British Trust for Ornithology

BTO Research Report No. 173

The Abundance and Distribution of Waterfowl Within Milford Haven After The *Sea Empress* Oil Spill. Interim Report January 1997

Authors

M.J.S. Armitage, N.H.K. Burton, M.M. Rehfisch & N.A. Clark

Report of work carried out by
the British Trust for Ornithology
under contract to the
Countryside Council for Wales
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Sea Empress Environmental Evaluation Committee

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The National Centre for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU
Registered Charity No. 216652

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Published in February 2005 by the
British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, U.K.

ISBN 1-904870-21-X

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EXECUTIVE SUMMARY

1. The *Sea Empress* oil spill in early 1996 affected much of the coastline in the Milford Haven complex. It has provided the opportunity to study the long-term recovery of waterfowl populations following such a disaster. The gathering of this information will be valuable in determining whether the oil spill and the cleaning operations had a lasting effect on the local waterfowl populations.

2. The aim of this summary report is to introduce the four sites in the study and the methods of data collection and analysis.

3. Some of the initial results from the counts of the first two months are presented and briefly discussed. Wigeon *Anas penelope* and Dunlin *Calidris alpina* are present at all sites in high numbers and have been chosen to highlight the methodology. Other species, including Shelduck *Tadorna tadorna*, Oystercatcher *Haematopus ostralegus*, Curlew *Numenius arquata* and Redshank *Tringa totanus* are also present in good numbers at the four sites. Until a full winter's fieldwork has been completed, however, it will not be possible to compare this year's findings with previous years' data.

4. Some of the challenges posed by this study are discussed.

1. INTRODUCTION

On 15 February 1996 the *Sea Empress*, laden with 130,000 tonnes of crude oil, ran aground on rocks at Mill Bay at the entrance to Milford Haven. Approximately 72,000 tonnes of crude oil and 360 tonnes of heavy fuel oil were released from the tanker over the following six days. Some of the oil was carried into Milford Haven, affecting a large extent of coastline. Angle Bay was heavily oiled and Pembroke River was heavily oiled in part. Oil sheens were reported as far up the Milford Haven complex as Landshipping and the lower reaches of the Eastern Cleddau, but these areas were considered to be only very lightly contaminated (Poole, 1996).

The *Sea Empress* spill has provided the opportunity to assess the impact of oil deposits on the waterfowl of intertidal areas. Other studies aim to assess the impact of the oil on the waterfowls' invertebrate prey in the intertidal sediments. In heavily oiled areas, these prey organisms may have been heavily depleted. As a result, birds that used affected mudflats may have remained and suffered increased mortality rates or may have been forced into other areas to feed. In either case, the local populations would be expected to have decreased in the immediate aftermath of the incident.

This study aims to monitor the use made by waterfowl of intertidal areas in the Milford Haven complex over two autumn and three winter seasons in relation to oiling levels. Four sites are being studied: two oiled sites, Angle Bay and Pembroke River and two effectively non-oiled sites, the Carew/Cresswell Rivers and the Cleddau River where the Eastern and Western Cleddau meet. The non-oiled sites are similar to Pembroke River in topography and substrate composition. Unfortunately, there is no site similar to Angle Bay that has not been oiled.

At the oiled sites, waterfowl populations are expected to recover with time as did most shoreline faunas after the *Torrey Canyon* spill (Figure 1.1). It is expected that the recovery rates, measured by waterfowl usage, will be more rapid at Pembroke River than at Angle Bay due to the less comprehensive deposition of oil at the former site. Furthermore, it is expected that the recovery rates will also differ between species according to their feeding preferences and will be dependant upon the mortality and recolonisation rates of their food organisms. Comparisons will be made between the oiled and non-oiled sites in the Milford Haven complex. The use of the non-oiled sites is expected to reflect the natural population changes, although initially there may be an increase due to a possible influx of birds from oiled areas.

2. METHODS

The same methodology will be used throughout the study period in order to allow direct comparisons to be made between seasons and years.

2.1 Study Area

The study area consists of four sites: Angle Bay (Figure 2.1.1), Pembroke River (Figure 2.1.2), Carew/Cresswell (Figure 2.1.3) and Upper Cleddau (Figure 2.1.4). Each site was divided into several mudflat count areas to allow detailed analyses of results. Angle Bay was divided into 10 mudflats, all affected by the spill. Mudflat 4 is an area of rocky shore and mudflat 10 is a small harbour. Each of the other three sites were divided into 12 mudflats. At Pembroke River, mudflats at the eastern end of the site (mudflats 7, 8, 10, 11 and 12) were probably not seriously affected by oil deposition (Poole, 1996). Saltmarsh is found at the fringes of all sites, except Angle Bay. Where possible, the boundaries of the mudflats follow those laid down by Hellawell & Phillips (1987) and Prŷs-Jones (1989). For the purposes of this study however, some count areas used by those studies have been divided into smaller units.

The species recorded include divers, grebes, cormorants, herons, wildfowl and waders. In order to monitor all species comprehensively, an area of open water (area 88) was also counted at each site.

2.2 Count Methodology

In order to gain a full picture of the use of the four intertidal areas by waterfowl, counts were carried out across the tidal cycle (an 'all-day' count - see Clark, 1990). Each site was counted once every hour from six hours before to five hours after low tide. Counts were made throughout the hours of daylight. Feeding and roosting birds were counted separately and factors such as disturbance to a mudflat or impaired visibility were noted. All birds present on the exposed mudflats were counted. Wildfowl feeding in the shallow water offshore, which were feeding on invertebrates or plants on or in the substrate were included in the counts for the respective mudflat. Waders and wildfowl roosting in areas of saltmarsh were not counted, as accurate counts are very difficult in this habitat. Those species such as divers, grebes, cormorants, shags and diving ducks which use open water were counted as feeding or roosting over the appropriate mudflat or on the open water count area.

Counts are divided into two seasons: autumn (September to October) and winter (November to March). This year, counts began in November. Each site was counted twice a month with one count on a spring tide and one on a neap tide where possible.

In future analyses, following Evans *et al.* (1990) and Burton *et al.* (1997), for each season, all day counts will be used to calculate the following:

1. the average exposure time per tidal cycle of each mudflat;
2. the average number of feeding bird hours per tidal cycle ('all day usage' - the term 'usage' will be used throughout the report) for each species for each mudflat;
3. the average number of birds of each species present on each of the four sites at each hour of the tidal cycle and the proportion feeding.

For waders and herons, all day usage was calculated as:

$$\sum_{A=+5}^{A=-6} (B \times C)$$

where A is the hours from low tide (0 hours being low tide and +5/-6 high tide, B is the average number of birds feeding at time A, and C is the proportion of counts when the area was exposed at time A.

For wildfowl and other species that may feed on or under the water, all day usage was calculated as:

$$\sum_{A=+5}^{A=-6} B$$

Baseline data from counts at various states of tide are available from three previous studies (Haycock, 1987; Hellawell & Phillips, 1987; Prŷs-Jones, 1989). Wetland Bird Survey (WeBS) counts (Poole, 1996) will provide an additional picture of the numbers of waterfowl present before, during and after the oil spill. Ringing data will provide information on the movements of waterfowl within and from the study areas during the non-breeding seasons.

For the purposes of the present report and to highlight methodology, detailed analyses are carried out on data for Wigeon *Anas penelope* and Dunlin *Calidris alpina*, as they are abundant at all four sites. Graphs displaying mean total numbers of these two species and mean numbers feeding at each hour of the tidal cycle are presented. Confidence limits are not shown as the figures are derived from only three counts. In addition, for each mudflat at each site, the mean number of bird feeding hours per tidal cycle is calculated and presented in the form of dot maps. The abundance and distribution of other species at each of the four sites is discussed.

3. RESULTS

One complete count was carried out at each site in November and two in December. A total of 38 species have been recorded during the counts so far.

The order of the species accounts follows Voous (1973).

3.1 Wigeon

Figures 3.1.1 to 3.1.4 show the mean numbers of Wigeon at different hours of the tidal cycle at the four sites. Figures 3.1.5 to 3.1.8 show the mean feeding usage of different mudflats within these four sites.

Wigeon were often seen roosting on the water, on the mud banks or at high tide, in the saltmarsh. Peak feeding activity typically occurred on the ebb and flood tides.

At Angle Bay, the mean number of Wigeon varied between 60 and 120 birds, with a peak at one hour after low tide. Peak feeding activity occurred four hours before and three hours after low tide, when most of the birds present were observed feeding. With the exception of mudflats 4 and 10, where usage was low, feeding Wigeon were fairly evenly distributed across the mudflats at Angle Bay. Mudflat 4 is chiefly composed of rocks over which the Wigeon are unlikely to find their preferred foods of eel grass *Zostera* spp, algae and other grasses (Lack, 1986). Mudflat 10 is used as a small harbour by the local villagers and its proximity to human habitation may deter the birds.

The highest numbers of Wigeon were found at Pembroke River, averaging between 600 and 1200 birds. Feeding activity here also peaked at four hours before and three hours after low tide. Very few birds fed either side of low tide. The highest concentrations of feeding Wigeon were found on mudflats 5 and 6, with smaller numbers on mudflats 2, 3, 4 and 9. No Wigeon were seen at the eastern end of the site.

At Carew/Cresswell, numbers averaged between 80 and 240. The highest numbers were present two to three hours after low tide. Peak feeding activity occurred three hours before and three to four hours after low tide. As at Pembroke River, only small numbers fed around low tide. Wigeon mostly fed on the upper River Carew on mudflats 8 and 9 and on the lower part of the River Cresswell on mudflats 1 and 2, although they were seen feeding on all mudflats.

Smaller numbers of Wigeon were found at the Upper Cleddau, on average varying between 25 and 110, with a peak four hours after low tide. Peak feeding activity was also during this period. In contrast to the other three sites, however, birds fed more consistently throughout the tidal cycle. Feeding usage was most concentrated on mudflats 1 and 2 at Sprinkle Pill, mudflat 4 at Landshipping Quay and mudlats 9 and 10 at Millin Pill.

3.2 Dunlin

Figures 3.2.1 to 3.2.4 show mean numbers of Dunlin at different hours of the tidal cycle at the four sites. Figures 3.2.5 to 3.2.8 show the mean feeding usage of different mudflats within these four sites.

At all four sites, flocks of Dunlin moved from their roosts an hour or two after high tide to feed on the mudflats as they become exposed. Numbers were observed to increase steadily towards a peak at or just before low tide. Although Dunlin fed across the exposed mudflats, they were often concentrated at the shoreline.

The pattern in Dunlin numbers seen across the tidal cycle was similar at Angle Bay, Pembroke River and Carew/Cresswell. Angle Bay had fewer Dunlin with a peak mean of about 120 birds. Pembroke River and Carew/Cresswell both had a peak mean of approximately 500 birds. The Upper Cleddau shows an

erratic pattern, as no birds were seen at low tide following a peak mean of about 340 birds one hour before that. Following low tide, numbers increase again to another smaller peak four hours after low tide.

At Angle Bay, feeding Dunlin concentrated on mudflats 2 and 3 with smaller numbers seen on mudflats 1 and 5 to 10. None were seen on the rocks of mudflat 4. It is possible that Dunlin would make more use of the south-eastern part of the site if it was less prone to disturbance by fishermen and bait-diggers.

Dunlin were seen feeding on all areas of Pembroke River, except mudflat 12. The greatest usage was found on the large areas of mudflats 5, 6 and 9. Moderate usage was found on mudflats 4, 7, 10 and 11. Few birds used other mudflats.

At Carew/Cresswell, feeding Dunlin were concentrated on mudflats 2, 5 and 6 where the two rivers meet near Lawrenny. With the exception of mudflat 10, smaller numbers of Dunlin were seen feeding on all other mudflats.

Dunlin were seen feeding on all mudflats except 3 and 11 at the Upper Cleddau. The highest level of usage was found at mudflat 5. Mudflats 3, 7 and 8 may have been avoided due to disturbance from walkers.

3.3 Other Species

In addition to Wigeon and Dunlin, seven other species were seen in good numbers. Table 3.3.1 summarises the numbers of each species recorded at the four sites.

Peaks of over 50 Shelduck *Tadorna tadorna* were present at all four sites. Teal *Anas crecca* were absent from Pembroke River but over 100 occurred at Angle Bay and the Upper Cleddau and over 50 at Carew/Cresswell. Oystercatchers *Haematopus ostralegus* were present at all sites. Fifty to 100 were found at both Angle Bay and Pembroke River with slightly fewer at Carew/Cresswell and the Upper Cleddau. Up to 500 Golden Plover *Pluvialis apricaria* and more than 500 Lapwing *Vanellus vanellus* were occasionally found at all sites except Pembroke River, although most of these birds did not feed. Curlew *Numenius arquata* were commonly found feeding at three of the sites with peaks of over 100 birds. At Carew/Cresswell numbers were slightly lower. Over 50 Redshank *Tringa totanus* were recorded at Pembroke River, though fewer were found at the other three sites.

Other species of note recorded, include Little Egret *Egretta garzetta* and Greenshank *Tringa nebularia*, which were found occasionally at all sites, and two Spotted Redshanks *Tringa erythropus* seen once at the Upper Cleddau in November.

4. DISCUSSION

At this stage of the project, conclusions can only be tentatively made about the bird populations in the study area. However, some points can be made with regard to future analysis. Several species: Shelduck, Wigeon, Oystercatcher, Dunlin, Curlew and Redshank occur at all four sites in good numbers.

For these species it will be possible to compare the expected recovery in all-day usage at Angle Bay and Pembroke River with changes caused by natural population fluctuations at Carew/Cresswell and the Upper Cleddau. The latter sites, however, may not be perfect controls as it is possible that there may have been an influx of birds to them immediately following the oil spill.

It would be useful, therefore, to compare waterfowl population changes at the sites in the Milford Haven complex with those at sites away from the incident. Cardiff Bay, some 100 miles away is being studied using similar techniques (Burton *et al.*, 1997). Unfortunately, with the completion of the Cardiff Bay Barrage early in 1998 the mudflats there will be flooded. Nevertheless, trends in waterfowl populations both in Milford Haven and other areas will be available through WeBS data, making the inferred conclusions more robust.

Future results will be displayed in a similar fashion to those for Wigeon and Dunlin in this report. Dot maps of feeding usage will indicate the most important feeding areas at each site and period. The mean number of birds and the proportion feeding at different times during the tidal cycle will be displayed graphically.

Acknowledgements

Thanks are due to Bob Haycock and Annie Poole (Countryside Council for Wales) for their help in discussion of the project and to Steve Sutcliffe for his advice.

The discussion of these results with other members of the BTO staff was of considerable value.

The Wetland Bird Survey (WeBS) is administered and funded by the British Trust for Ornithology, The Wildfowl & Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee (on behalf of the Countryside Council for Wales, the Department of the Environment for Northern Ireland, English Nature and Scottish Natural Heritage). We acknowledge the extraordinary contribution made by all of the volunteers involved.

Nicola Read and other secretarial staff gave considerable assistance in the completion of this report.

We thank the Countryside Council for Wales for their funding of this project.

Species	Angle Bay	Pembroke River	Carew Cresswell	Upper Cleddau
Great Northern Diver *Gavia immer*	1	1	0	0
Little Grebe *Tachybaptus ruficollis*	0	1	1	1
Great Crested Grebe *Podiceps cristatus*	2	1	0	1
Red-necked Grebe *Podiceps grisegena*	1	1	0	0
Slavonian Grebe *Podiceps auritus*	1	0	0	0
Cormorant *Phalocrocorax carbo*	1	1	1	1
Shag *Phalocrocorax aristotelis*	0	1	0	0
Little Egret *Egretta garzetta*	1	1	1	1
Grey Heron *Ardea cinerea*	1	1	1	1
Mute Swan *Cygnus olor*	0	0	1	1
Pink-footed Goose *Anser brachyrhynchus*	0	0	0	1
Canada Goose *Branta canadensis*	0	0	0	4
Brent Goose *Branta bernicla*	0	0	1	1
Shelduck *Tadorna tadorna*	3	3	3	3
Wigeon *Anas penelope*	4	5	4	4
Gadwall *Anas strepera*	0	0	1	0
Teal *Anas crecca*	4	0	3	4
Mallard *Anas platyrhynchos*	2	1	2	3
Shoveler *Anas clypeata*	0	0	0	1
Pochard *Aythya ferina*	0	0	0	1
Eider *Somateria mollissima*	0	1	0	0
Goldeneye *Bucephala clangula*	0	1	1	1
Red-breasted Merganser *Mergus serrator*	1	1	1	1
Oystercatcher *Haematopus ostralegus*	3	3	2	2
Ringed Plover *Charadrius hiaticula*	1	2	0	1
Golden Plover *Pluvialis apricaria*	4	0	4	2
Grey Plover *Pluvialis squatarola*	1	2	1	1
Lapwing *Vanellus vanellus*	5	0	5	5
Knot *Calidris canutus*	1	1	0	0
Dunlin *Calidris alpina*	4	5	5	4
Snipe *Gallinago gallinago*	1	0	1	0
Black-tailed Godwit *Limosa limosa*	0	0	0	2
Bar-tailed Godwit *Limosa lapponica*	2	1	0	1
Curlew *Numenius arquata*	4	4	3	4
Spotted Redshank *Tringa erythropus*	0	0	0	1
Redshank *Tringa totanus*	2	3	2	2
Greenshank *Tringa nebularia*	1	1	1	1
Turnstone *Arenaria interpres*	1	2	0	0

Table 3.3.1. A summary of the peak numbers of species recorded at each site. 0 = no birds; 1 = 1-9 birds; 2 = 10-49 birds; 3 = 50-99 birds; 4 = 100-499 birds; 5 = more than 500 birds.

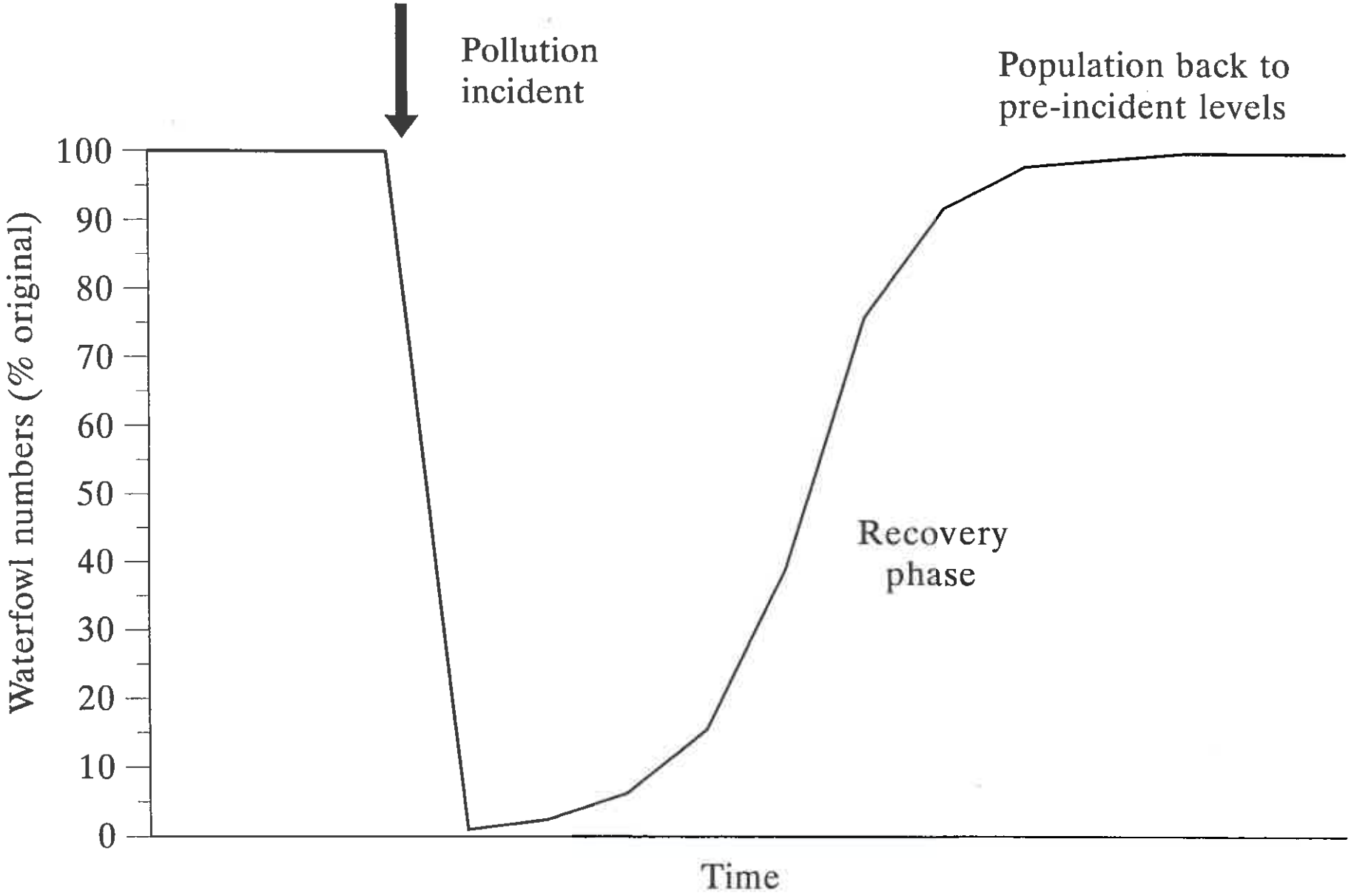

Figure 1.1 The expected pattern of population recovery.

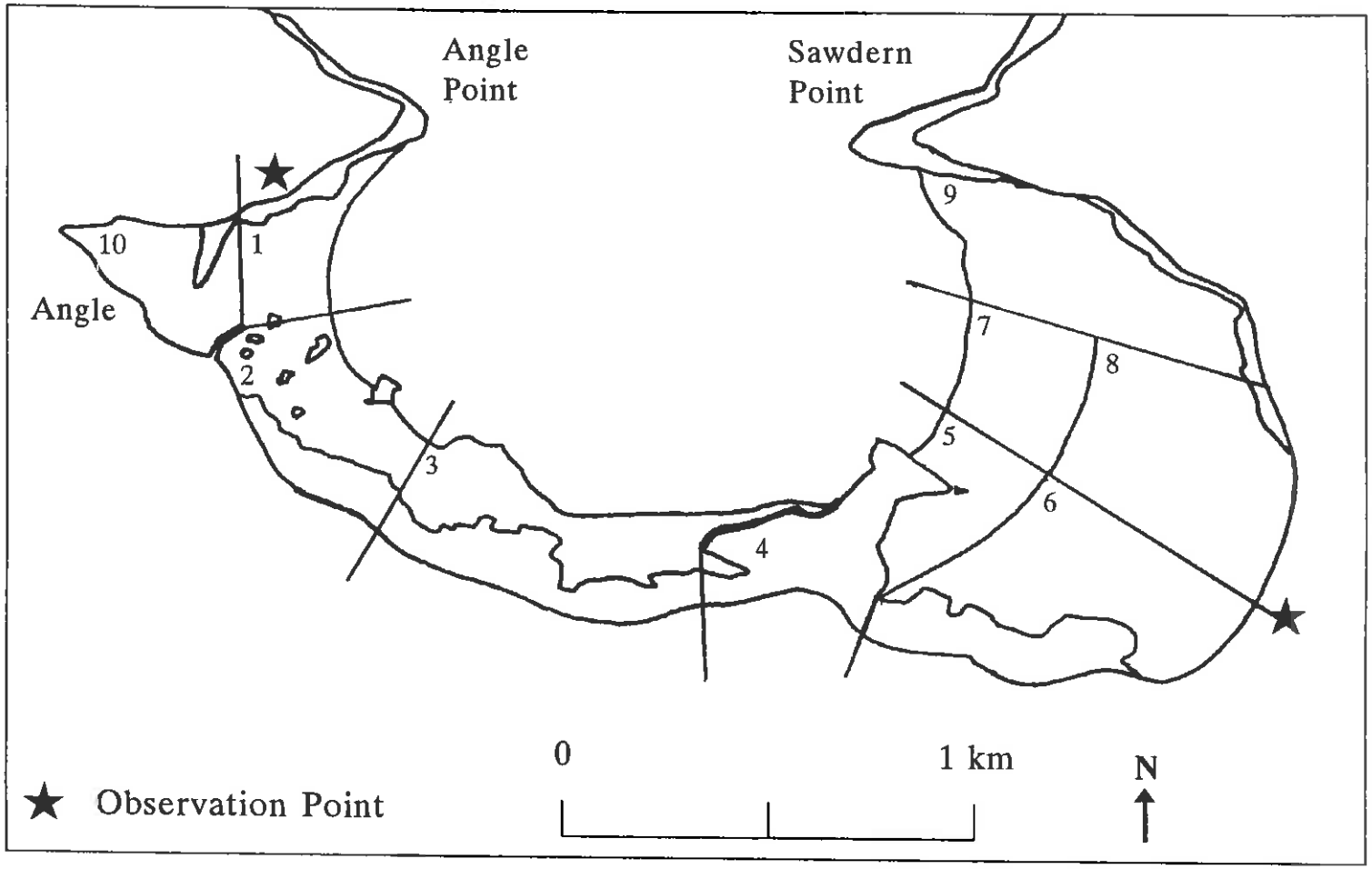

Figure 2.1.1 The Angle Bay study site, showing numbered mudflat count areas. Observation points are marked with an asterisk.

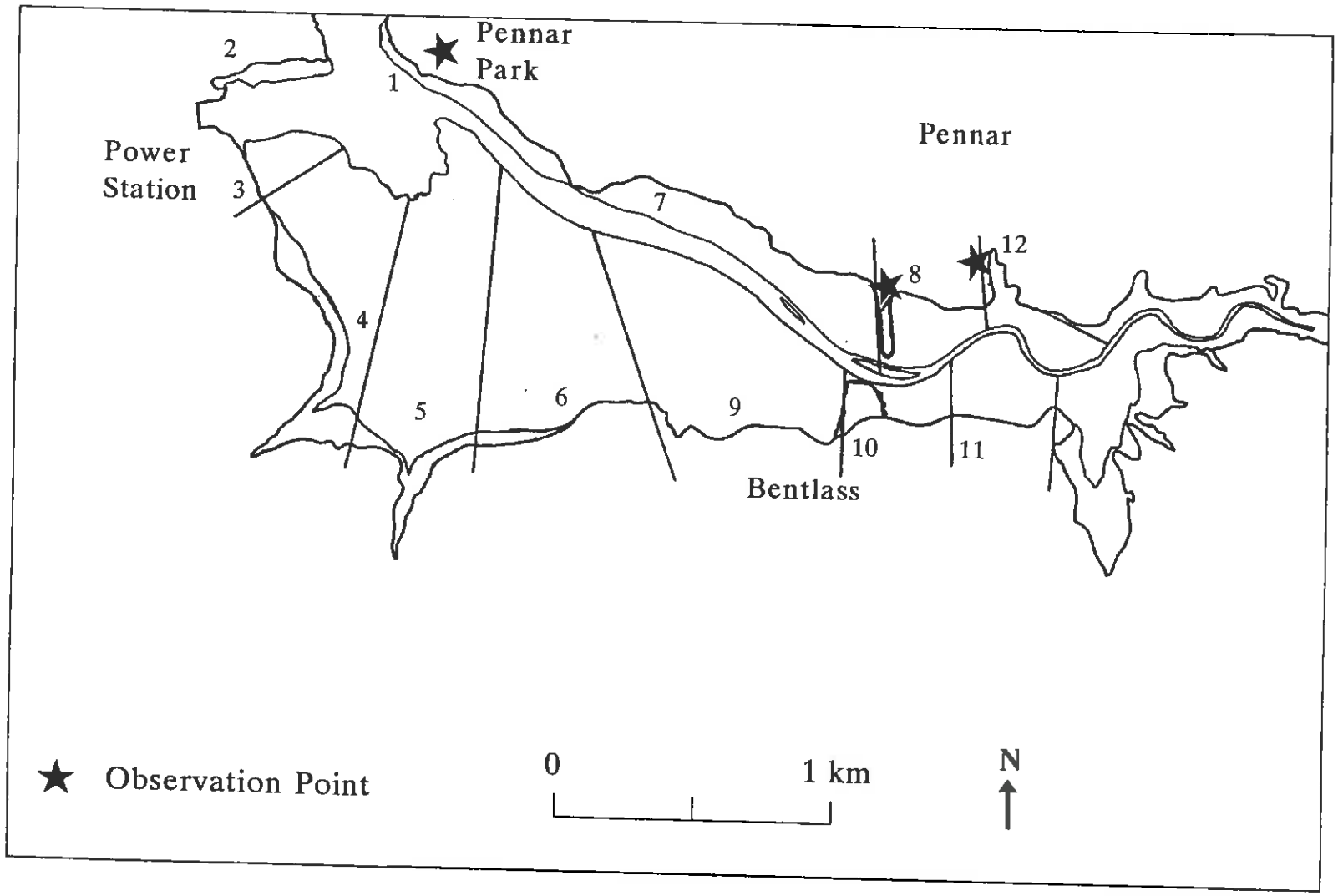

Figure 2.1.2 The Pembroke River study site, showing numbered mudflat count areas. Observation points are marked with an asterisk.

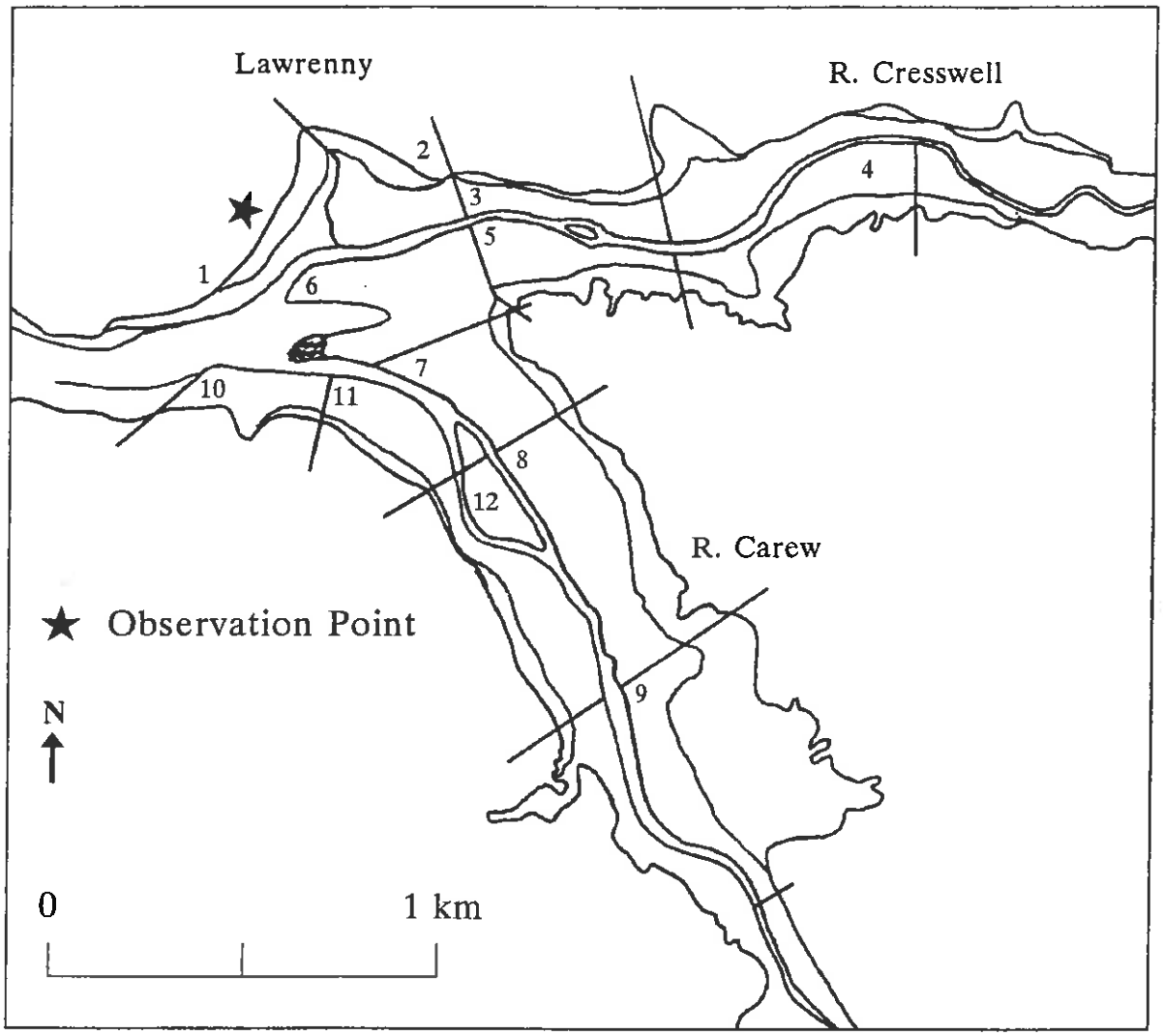

Figure 2.1.3 The Carew/Cresswell study site, showing numbered mudflat count areas. The one observation point is marked with an asterisk.

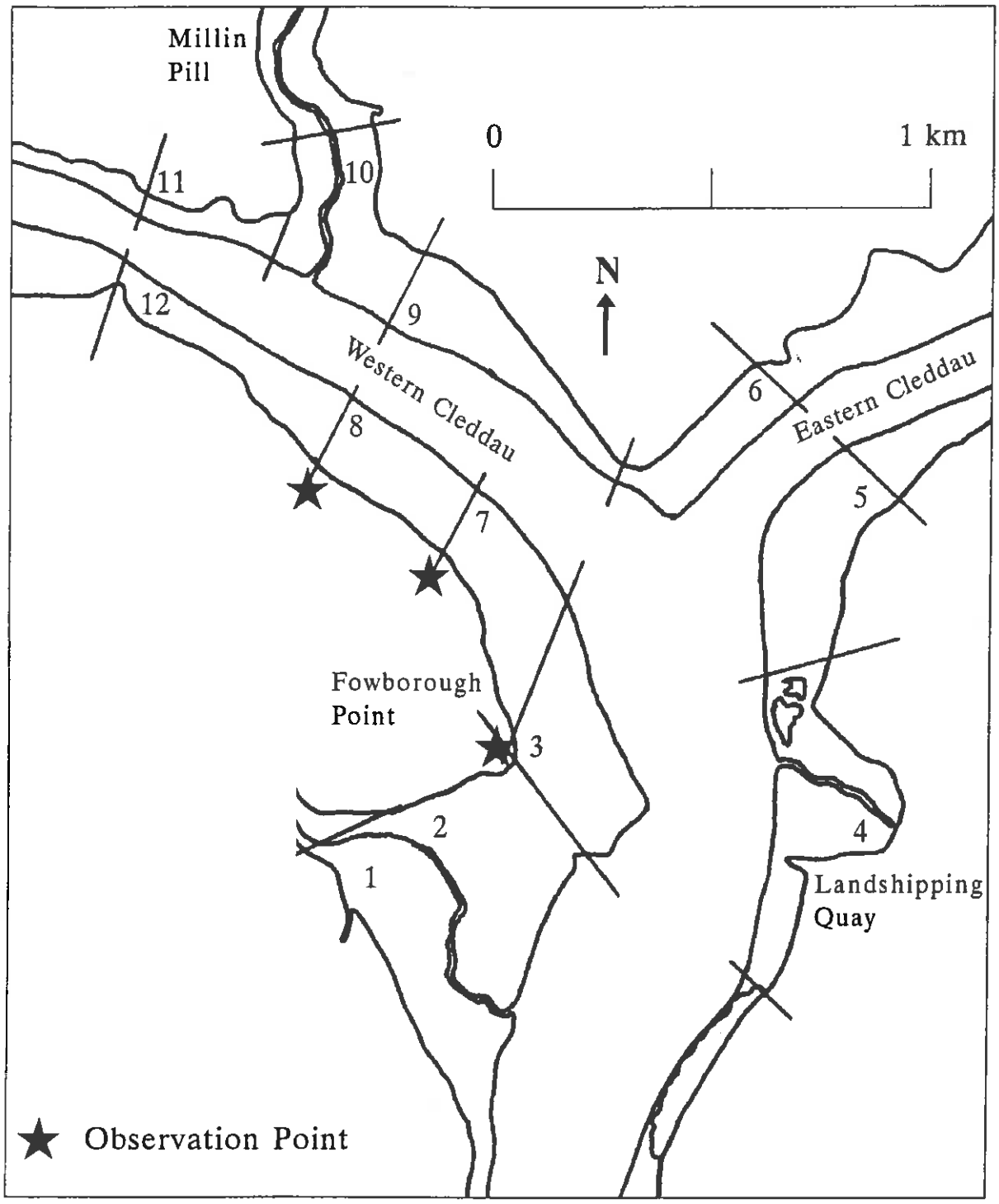

Figure 2.1.4 The Upper Cleddau study site, showing numbered mudflat count areas. Observation points are marked with an asterisk.

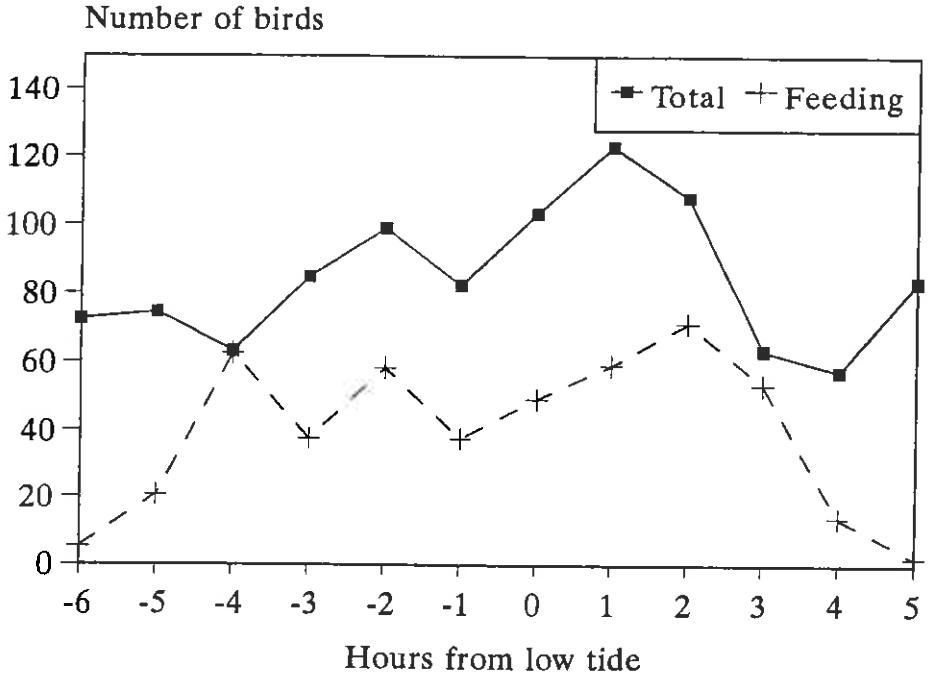

Figure 3.1.1 The mean number of Wigeon present and the mean number feeding during each hour of the tidal cycle at Angle Bay.

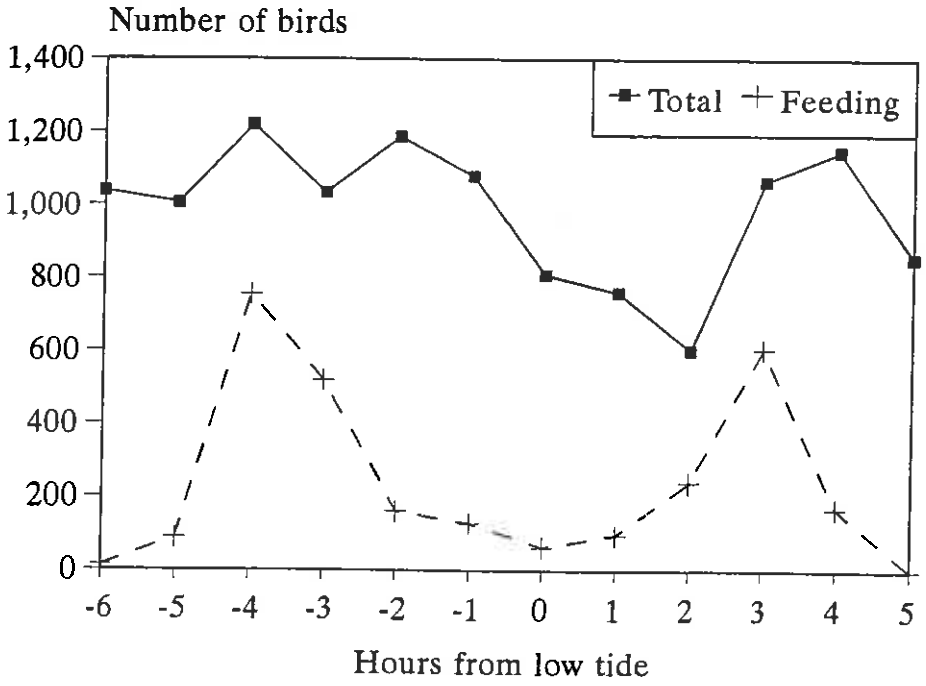

Figure 3.1.2 The mean number of Wigeon present and the mean number feeding during each hour of the tidal cycle at Pembroke River.

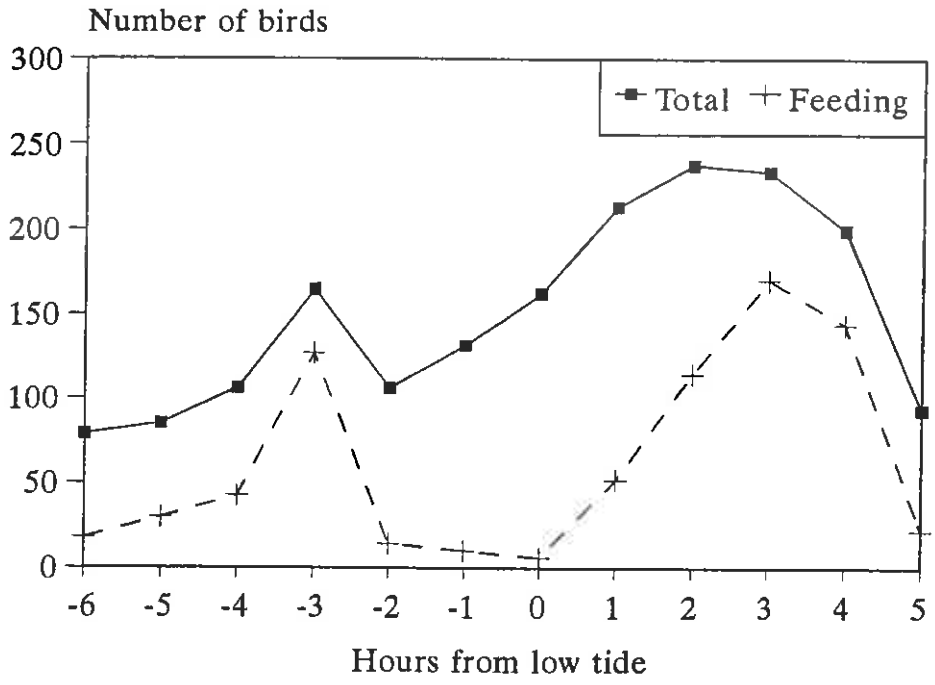

Figure 3.1.3 The mean number of Wigeon present and the mean number feeding during each hour of the tidal cycle at Carew/Cresswell.

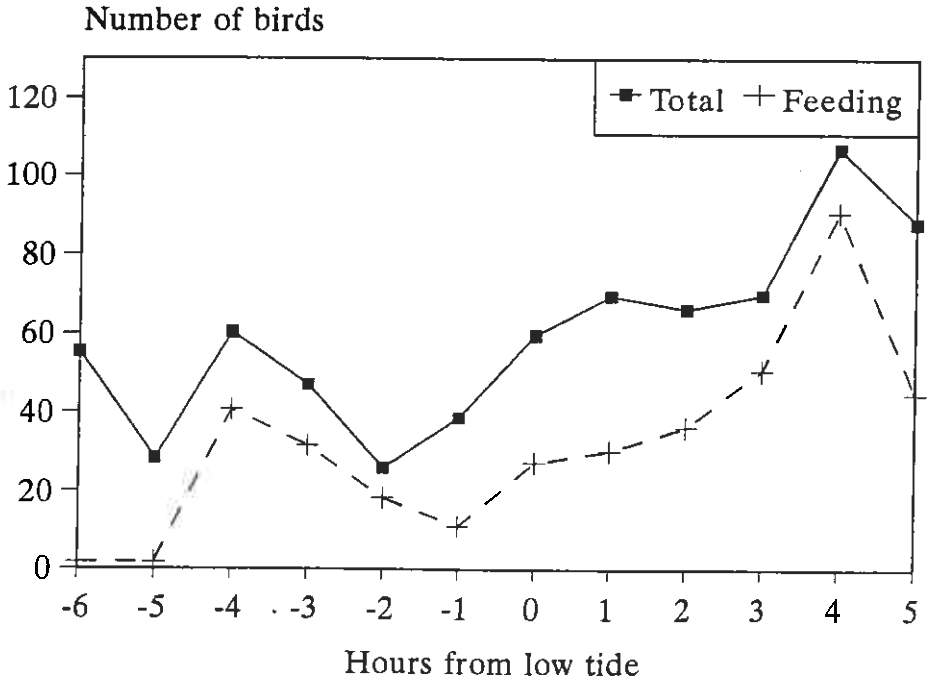

Figure 3.1.4 The mean number of Wigeon present and the mean number feeding during each hour of the tidal cycle at Upper Cleddau.

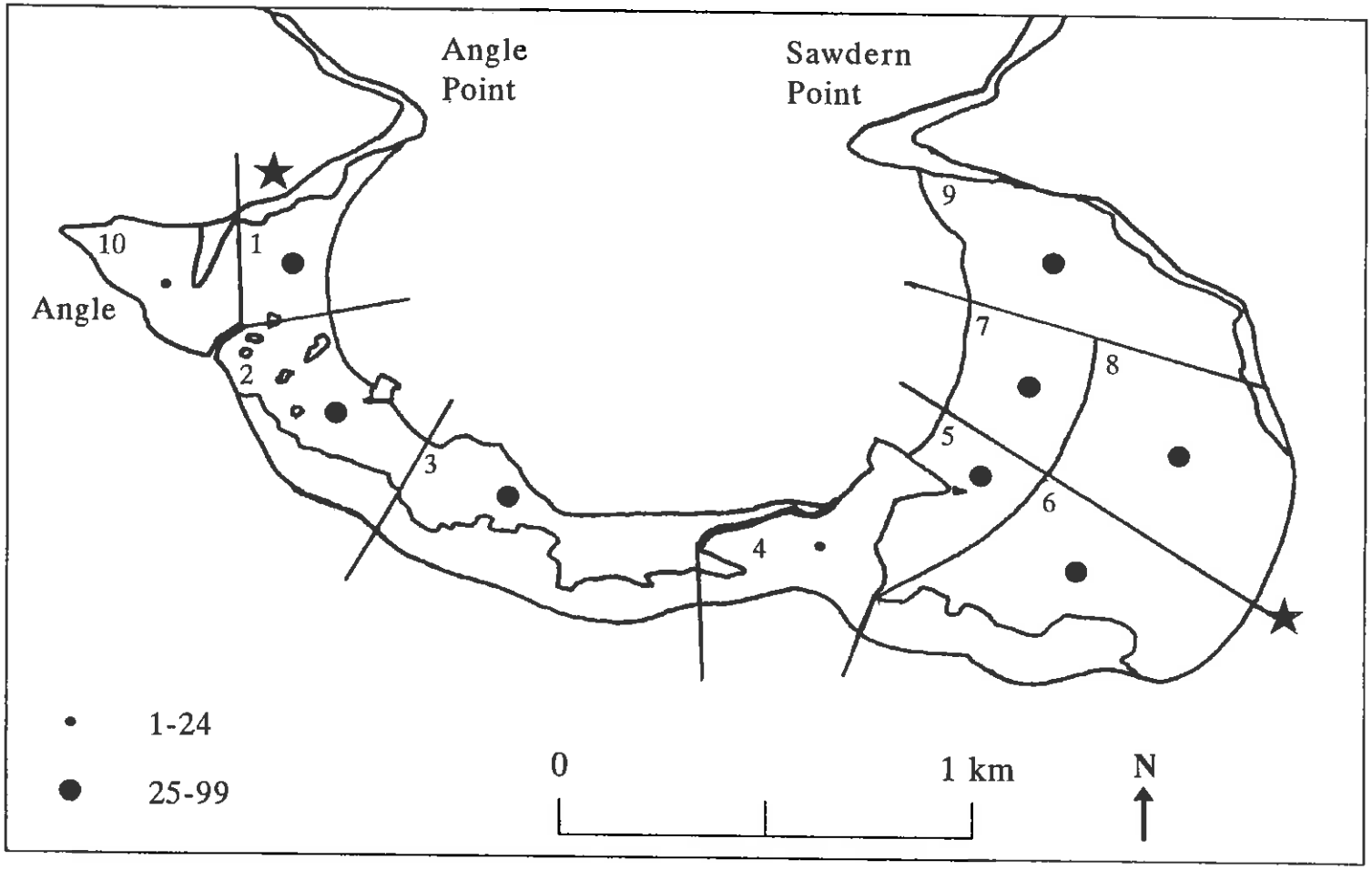

Figure 3.1.5 The distribution of feeding Wigeon at Angle Bay during November and December 1996. The average number of bird hours per tidal cycle is depicted.

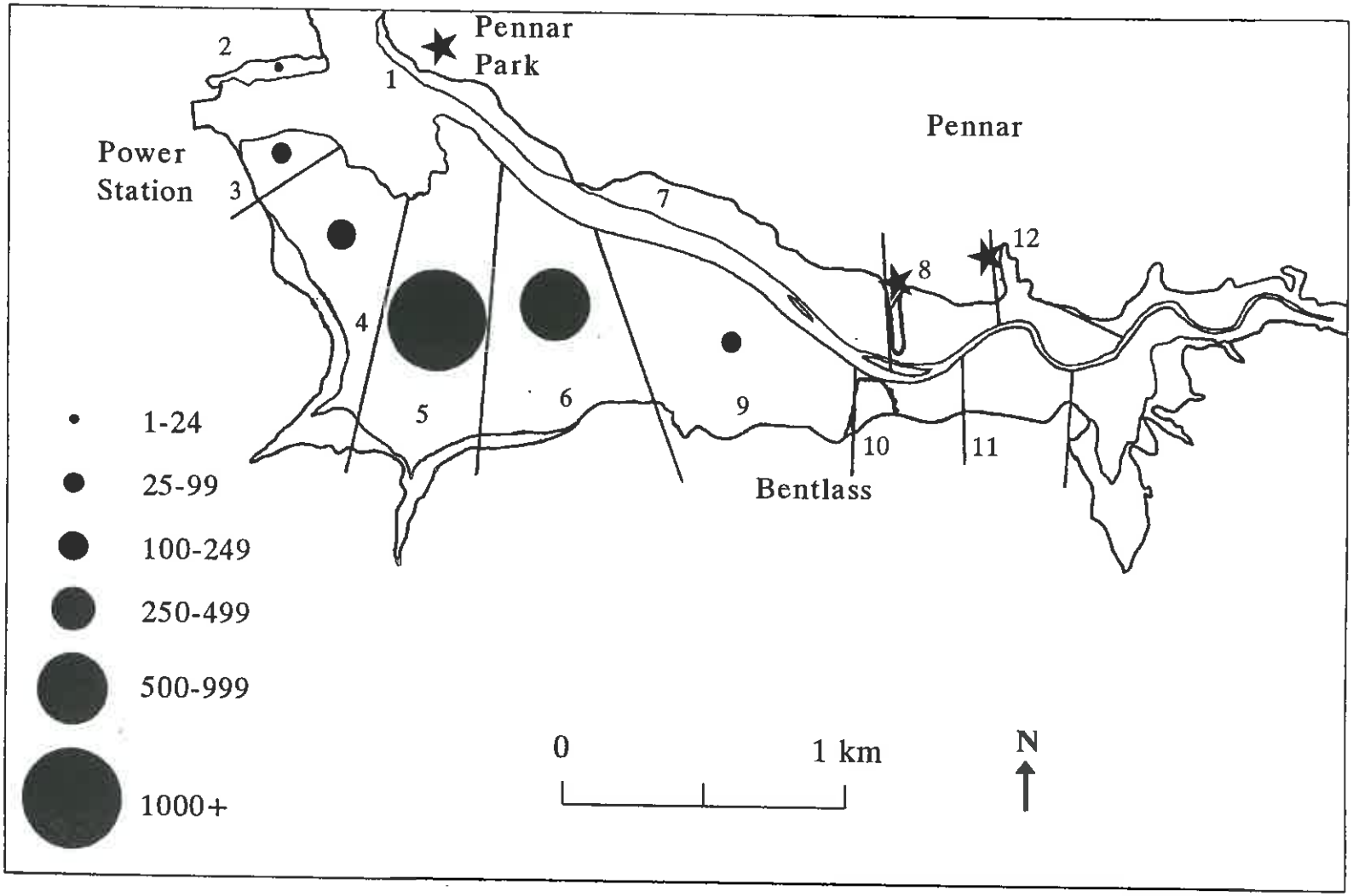

Figure 3.1.6 The distribution of feeding Wigeon at Pembroke River during November and December 1996. The average number of bird hours per tidal cycle is depicted.

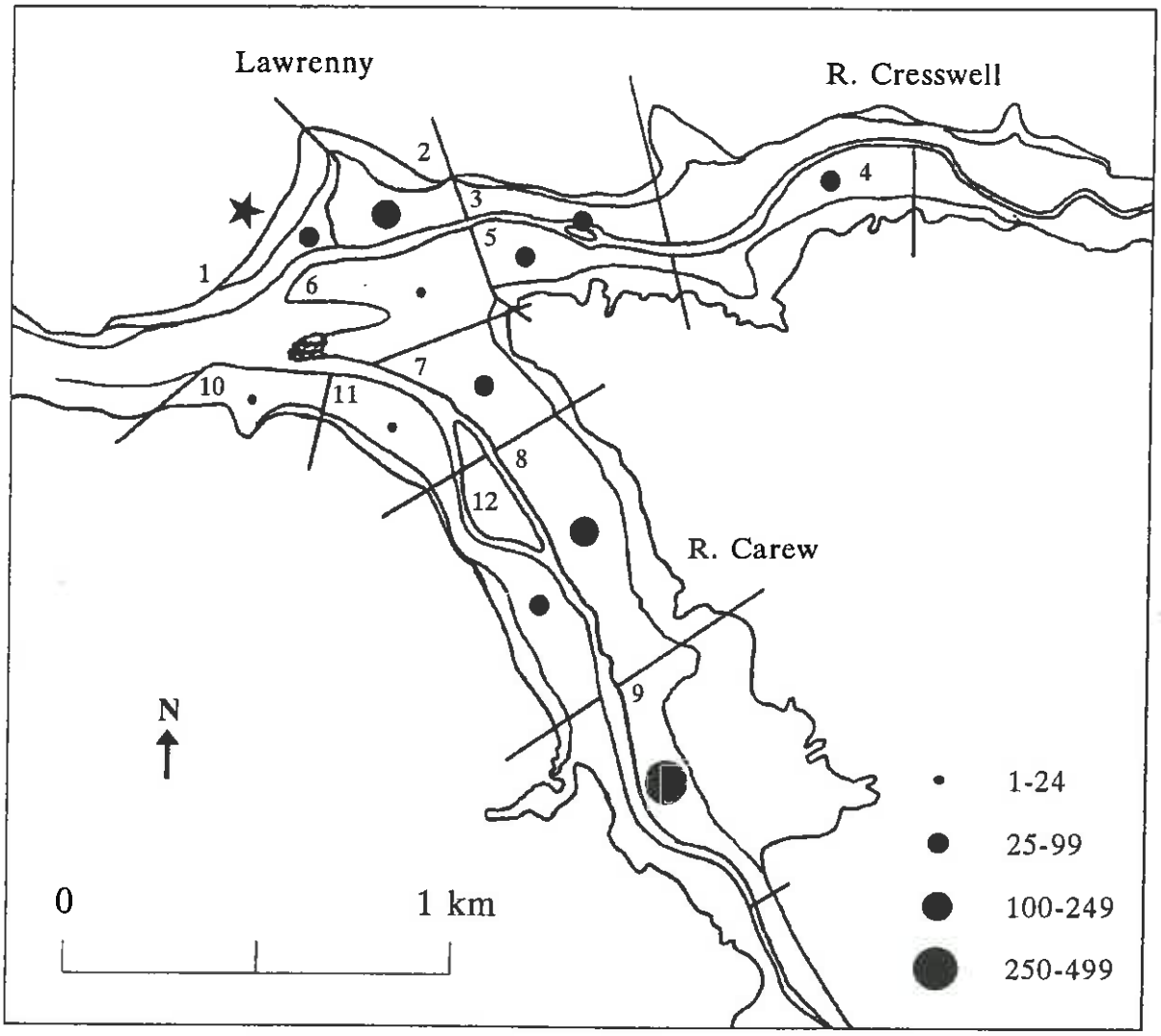

Figure 3.1.7 The distribution of feeding Wigeon at Carew/Cresswell during November and December 1996. The average number of bird hours per tidal cycle is depicted.

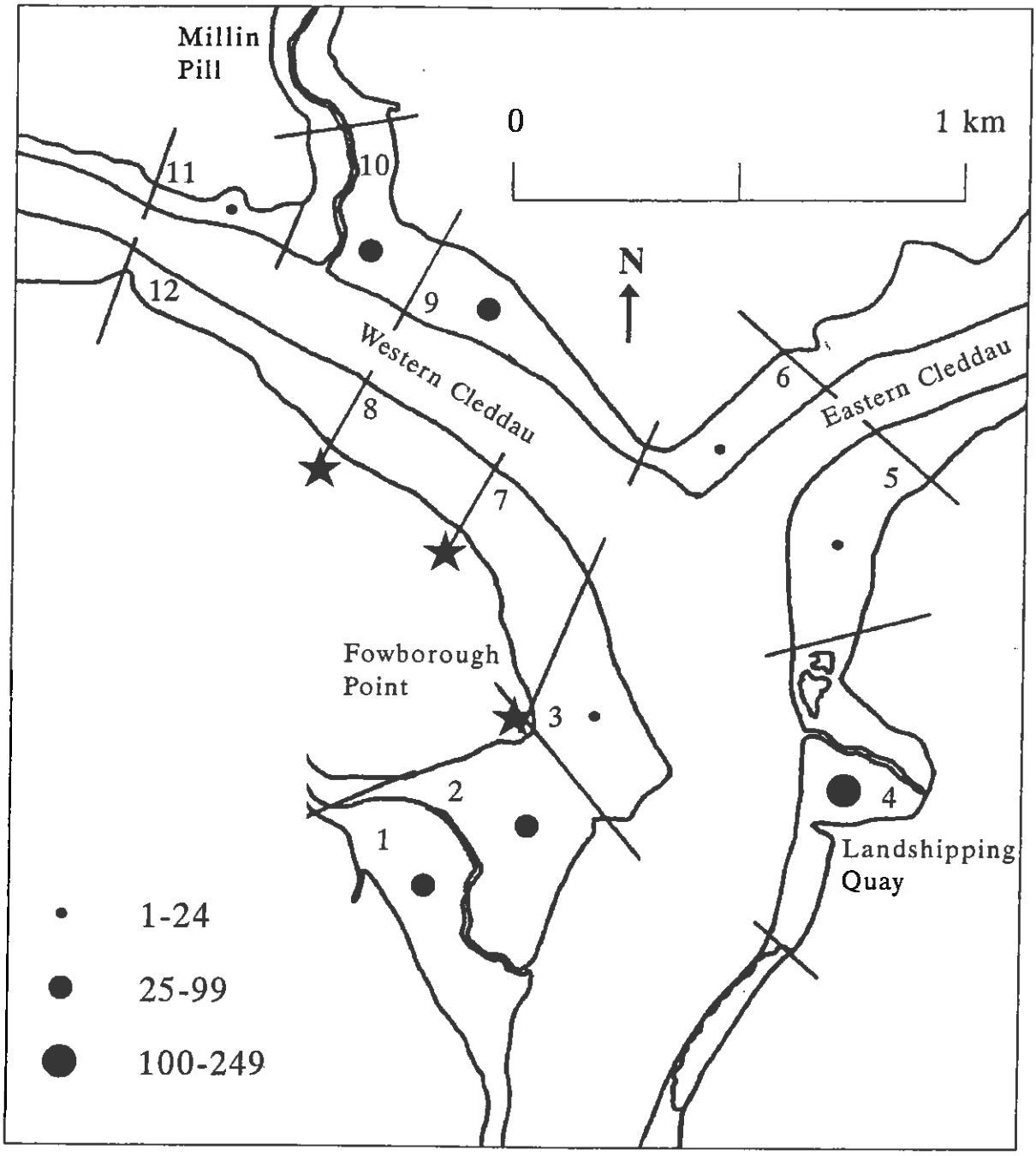

Figure 3.1.8 The distribution of feeding Wigeon at Upper Cleddau during November and December 1996. The average number of birds per tidal cycle is depicted.

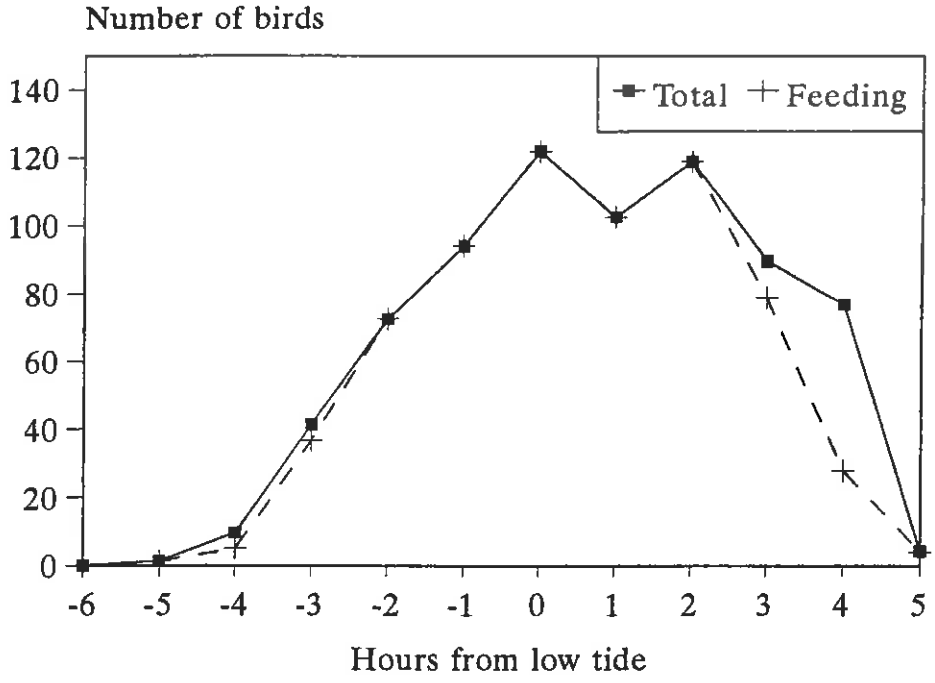

Figure 3.2.1 The mean number of Dunlin present and the mean number feeding during each hour of the tidal cycle at Angle Bay.

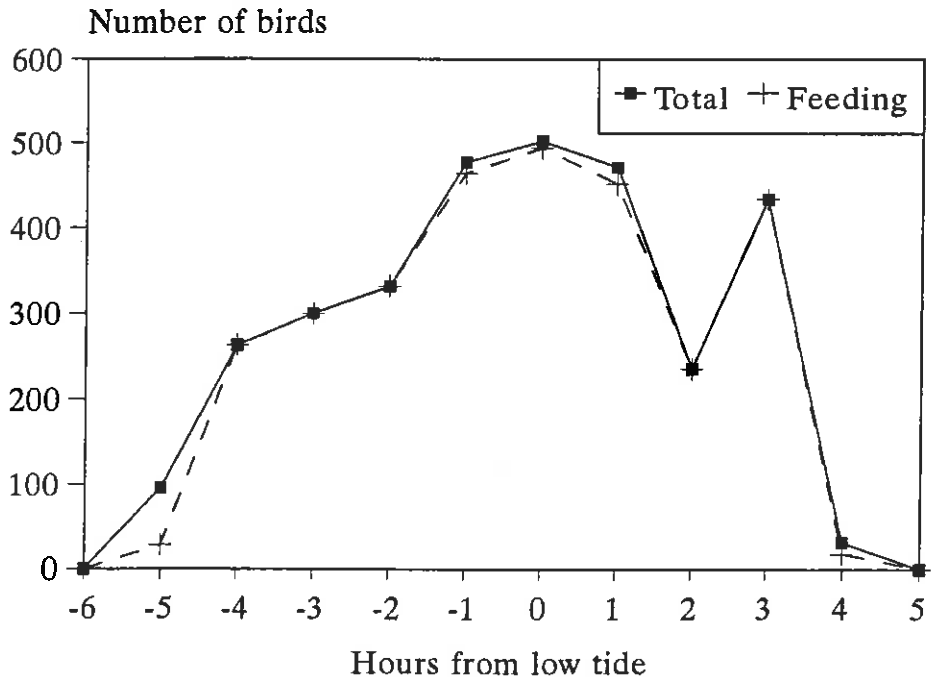

Figure 3.2.2 The mean number of Dunlin present and the mean number feeding during each hour of the tidal cycle at Pembroke River.

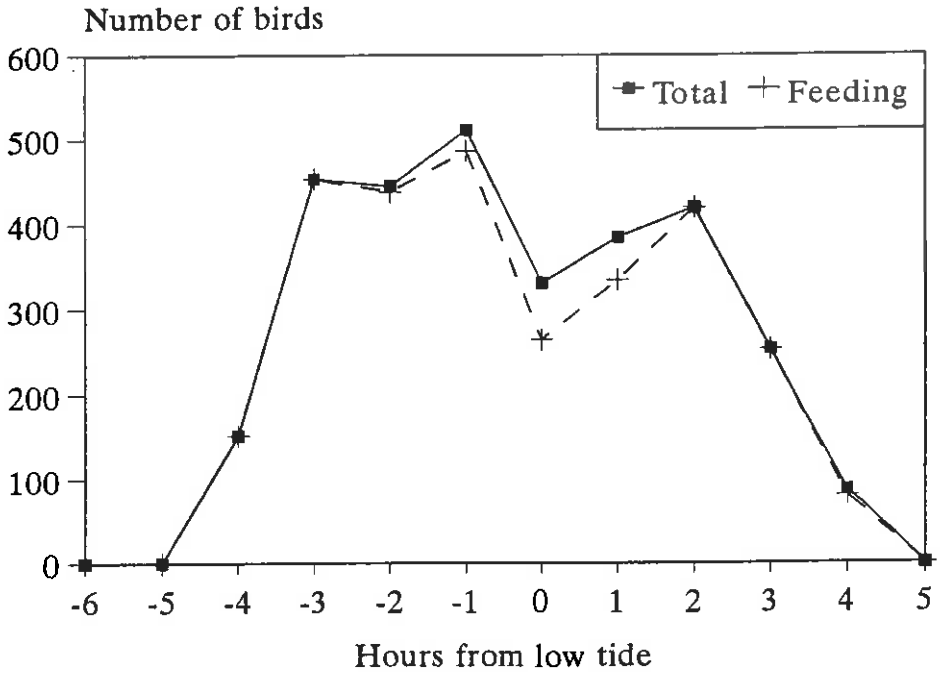

Figure 3.2.3 The mean number of Dunlin present and the mean number feeding during each hour of the tidal cycle at Carew/Cresswell.

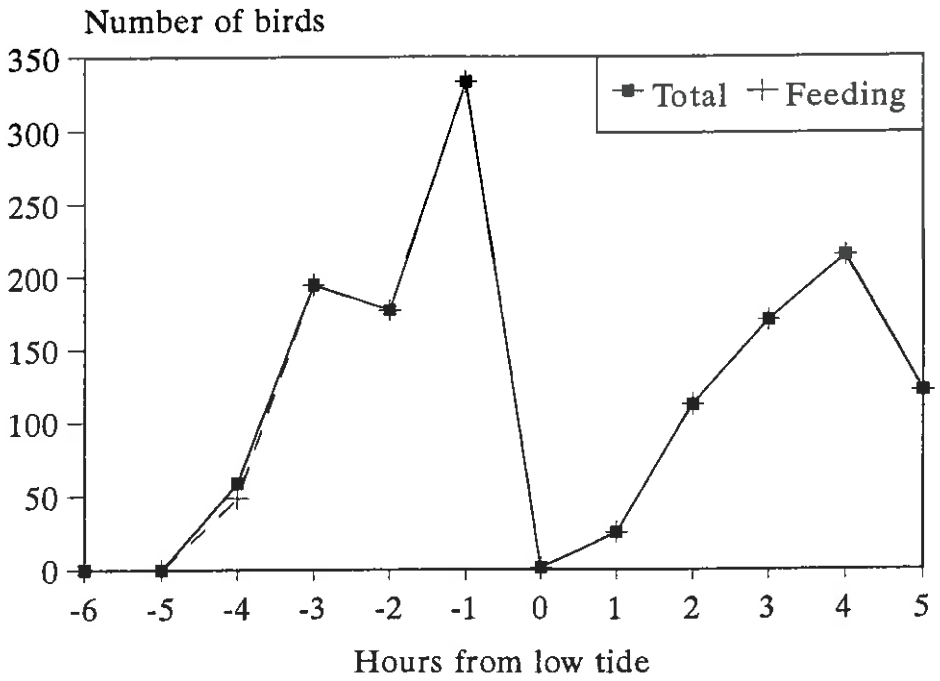

Figure 3.2.4 The mean number of Dunlin present and the mean number feeding during each hour of the tidal cycle at Upper Cleddau.

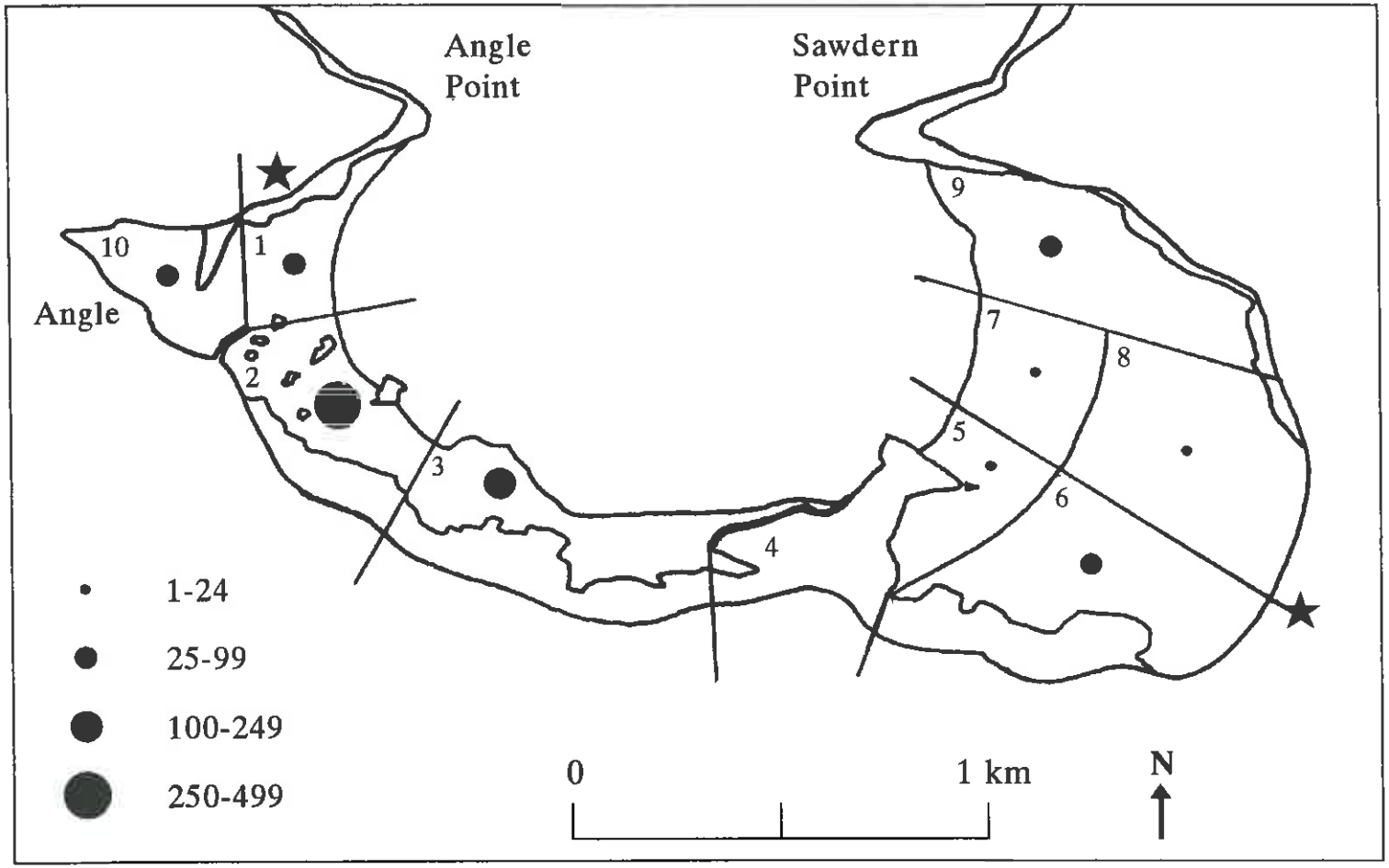

Figure 3.2.5 The distribution of feeding Dunlin at Angle Bay during November and December 1996. The average number of bird hours per tidal cycle is depicted.

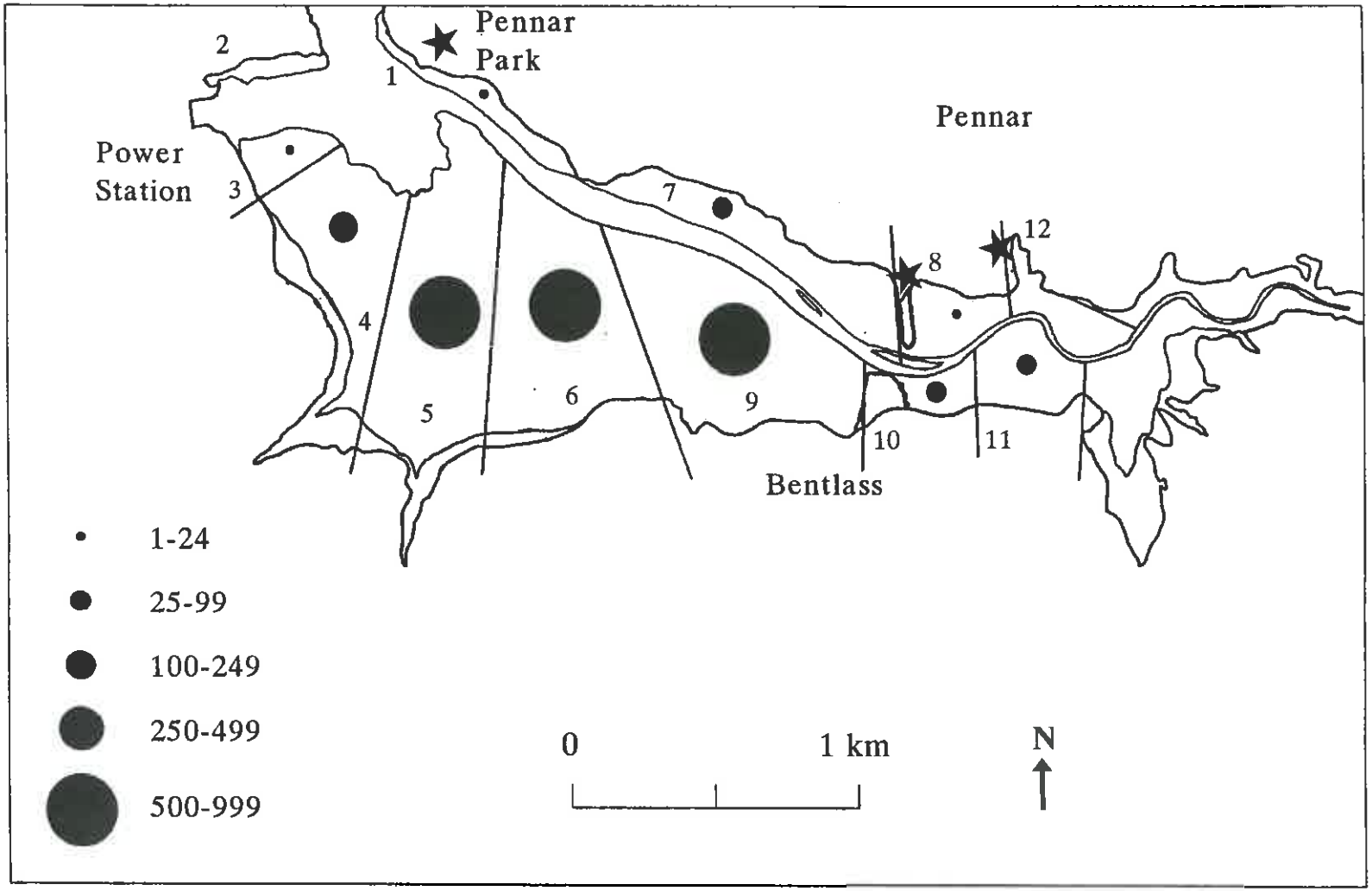

Figure 3.2.6 The distribution of feeding Dunlin at Pembroke River during November and December 1996. The average number of bird hours per tidal cycle is depicted.

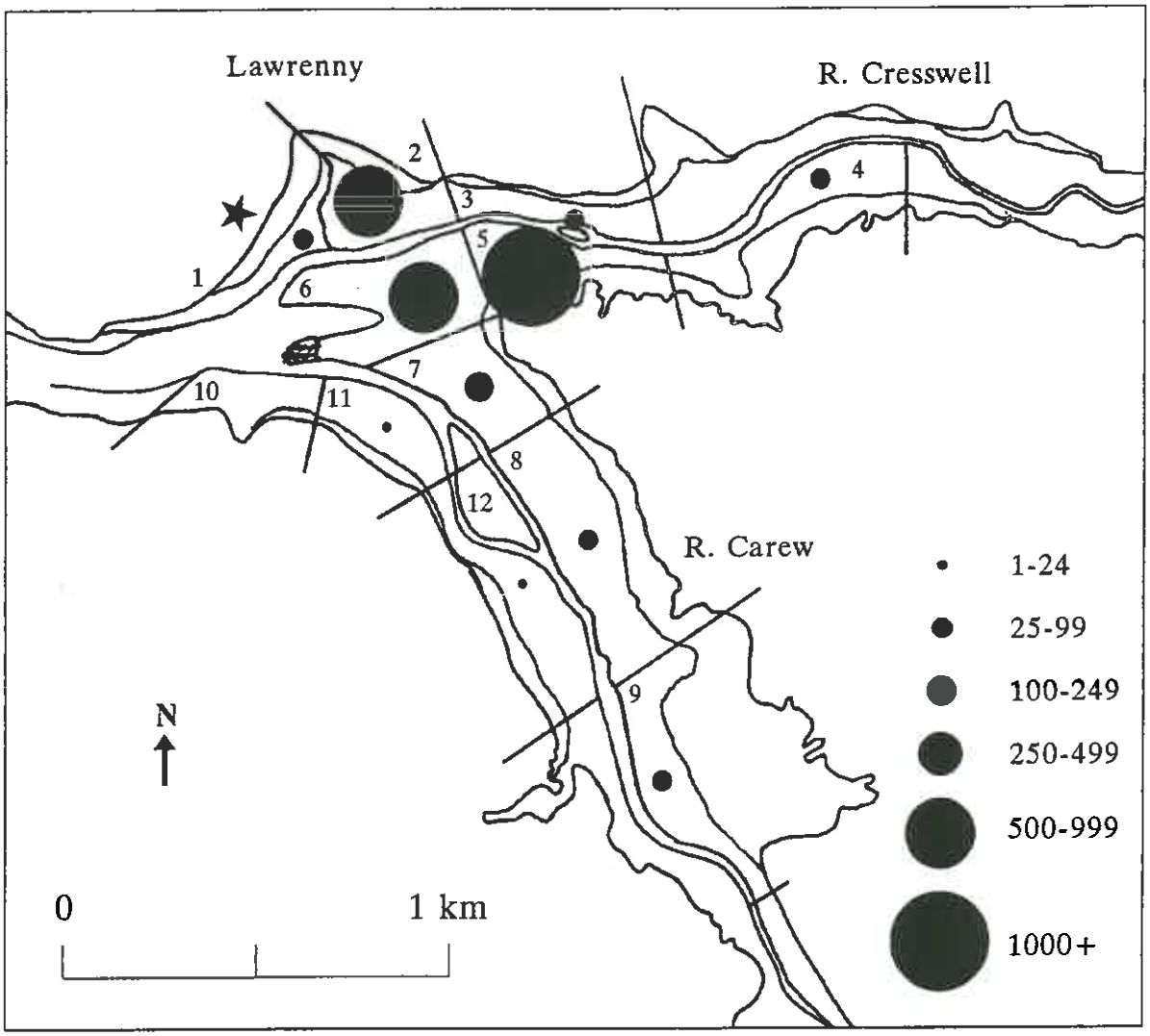

Figure 3.2.7 The distribution of feeding Dunlin at Carew/Cresswell during November and December 1996. The average number of bird hours per tidal cycle is depicted.

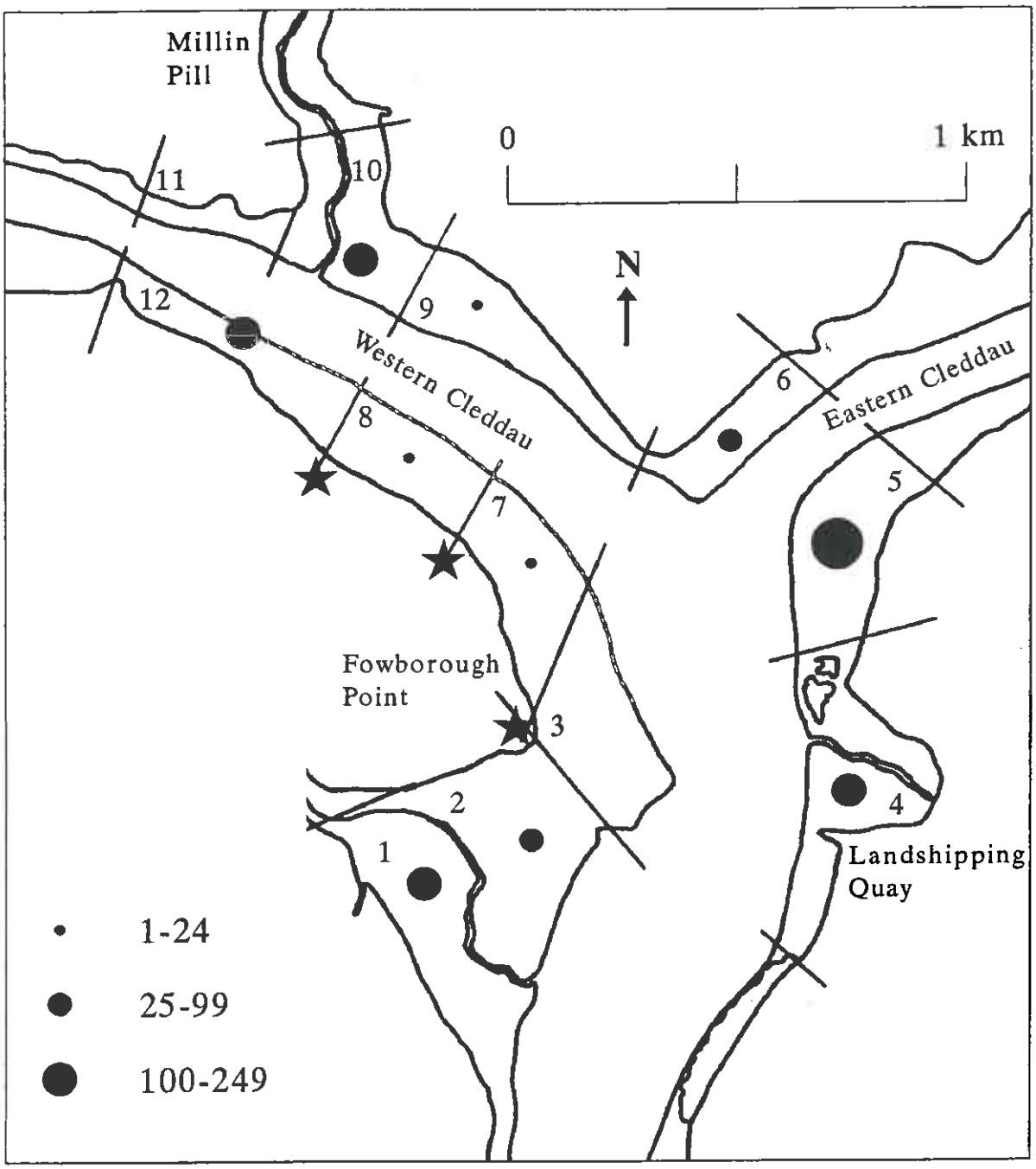

Figure 3.2.8 The distribution of feeding Dunlin at Upper Cleddau during November and December 1996. The average number of bird hours per tidal cycle is depicted.