wave action and dieback, by the middle of the winter. In this case there does seem to be a limitation of the usage of a food resource by disturbance from shooting and other factors.

To summarise, this study showed how difficult it is conclusively to demonstrate an impact of disturbance at the population level, or even at individual sites. This may partly be because the impact is not great at the sites investigated at the current level of shooting. It is also undoubtedly true that the data available, particularly on habitat and other characteristics of sites that indicate their suitability or otherwise for birds, are not precise enough to enable an effect to be demonstrated, even if it is considerable.

There is no doubt, however, that refuges are a very important part of site management, and this is recognised by wildfowlers and site managers. We should continue to work together to create refuges on all our estuaries and to manage them successfully for our waterfowl populations and their uses.

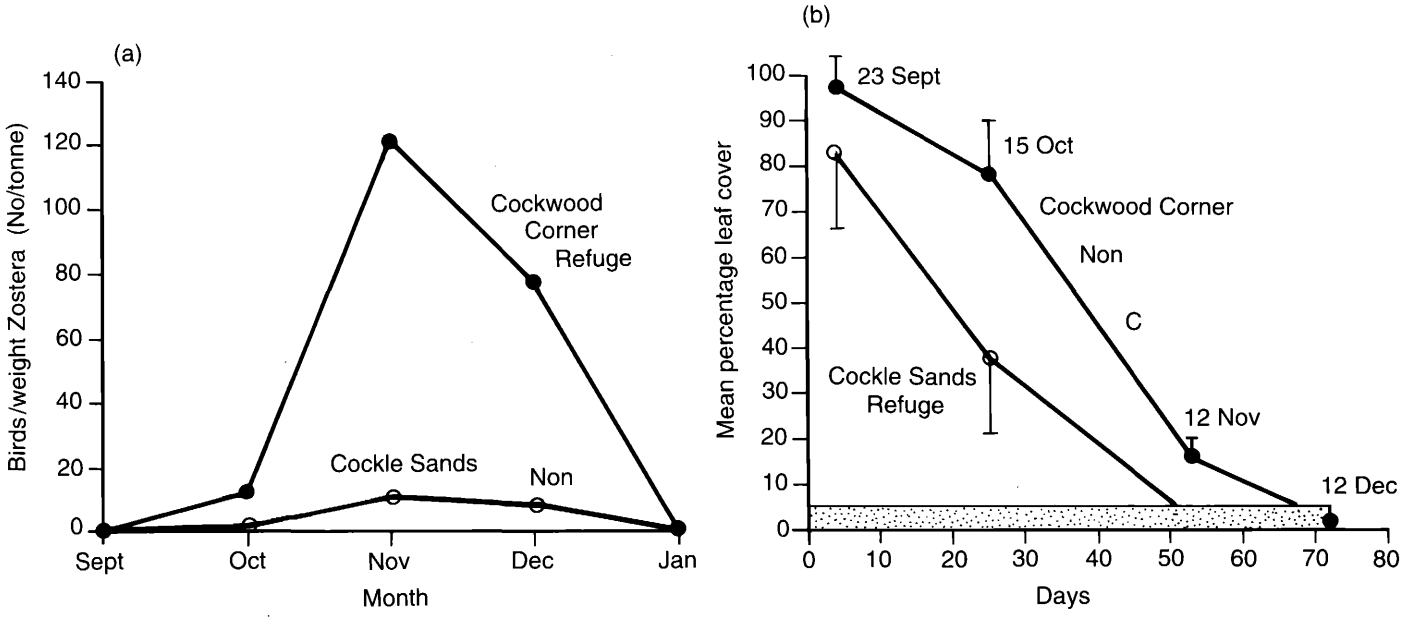


Figure 11. The number of Brent Geese feeding on two areas on the Exe Estuary per unit weight of *Zostera* at each location (a). Also shown is the decline in biomass of *Zostera* over the winter (b).

REFERENCES

Atkinson-Willes, G.L. 1963. *Wildfowl in Great Britain*. HMSO, London.

Bell, D.V. & Fox, P. 1991. Shooting Disturbance: An assessment of its impact and effects on overwintering waterfowl populations and their distribution in the United Kingdom. Unpublished Report, WWT/BASC.

Laws, A.R. & Goater, R. 1989. Wildfowling on Nature Reserves *In The New Wildfowler* (Ed. Eric Begbie). Stanley Paul & Co. Ltd.

Hirons G. & Thomas G.J. 1993. Disturbance on estuaries: RSPB nature reserve experience. Wader Study Group Bull. 68 (Special Issue).

Moser, M.E. 1988. Limits on the numbers of Grey Plover *Pluvialis squatarola* wintering in British estuaries: an analysis of long term population trends. *J. Appl. Ecol.* 25: 473-485.

Mudge, G.P. 1989. Night shooting of wildfowl: An assessment of its prevalence, intensity and disturbance impact. Report to the Nature Conservancy Council. Unpublished Report, WWT.

Owen, M. in press. Nocturnal feeding in waterfowl. *Proc. Int Orn. Cong., Christchurch 1990.*

Owen M. & Dix, M. 1986. Sex ratios in some common British wintering ducks. *Wildfowl* 37: 104-112.

Owen M. & Thomas, G.J. 1979. The feeding ecology and conservation of Wigeon wintering at the Ouse Washes, England. *J. Appl. Ecol.* 16: 95-809.

Owen M., Atkinson-Willes, G.L. & Salmon, D.G. 1986. *Wildfowl in Great Britain*. Second Edition. Cambridge University Press, Cambridge.

Thomas, G.J. 1978. Breeding and feeding ecology of waterfowl at the Ouse Washes, England. PhD thesis, Council for National Academic Awards.

P Doherty (RSPB)

Wigeon