BTO Research Report No. 74

THE ROOSTING BEHAVIOUR OF WADERS AND WILDFOWL IN CARDIFF BAY

Report of work carried out by
The British Trust for Ornithology
under contract to
Cardiff Bay Development Corporation

Authors

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EXECUTIVE SUMMARY

1. The present study, commissioned and funded by Cardiff Bay Development Corporation, aims to examine the roosting behaviour of waders and wildfowl in Cardiff Bay. Intensive observations of high tide roosts were collected for the study and further information included, where possible, from work being undertaken by the BTO on the distribution of feeding birds. This latter work is also funded by CBDC.

2. The study was commissioned because of concern over the possible effects of the Phase 2 saltmarsh reclamation necessary for the creation of the proposed Hamadryad Community Park.

3. Several distinct roost sites were identified in Cardiff Bay. These were used by different species on different heights of high tide. The present study shows that a prediction can be made of the likely location of roosting flocks given the height of high tide.

4. Wildfowl species were found to roost predominantly on the open water and were thus considered unlikely to be affected by the proposed reclamation. Of all the wader species roosting in Cardiff Bay, Redshank were considered to be the one most likely to be affected by engineering proposals. The proposed saltmarsh reclamation and the continuing work on the Peripheral Distributor Road will result in the removal of both the most regularly used roost sites for this species. The reluctance of this species to leave Cardiff Bay at high tide is likely to increase the threat to the wintering Redshank population. If birds are unable to find suitable alternative roost sites, permanent damage to the population could occur. Several suggestions for reducing the impact of the proposed development on roosting Redshank are given. Populations of other wader species are not thought likely to be seriously affected by the proposed reclamation.

LIST OF FIGURES

1 INTRODUCTION

The Phase 2 development for the proposed Hamadryad Community Park and the Peripheral Distributor Road (PDR) would involve the reclamation of part of the Taff/Ely Site of Special Scientific Interest. In particular, a large area of saltmarsh in the vicinity of the Hamadryad Hospital and Windsor Esplanade would be lost. Parts of this area have long been known to be of importance for high tide roosts of waders and wildfowl during the winter months (eg. Hinsley 1984, Ferns 1987). Redshank, Dunlin and Curlew often roost in large numbers in the Windsor Esplanade saltmarsh, the size and position of each high tide roost depending on the height of the tide, the prevailing weather conditions and any disturbance from human activities or predators. Fieldwork carried out by the BTO in the area since 1989 as part of the ongoing ornithological studies related to the proposed Cardiff Bay Barrage suggested that certain areas of the estuary were favoured by roosting waders or wildfowl. However the studies concentrated on feeding birds and thus no quantitative assessment of the importance of each area could be extracted from that data set. The present study, commissioned by Cardiff Bay Development Corporation, aims to assess in more detail the importance of each roost site to waterfowl in Cardiff Bay and attempts to predict the impact of the Phase II work on waterfowl roosting behaviour in the area. This report does not include data on the importance of the saltmarsh for passerine species; such information can be found in Kalejta (1984).

The formation of communal roosts, either in mixed or single species flocks, is by far the most usual behaviour adopted by waders at high tide. On low neap tides, however, enough intertidal feeding grounds may remain exposed to allow certain species to feed throughout the high tide period. This situation occurs only infrequently in Cardiff Bay and generally birds are starting to form roosts well before high tide.

Communal roosting is not confined to waders, with many species in many bird families exhibiting similar forms of behaviour.

Ydenberg & Prins (1984) noted a strong correlation between social feeding and communal roosting across a range of bird families. This was particularly pronounced in species which fed in large mobile flocks, as is the case with many species of wader. At least four possible benefits of roosting communally have been suggested. Whitlock (1979) showed that windspeed was lower in the centre of a roosting Redshank flock than at its edges. The doubtful benefits of this to birds roosting at the edge of the flock and the fact that roosts are frequently linear rather than compact suggest that this is not the only reason for roosting in groups. The increased ability of large numbers of birds roosting together to detect approaching predators has also been suggested as a benefit of communal roosting (Bertram 1978). With more birds looking for potential predators, the vigilance of each bird can be lower, allowing more time for sleeping or preening. The commonly held theory that waders form large flocks in order to confuse avian predators seems unlikely since the highly visible aerial displays exhibited by many species prior to roosting are as likely to attract predators as to deter them. Lack (1966) suggested that roosts occur as birds undisturbed by predators return to the same site to rest. There is some evidence that the location of Dunlin roosts on the Severn change in relation to changes in the numbers of Peregrine Falcons in some areas (Clark, N.A., pers. obs.). A third possible benefit of communal roosts is that they may act as a way of regulating numbers of birds using an area. Wynne-Edwards (1962) suggested that birds at communal roosts are able to assess their own numbers and emigration may occur away from areas where the population is too high. As Hale (1980) pointed out, however, this assumes that birds are aware of the numbers of birds roosting in other areas but using the same feeding grounds. A final possible explanation of the advantages of communal roosting (and one that is widely held) is that roosts act as 'information centres'. By following experienced birds out of the roost to good feeding sites, less experienced birds, such as immatures, may find such productive areas more easily (Ward & Zahavi, 1973). The true reason for the evolution of communal roosting is most likely to lie in a combination of some or all of the above possible explanations.

The importance of secure roost sites should not be underestimated. Indeed, the availability of suitable roosting areas can be more important than the availability of food in determining the numbers of birds able to use an area. On an area of the Forth Estuary, the creation of lagoons for tipping ash from a local power station allowed birds which previously only fed in the area to roost there also. Numbers of birds feeding in the area increased dramatically as a result of the fortuitous creation of a new secure roost (Furness, 1973). Unfortunately, there appear to be no documented accounts of the effects on bird numbers of roost site destruction.

2 METHODS

Daytime observations of 28 high tide roosts were carried out in Cardiff Bay between 14th August 1990 and 28th February 1991, although only roosts between 10th January and 28th February were observed in detail for the present study. In addition, five count sheets from the winter 1989/90 were found to contain sufficient information to be included into the data set for some analyses, bringing the total number of roosts observed to 33. Of these, 21 observations were of birds roosting on spring tides and 12 on neap tides. Observation dates were chosen to yield information from as wide a range of high tides as possible (from 8.15m to 13.72m).

Eight high tide roosts were observed at night. These were all on spring tides, although several visits to the study area at night during neap tides also gave some indication of where birds were roosting.

During each observation, weather conditions and disturbance factors were noted and an assessment made of whether these affected the location of roosts. Where possible, the position of the roosts were monitored every twenty minutes. Observations started when birds began to form high tide roosts, continued through the high tide period and ceased when roosts started to break up as birds left for recently uncovered feeding grounds. The height of the tide was calculated for each twenty-minute observation. This was done by obtaining a measurement of the height of high tide from the accurate data set kept by the Harbour Master in Cardiff Docks. The height of the tide at different times before and after high tide was calculated using Admiralty conversion charts. In this way it was possible to determine where birds were roosting at different heights of tide. This method was not suitable for night roost observations, since finding the location of the birds inevitably involved disturbing the roost.

Particular attention was paid to roosts of Redshank, Curlew, Dunlin and Teal, since previous fieldwork by the BTO suggested

that these species frequently roost in the area covered by the Phase 2 land claim.

For the purposes of the present report, neap high tides are considered to be those of less than 10.85m in height, spring tides are those over 10.85m. A tide height of 10.85m lies half way between Mean High Water Neaps and Mean High Water Springs in Cardiff Bay.

3 RESULTS

Observations of roosts in Cardiff Bay over the winter 1990/91 showed that eight sites were regularly used by roosting birds at high tide (Figure 1). A brief description of these areas and the species observed roosting in each is followed by more detailed species accounts. Areas follow those shown in Figure 1.

3.1 Roost Sites

Area A The upper mudflats along the southern edge of the Windsor Esplanade saltmarsh. This area was used mainly as a feeding area by Redshank and Dunlin on rising and falling tides and as a roost site, particularly by Redshank, on neap high tides which did not cover this area. This area does not include the muddy banks of the old South Glamorgan Canal. The most frequent forms of disturbance in this area were from the occasional wildfowler and from avian predators, usually Peregrines (although Merlins were noted on several occasions).

Area B The banks of the South Glamorgan Canal and the saltmarsh to the east of the canal mouth as far as the large creek adjacent to the western end of Windsor Esplanade. The lower limits of this area were the first part of the Windsor Esplanade saltmarsh to become covered by an advancing tide. The area was used as a roost site particularly by Redshank and Dunlin, but also by smaller numbers of Teal, Shelduck and Curlew. Redshank usually formed roosts in this area even when high spring tides later forced them to move to another roost site. The birds often returned to this site when it became uncovered again by the retreating tide.

Occasional disturbance from wildfowlers and dogs was noted. More regular disturbance arose from engineering works associated with the Phase 1 land claim.

Area C The saltmarsh east of Area B as far as the artificially raised ground adjacent to the eastern end of Windsor Esplanade.

This area was most often used by roosting Curlew, although Redshank displaced by the rising tide from Area B often moved into this area, which is higher and so covered less often, or later, than the previous area. Although difficult to find at high tide, Grey Plover probably used this area on most tides. A small flock of Shelduck was often found roosting on this area, which appeared comparatively free from disturbance.

Area D The old wooden jetty adjacent to the Graving Docks. This Redshank roost site was used on high spring tides when birds were disturbed from their more usual area (Area F) or occasionally at night. The jetty is much the same type of structure as those which used to lie to the north of Ferry Road on the western shore of the Bay and which formed the usual roost site for Redshank on high spring tides. However, heavy disturbance, at least during the day, limits the amount of use made of the site by roosting birds. Human activities in the area around Pierhead are responsible for most of this disturbance. The importance to Redshank of this area at night is difficult to assess from the data gathered for the present study (see Species Accounts).

Area E The artificially raised ground to the eastern end of the Windsor Esplanade saltmarsh. Redshank often used this area as a temporary roost site but rarely stayed at the site over the whole high tide period. Curlew, Grey Plover, Dunlin and Shelduck all roosted on this area at irregular intervals. The area was often disturbed by dogs and their owners and, on several occasions, by bird-watchers.

Area F The embankment of the Peripheral Distributor Road on the western shore of the Bay. This recently constructed site has partly taken the place of the old wooden jetties which were removed from this area of the Bay in 1989. It was found to be the most usual roost site for Redshank on spring high tides during the winter 1990/91. These birds roosted around the sides or tip of the embankment or on the waste ground to the north of site. Curlew and Shelduck often roosted on the top of the structure, although they were very prone to disturbance in this area.

Occasionally, Turnstone, Lapwing and Grey Plover joined the Redshank roost but very few Dunlin roosted at this site. At night, several observations suggested that the waste ground to the north of the construction works and even areas around the new housing development inland of this area, were used by roosting Redshank.

Disturbance was caused primarily by building work and human disturbance and large numbers of Curlew and Shelduck were only found at times when no major construction work was being carried out on the site. Redshank roosting along the sides of the embankment or on the lower ground at its tip were less prone to disturbance. However, as further work is carried out on this site, roosts will suffer increasing disturbance and on completion of building works, the area is likely to be unsuitable for roosting.

Area G The saltmarsh to the west of the South Glamorgan canal was used as a roost predominantly by Lapwing, although it is likely that some Redshank also roosted in the area on certain tides. Wildfowling was thought to be the most frequent form of disturbance before work started on the Phase 1 land claim.

Area H The rocky boulder strip adjacent to Ferry Road. This area formed the usual high tide roost for Turnstone. On the rare occasions when the tide covered this area completely, Turnstone either moved to the tip of the PDR embankment or left the Bay altogether. This species is particularly tolerant of human activities and roosting flocks were only disturbed infrequently despite the heavy use made of the adjacent area. Some observations suggested that when birds were disturbed, they flew to another site somewhere up the Ely. Small numbers of Redshank could often be found feeding or roosting on exposed mud just offshore from this area on certain neap tides. Large numbers of Dunlin were also recorded on some occasions feeding offshore from this area at high tide.

The Open Water At high tide, the majority of the Shelduck, Teal and Mallard roosted on the open water. Rafts of Teal and Mallard roosted in the central areas of the Bay, with a preference for the areas just off Area C, whilst Shelduck were more dispersed and tended not to form large flocks. Smaller groups of Teal and Mallard could be found roosting on, or just offshore of, virtually any part of the Bay's shore. The enormous evening gull roost (over 10,000 birds) favoured central areas of the bay. The use of watercraft, particularly speed boats, was responsible for most of the disturbance noted on the open water.

Other Roosts within Cardiff Bay Roost sites noted in previous winters, but not during the present study, include Penarth Moors (now covered by tipping but once the most important roost site in the area) and various areas in Cardiff Docks (Ferns, 1987).

Roosts outside Cardiff Bay Several species which feed in Cardiff Bay at low tide are forced to leave the Bay on the highest spring tides. Curlew and Oystercatcher left for the large roost of these species on Peterstone Great Wharf, east of the River Rhymney. The usual roost site for Dunlin feeding in Cardiff Bay is at Sully Island, some three miles west of the Bay. In recent years, however, Dunlin have been seen flying across the Severn to roost at Clevedon (Clark, 1990).

3.2 Species Accounts

3.2.1 Shelduck

On neap high tides, Shelduck were widely distributed throughout the Bay. The majority of birds roosted on the open water, although some birds were usually present on any exposed mud, particularly adjacent to Ferry Road. A concentration of around fifty birds often roosted at the eastern end of Area C. Very few birds were found to use the other roost areas on neap tides although there were odd individuals scattered along the whole

perimeter of the Windsor Esplanade saltmarsh. Birds roosting on the open water tended to remain fairly close inshore, starting to feed as the areas over which they were roosting became exposed by the retreating tide. However, if there was excessive disturbance along the banks of the estuary birds tended to move out offshore.

Spring tides over 12.5m forced birds roosting on saltmarsh to find an alternative site. When such tides coincided with weekends or were early in the morning or late in the afternoon, up to 100 birds (around 25% of the total population in the Bay) roosted on the top of the PDR embankment (Area F). This area is some 5m above the level of the surrounding saltmarshes and is heavily disturbed whilst contruction work is taking place on weekdays. Figure 2 shows the distribution of roosting flocks of over fifty birds, which were found in only two locations.

It is likely that the main advantage to birds of roosting on dry land rather than the safer areas of open water is that they can preen feathers they cannot reach whilst afloat. Several heavily oiled Shelduck appeared in Cardiff Bay after the large oil spill from Llanwern Steel Works on 11th february 1991. Most of these birds were seen roosting on the top of the PDR embankment. Since these birds were more likely to spend the high tide period preening, this observation provides some evidence that the habit of roosting on dry land is associated with ease of preening. The importance of this behaviour is not known, although there are large areas of saltmarsh exposed on neap tides which are not occupied by roosting Shelduck while many birds roost on the open water.

3.2.2 Teal

Unusually high numbers of Teal were present in Cardiff Bay after the severe weather early in 1991, with the total approaching 500 in February. This species roosts and feeds during the day in Cardiff Bay on mudflats and in saltmarshes, although nocturnal feeding probably accounts for the bulk of feeding effort in this

species. The importance of night feeding has been demonstrated in several estuaries (eg. Clark et al, 1990).

At low tide, Teal are widely distributed throughout Cardiff Bay. Birds appear to feed sporadically but spend the greater part of the day roosting. The most important low tide roosts lie along the steep banks of the deep channels of the River Taff. It was not possible to assess accurately the importance of the Windsor Esplanade saltmarsh as a low tide roost site. Several walks through the area flushed relatively few Teal but numbers counted at low tide on mudlfats and open water were considerably lower than those counted on high spring tides, when all birds were easily visible. It is likely that many Teal roost at low tide in creeks on the mudflats where they are not visible and that at least some birds move to the outermost intertidal areas, around the mouth of the Bay. Observations of large numbers of Teal following the advancing tide into the Bay suggest that a proportion of the population roost on the open water outside the study area at low tide.

Observations from previous years showed that large numbers of Teal roosted on neap high tides in the South Glamorgan Canal (Ferns, 1987) and on high spring tides on the open water. During the period of intensive roost observation (10th January to 28th February), no large concentrations of Teal were observed roosting in the South Glamorgan Canal, although small parties were present. At night, however, large numbers of Teal were heard calling in this area, although an accurate assessment of the numbers present was not possible. This difference was probably due to the heavy disturbance during the day associated with the Phase 1 land claim. A roost of around fifty birds was present in the creek at the eastern end of Area B and smaller groups were noted along the tideline in Area C on neap tides. However the majority of birds roosted on the open water, usually just offshore of Area C. Small parties, generally of less than ten birds, could be found roosting on exposed shores throughout the Bay. On high spring tides, most birds roosted on the open water, although a concentration of up to fifty birds was sometimes present in Area E (Figure 3).

3.2.3 Grey Plover

The small population of Grey Plover wintering in Cardiff Bay rose to around 25 birds early in 1991. At high water on all except high spring tides, these birds roosted at the eastern end of Area C, usually in association with the roosting flock of Curlew. On high tides over 12.5m, birds either roosted on exposed areas of Area E or left the Bay, although a few birds could often be found roosting with Redshank at the end of the PDR embankment. One observation of a flock of around fifty birds suggested that, on occasion, the population feeding in Cardiff Bay was augmented at high tide by birds coming in to roost from surrounding areas, almost certainly the Rhymney Estuary to the east.

3.2.4 Lapwing

The wintering population of Lapwing in Cardiff Bay peaked at around 100 birds during the winter 1990/91. These birds roosted in a single flock during daylight hours and probably left the area at night for feeding grounds elsewhere. At low tide, the majority of birds were found roosting on mudflats beside the River Taff, west of the Hamadryad Hospital. On neap tides, birds roosted at high water in the area of saltmarsh west of the South Glamorgan Canal (Area G). Lapwing was the only species present in Cardiff Bay found to be roosting predominantly in this area. Birds were forced to leave this area by tides higher than 12m, when they moved either to the waste ground just to the north of Area F or, more usually, left the Bay altogether. Birds were always seen to leave the Bay in a northward direction and it was thought that an alternative roost site lay further up the River Taff, possibly on the small area of raised ground just north of the Clarence Bridge. On one occasion, 40 birds were seen roosting on Area E.

This species appeared to spend a high proportion of the high tide period on the wing, suggesting birds were particularly prone to disturbance.

3.2.5 Dunlin

There is a complex pattern of movements of Dunlin between the Rhymney Estuary and Cardiff Bay (Worrall, 1988; Evans et al, 1990). Birds tend to feed in Cardiff Bay on advancing and retreating tides and move to the Rhymney at low tide. The usual roost site for these birds is at Sully Island, three miles west of Cardiff Bay, although in recent years it is has been shown that birds fly across the Severn to roost at Clevedon on some occasions (Clark, 1990). Birds roosting in Cardiff Bay at high tide are those which entered the Bay some hours earlier to feed after being displaced by the advancing tide from the Rhymney. The numbers of birds adopting this feeding strategy fluctuated greatly. It is thus very difficult to assess the importance of Cardiff Bay as a high tide roost area for Dunlin.

Dunlin only roosted in any numbers in Cardiff Bay on high tides of less than 12m in height, although birds were seen roosting before being displaced by higher tides. Birds generally roosted in a single flock. The most usual roost site was found to be Area B, with the banks of the South Glamorgan Canal and the creek at the eastern end of the area being used by a high proportion of birds. Birds tended to roost initially on the mudbanks of the mouth of the canal, being pushed further up the canal as the tide rose. The extent to which birds seemed willing to move up the canal depended on the levels of disturbance from the works associated with the Phase 1 land claim. At night, large numbers of Dunlin were noted on several occasions roosting as far up the canal as the Phase 1 works.

As the height of the tide approached and exceeded 12m birds either moved to the higher eastern end of Area C or, more usually, left the Bay altogether. Parties of birds could be seen leaving the Bay when the height of the tide was as low as 10m. There were no observations of large numbers of Dunlin roosting on the western shore of the Bay. Figure 4 shows the location of Dunlin roosts at high tides of different heights. Only one roost was observed on

Area A although this area was heavily used on low neap tides as a site where feeding could continue throughout the high tide period.

In the extremely hard weather in early February 1991, up to 2,000 Dunlin fed and roosted at high tide along the banks of the South Glamorgan Canal and along the edge of the saltmarsh to the east of the canal (Area B), the creek at the eastern end of this area providing shelter for a particularly high concentration of birds. Numbers of Dunlin roosting in Cardiff Bay before and after the high numbers associated with the hard weather ranged from just one or two individuals roosting with Redshank on spring high tides to around 500 birds on lower neap tides. Figure 5 shows the numbers of Dunlin roosting in Cardiff Bay during the intensive study period (10th January to 28th February 1991). The exact location of these roosts is shown in Figure 6.

On neap tides lower than 9m, Dunlin continued to feed on exposed mud throughout the high tide period. Area A and any exposed mud along Ferry Road on the western shore of the Bay were the most usual high tide feeding sites.

3.2.6 Curlew

Between 60 and 120 Curlew roosted in a single flock in Cardiff Bay on most high tides. Curlew began to form roosts earlier than any other species in Cardiff Bay. A sub-roost began to form on the open mudflats just south of the Windsor Esplanade saltmarsh up to three hours before high tide. Sub-roosts formed earlier on neap tides than spring tides. As the tide advanced, birds were pushed up into the Windsor Esplanade saltmarsh. On high tides up to around 11m, the creek at the eastern end of Area B was the most regularly used site. As the tide rose above 11m, birds tended to move towards the eastern end of Area C. When birds were displaced from there by tides over 12.5m, Curlew either roosted on top of the PDR embankment (Area F) or, if this area was disturbed, left the Bay altogether, probably for the large Curlew roost on Peterstone Great Wharf.

Figure 7 shows the location of high tide roosts of Curlew on tides of different heights. Curlew tended to roost well inside the saltmarsh, where they were extremely difficult to count. This species rarely roosted in the South Glamorgan Canal.

3.2.7 Redshank

This species is thought to be that most at risk from the Phase 2 land claim because of its known preference for roosting, when possible, along the banks of the South Glamorgan Canal and along the edge of the saltmarsh to the east of the canal.

Numbers of Redshank feeding and roosting in Cardiff Bay remained at a fairly constant level of around 350 birds until the cold weather of early February 1991 (Figure 8). After this, numbers declined to around 200 birds by the end of February. The Cardiff Bay population of Redshank is known to be discrete from that feeding and roosting at the Rhymney. Ongoing work by the BTO, using observations of dye-marked and colour-ringed birds, has shown that Redshank very rarely leave Cardiff Bay, either to feed or to roost. All other wader species leave the Bay regularly, either to find a roost on a particularly high tide (eg. Curlew, Dunlin, Lapwing) or to feed elsewhere (eg. Dunlin, Oystercatcher, Turnstone). The extreme measures taken by Redshank to remain in Cardiff Bay during the high tide period, which include roosting on the open water, suggest that this species requires a roost site in Cardiff Bay near its feeding areas. This species has remained in the Bay despite the destruction of the traditional spring high tide roost site, on the old wooden jetties which lay just north of Ferry Road.

Birds almost always roosted in a single flock. Figure 9 shows the distribution of the Redshank roosting flock on different heights of high tide. On extremely low neap high tides, birds tended to roost and feed on Area A, with smaller numbers feeding on any exposed mud adjacent to Ferry Road. On higher tides, up to around 11m, birds roosted on the banks of the South Glamorgan Canal and in the saltmarsh just to the east of the canal (Area B). The

creek at the eastern end of Area B often held a large proportion of the roosting flock. If tides exceeded 11m, birds began to move to the higher saltmarsh at the eastern end of Area C. As this became covered on tides over 12m birds either moved onto the higher tipped ground in Area E or, more usually, to the PDR embankment (Area F). Area E was seen to be used also on neap tides when there was excessive disturbance around the South Glamorgan Canal. The PDR embankment seems to be the preferred high spring tide roost site, with few observations of birds roosting on the old wooden jetties in Area D, probably due to disturbance. This latter site was observed to attract roosts only when the PDR area was heavily disturbed or when high tide coincided with dusk. This strongly suggests that disturbance factors play a larger part in roost site selection than does the nature of the roost site itself. During the period when the old wooden jetties off Ferry Road were being dismantled and before the construction of the PDR embankment, Redshank were observed roosting on the open water, along the River Ely and, on occasion, in Cardiff Docks. These are undoubtedly sub-optimal sites where birds are subject to high levels of disturbance. The amount of energy expended in flying from one roost site to another may be more than birds can afford and sub-optimal roosting may increase mortality in hard weather.

Area B (which forms part of the area to be claimed by the Phase 2 development) was found to be more important for Redshank than just as a high tide roost on neap and low spring high tides. Figure 10 shows that even on high spring tides which completely inundate Area B, a high proportion of roosts use the area before and after high tide itself. The mouth of the South Glamorgan Canal, which was one of the last areas of mudflat to be covered by an advancing tide, concentrated birds and acted as a site where roosts could form. As spring high tides covered the area, roosts moved elsewhere but usually returned to the area after the tide had retreated to uncover the saltmarsh there. Virtually all Redshank roosts, on all heights of high tide, were found to use Area B during some part of the high tide period (for the purposes of this study, 100 minutes either side of high tide), and usually for as

much time as the area was uncovered. The area thus assumes an importance which would not be apparent from observations made at high tide alone. The fidelity shown by Redshank to this area strongly suggests that this is the most preferred roost site for this species in Cardiff Bay.

Evidence that night high tide roosts may differ from those used during the day comes from several observations of the main Redshank flock roosting around the muddy puddles on the construction site to the north west of the PDR embankment. These observations were all made on high spring tides. This area was not used during the day, presumably because of the high levels of disturbance associated with the building work. The location of night roosts on neap tides was possible on only one occasion, when birds were ween to be roosting further up the South Glamorgan Canal than was observed during the day. Birds were heard calling from the vicinity of the mouth of the South Glamorgan Canal on several occasions. The distribution of day and night roosts is shown in Figure 11.

During the period of intensive observation, particular attention was paid to the location of Redshank roosts. Observations every 20 minutes of the location of the roost on different heights of tide (advancing and receding as well as high tide itself) were pooled, with both spring and neap tides included, to give an indication of the percentage use of each area on different heights of tide during the period of intensive observation. A total of 106 day-time observations were included. Figure 12 shows that, on the dates on which observations were carried out, Redshank were always seen roosting in Area B when the sea level in Cardiff Bay was between 8m and 9m, and that when the sea level rose above 13m, the birds were always observed roosting on Area F. Area A was not included as a high proportion of birds using this area were feeding.

This method of data presentation should not be used to assess quantitatively the relative importance of each area for several reasons. Firstly there was considerable variation in the number

of observations made at each 0.5m tide interval since observation dates included more spring cycles than neap cycles. Figure 13 shows the proportion of the total observations which were made in each tide interval. The low proportion of observations made during the extremes in tide heights need to be borne in mind in the interpretation of Figure 12. It should also be remembered that during the period of intensive roost study, there was frequent disturbance in the region of the South Glamorgan Canal from the Phase 1 engineering works, and that the effects of disturbance from other sources are also reflected in the results. A particularly severe spell of weather dominated early February and could have influenced the location of roosts, although this is not thought to be the case as during this period, Redshank roosted in the 'expected' areas for the relevant tide height

Despite these caveats, Figure 12 is thought to provide a reasonable assessment of the pattern of usage of the different areas at different heights of sea level by the roosting Redshank flock. An attempt at a more quantitative approach would be unwise given the caveats mentioned above.

3.2.8 Other Species

The Cardiff Bay population of Mallard reached around 100 birds during the early part of 1991. These birds behaved in much the same way as Teal although probably a higher proportion roosted on the open water at high tide. No concentrations of birds were noted in the vicinity of the Phase 2 land claim area.

Up to 30 Oystercatcher roosted irregularly in Cardiff Bay on tides less than 12m in height. On such tides, the birds roosted at the very edge of the Windsor Esplanade saltmarsh in both Areas B and C. Oystercatcher entered Cardiff Bay to continue feeding once Orchard Ledges became covered by the advancing tide. The usual roost site of these birds is either on Peterstone Great Wharf to the east or, possibly, Sully Island to the West.

Between 20 and 80 Turnstone regularly roosted and fed in Cardiff Bay at high tide. The strip of boulders along Ferry Road (Area H) was used on all but the highest spring tides, when birds either roosted on the PDR embankment or flew to another, as yet unknown, roost site up the River Ely. This species was not observed roosting away from the western shore of the Bay.

4 DISCUSSION AND CONCLUSIONS

The present study has demonstrated the presence of a number of distinct high tide roost sites in Cardiff Bay which were found to be used in a predictable way. This confirms the general pattern of roosting which had been subjectively observed during the BTO's fieldwork in Cardiff Bay during the winters 1989/90 and 1990/91, although these studies are designed to yield data primarily on feeding birds of the open mudflats. The importance of some areas has been highlighted by the present study. The following assessment of the likely impacts of the proposed development work in Cardiff Bay is based solely on the predicted effects of land claim. Such side-effects as noise disturbance and changes in the sedimentary regime of the area are outside the scope of this report.

The effects of the proposed Phase 2 land claim and the continuation of the PDR project are likely to be greatest on Redshank, which the present study has confirmed to be the species which most regularly uses the areas likely to be affected. Dunlin regularly roost along the banks of the South Glamorgan Canal and adjacent saltmarsh, but suitable roost sites are known to exist for this species outside Cardiff Bay and birds often choose to leave the area at high tide when suitable roost sites are still available in the Bay. Curlew are shown by the present study to roost more often on eastern areas of the Windsor Esplanade saltmarsh than in areas likely to be affected by the Phase 2 development. Of the wildfowl species, Teal were shown to roost in the South Glamorgan Canal less often, and in smaller numbers, than previous work suggested, although the effects of disturbance from the Phase 1 development may be at least partly responsible for a change in roosting behaviour. No large concentrations of Shelduck were observed in the Phase 2 area, although considerable numbers often roosted on top of the PDR embankment. This species has been increasing in Cardiff Bay for several years in the absence of this roost site and it is thought unlikely that the proposed developments will affect Shelduck numbers in Cardiff Bay.

The use of the area around the South Glamorgan Canal made by Redshank assumes greater importance when it is appreciated that even during tidal cycles which inundate the area at high tide, roosting will still occur before and after inundation. Thus this area is found to be used during at least some part of almost every high tide cycle. The importance of the creek just east of the mouth of the South Glamorgan Canal was found to rival that of the canal mouth itself. Both areas lie within the Phase 2 land claim area. The fact that birds were shown to move to the eastern areas of the Windsor Esplanade sltmarsh only when displaced by the rising tide further illustrates the attraction of the South Glamorgan Canal for roosting Redshank.

The present study has also demonstrated the existence of a new redshank roost site. The PDR embankment on the western shore of the Bay was found to be an important roost site for Redshank on high spring tides and has provided a fortuitous, although temporary, replacement for the old wooden jetties which once occupied the same area. The high levels of disturbance in this area during contruction work make this a sub-optimal roost site and demonstrate the reluctance of Redshank to leave Cardiff Bay. This species is known to be extremely susceptible to periods of hard weather and the added energy expenditure needed to fly to roost sites on the Rhymney could affect survival during adverse conditions or could lead to a fall in the number of Redshank feeding in Cardiff Bay. The availability of suitable roost sites is thus of great importance. Although the proposed Phase 2 land claim and the building of the PDR will simultaneously remove the most regularly used neap and spring high tide Redshank roosts in Cardiff Bay, the effects of this development cannot be predicted. The long-term suitability of other roost sites used by this species at present is masked by the obvious preference for the area around the South Glamorgan Canal on lower tides and the PDR embankment on higher tides. However it is possible that some damage to the Cardiff Bay Redshank population could result in the absence of the provision of suitable alternatives. Such mitigating factors could include the provision of an artificial wader scrape on the eastern end of the Windsor Esplanade

saltmarsh, as suggested by Ferns (1987). Other possibilities include the provision of a floating platform or the provision of an island which is protected from disturbance by physical barriers such as deep channels. Such sites could include provision of a hide so that birds can be shown to the public.

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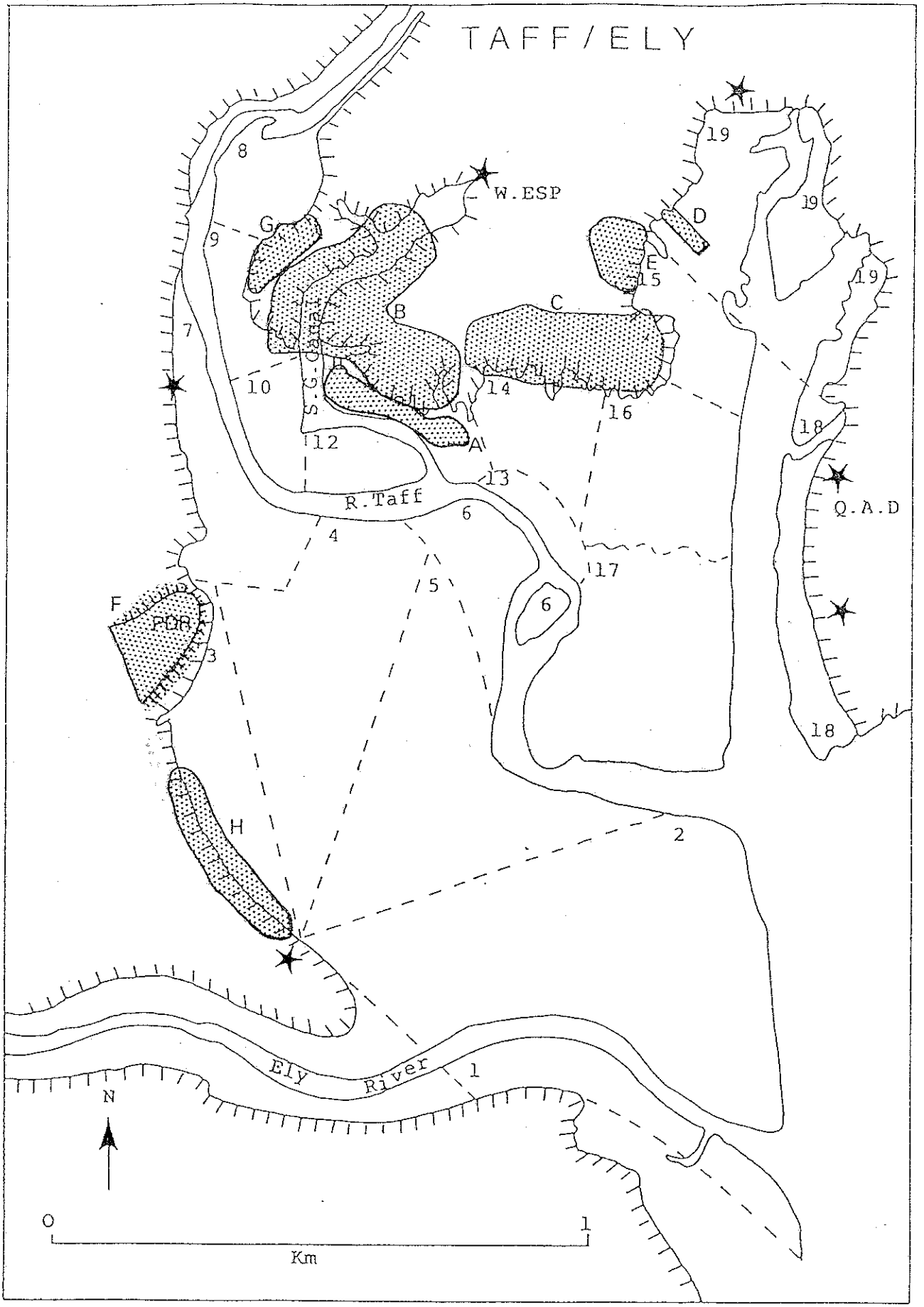


Figure 1 Roost sites identified in Cardiff Bay.
Stars denote observation points. Numbers refer to count areas used in ongoing fieldwork for CBDC.

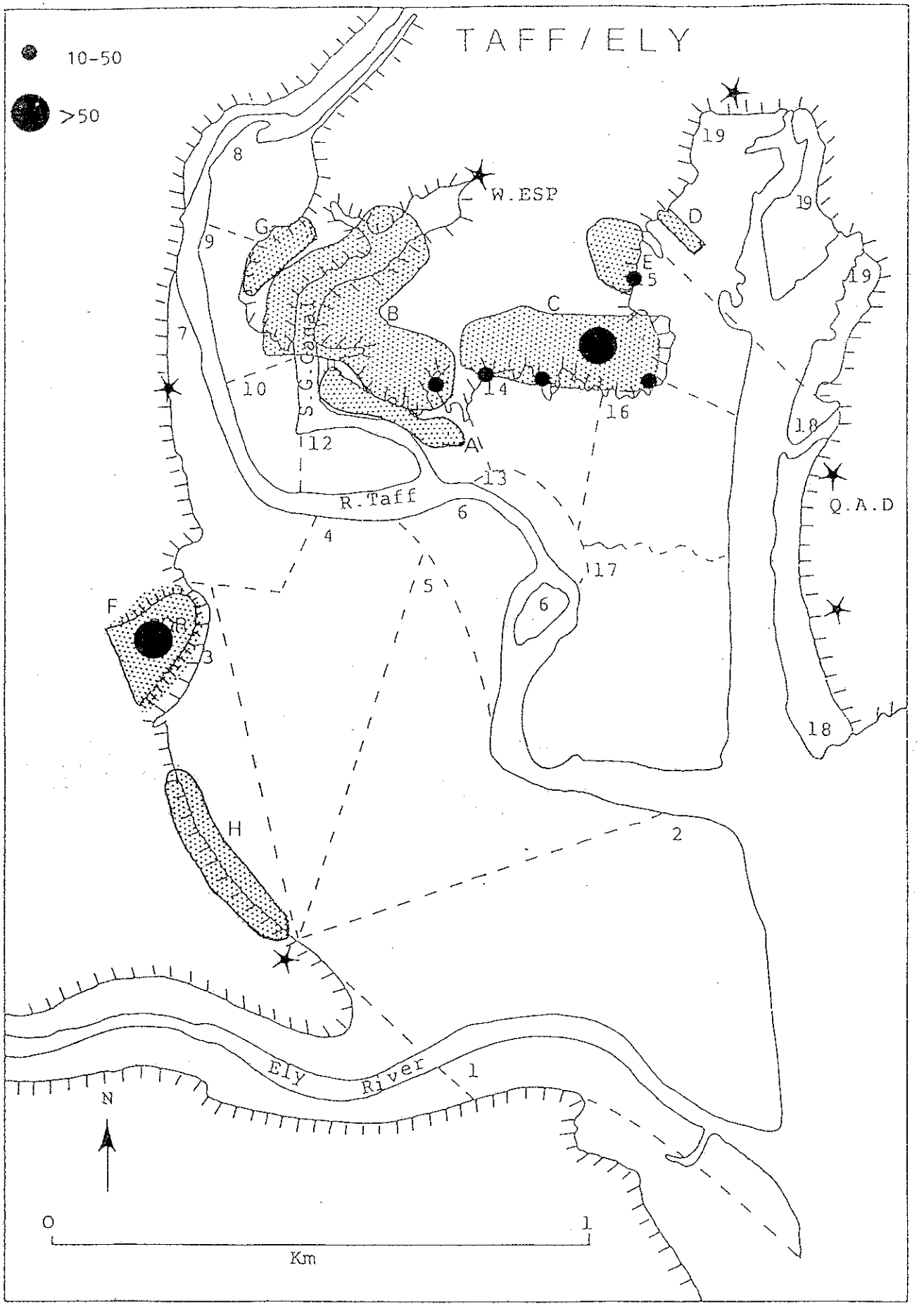


Figure 2 The distribution of roosting Shelduck flocks in Cardiff Bay. Only regularly occurring flocks are shown. Roosts in areas B, C and E only occur if these areas are not covered by the tide.

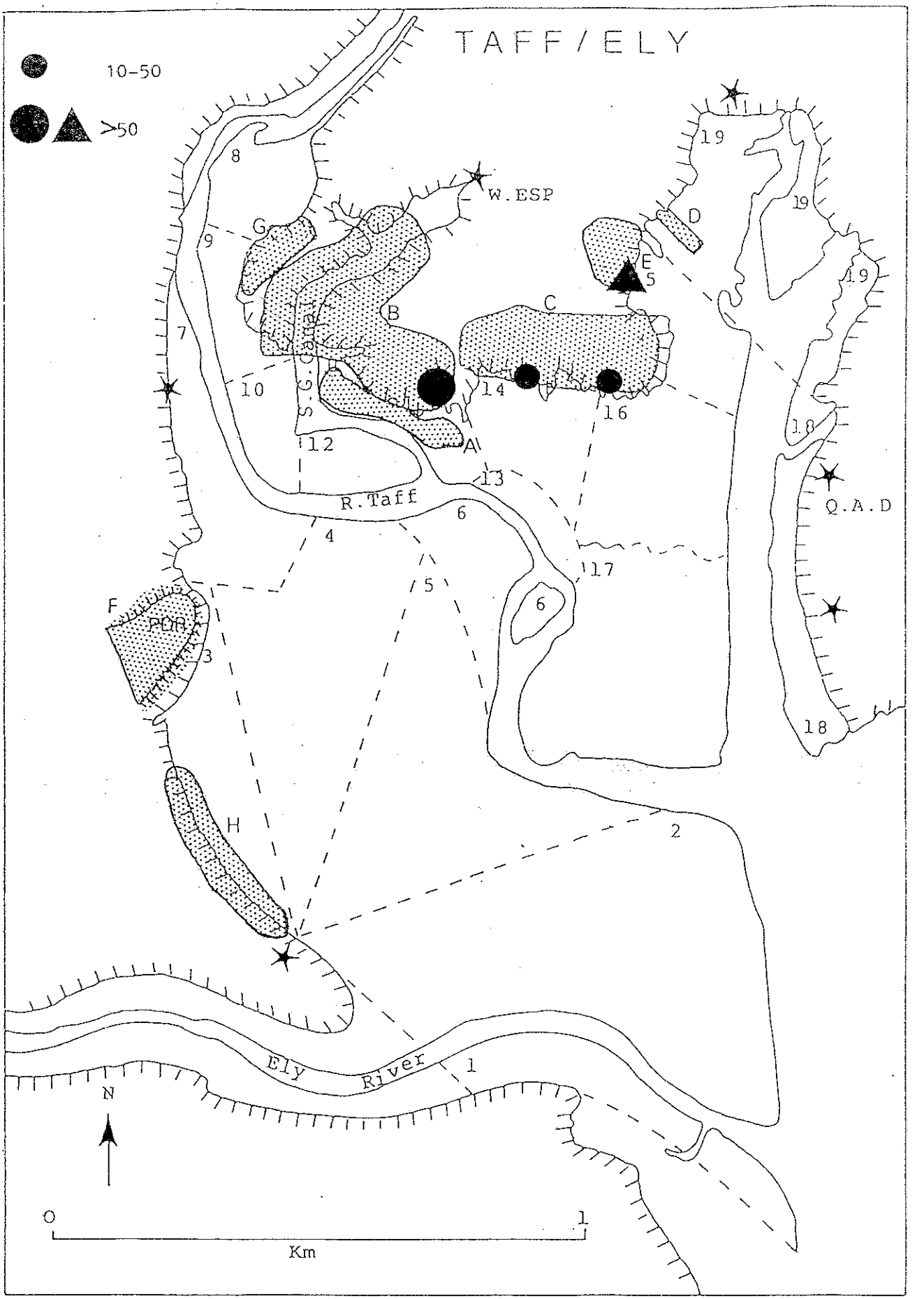


Figure 3 The distribution of roosting Teal flocks in Cardiff Bay. Only regularly occurring flocks are shown. Circles represent neap high tide roosts, triangles spring high tide roosts.

DUNLIN

Position of Roosting Flocks at High Tide

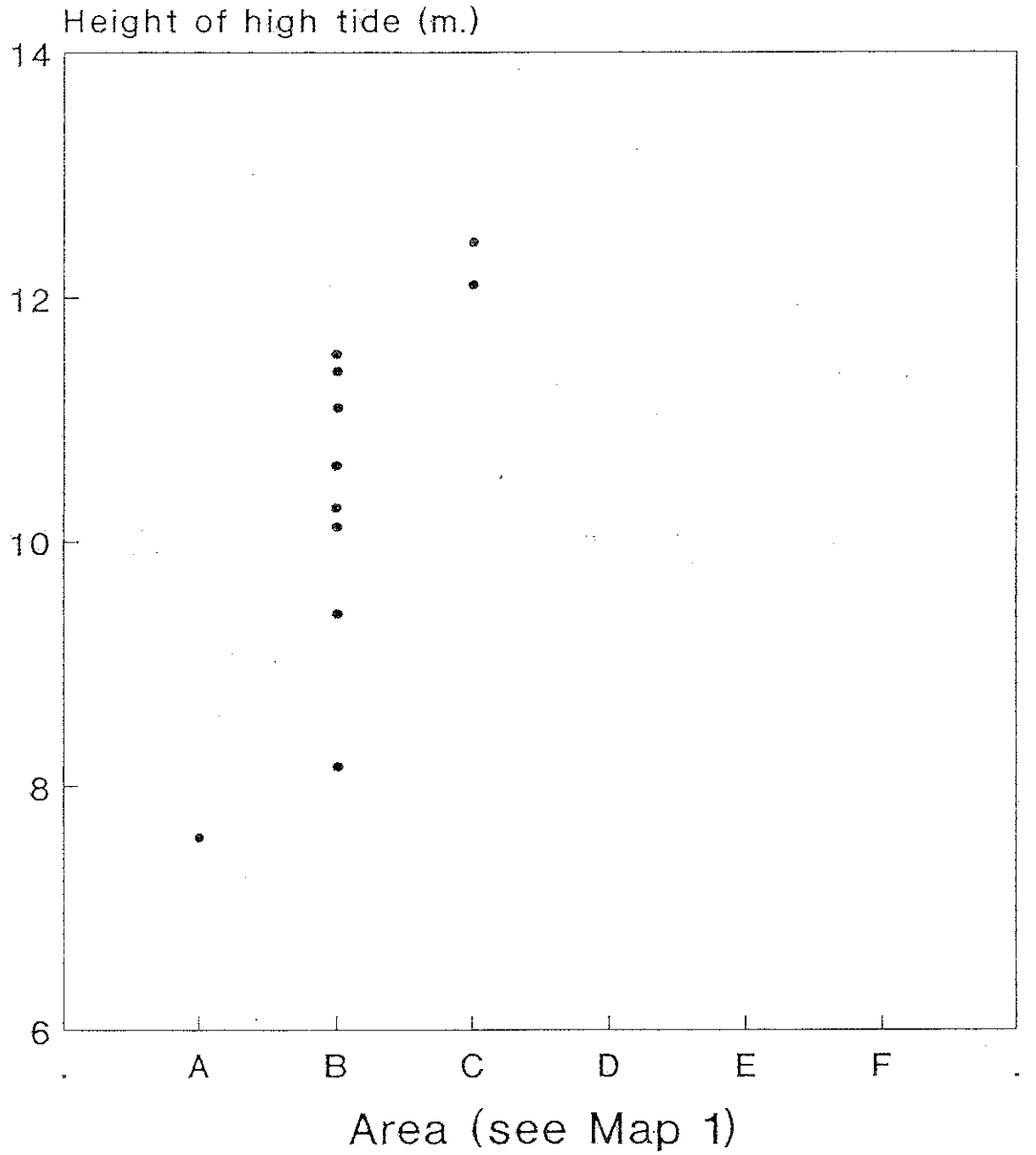


Figure 4 The distribution of roosting Dunlin in relation to tide height. Only numbers noted during the intensive study period are shown.

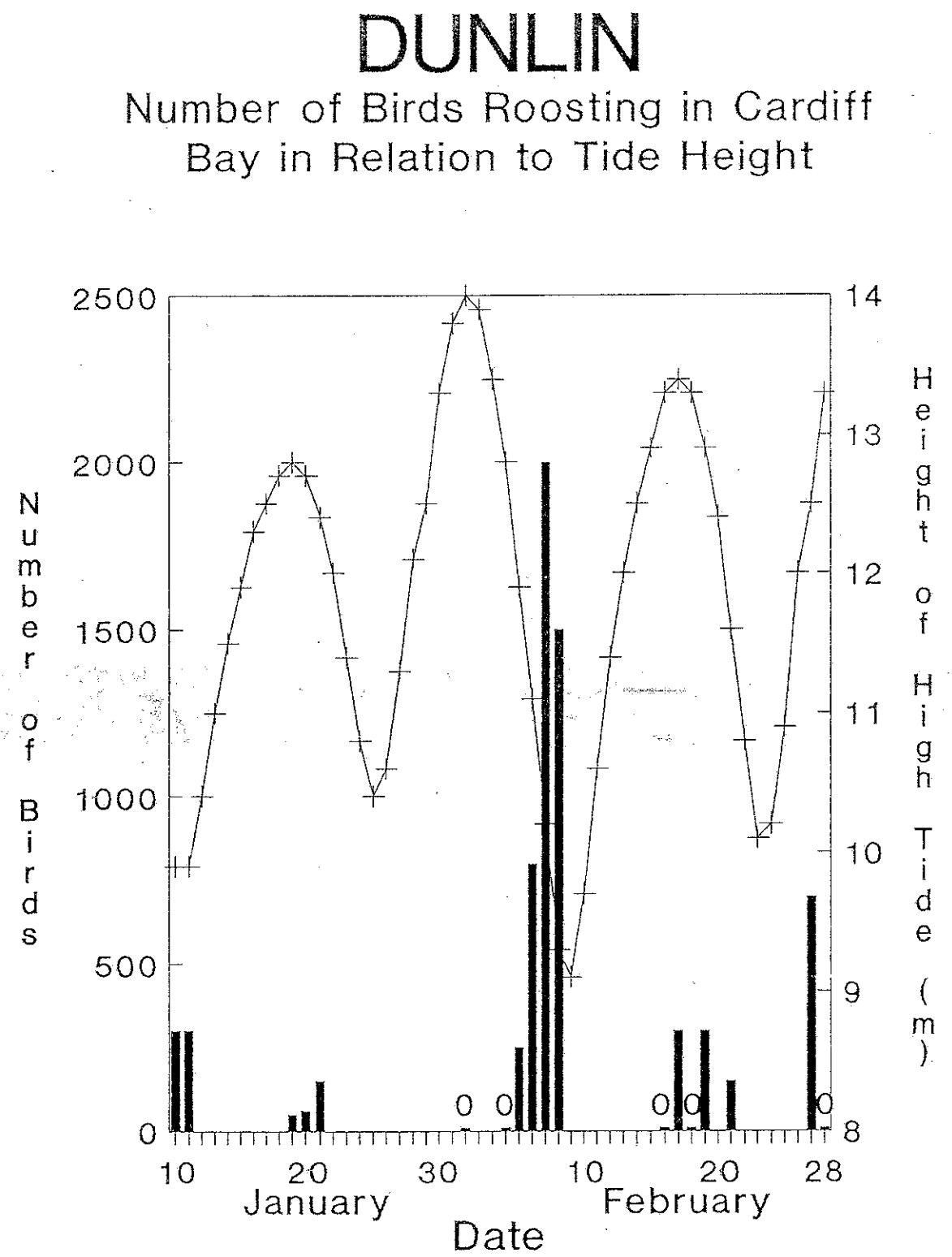


Figure 5 The number of roosting Dunlin in Cardiff Bay in relation to tide height.
Only numbers noted during the intensive study period are shown.

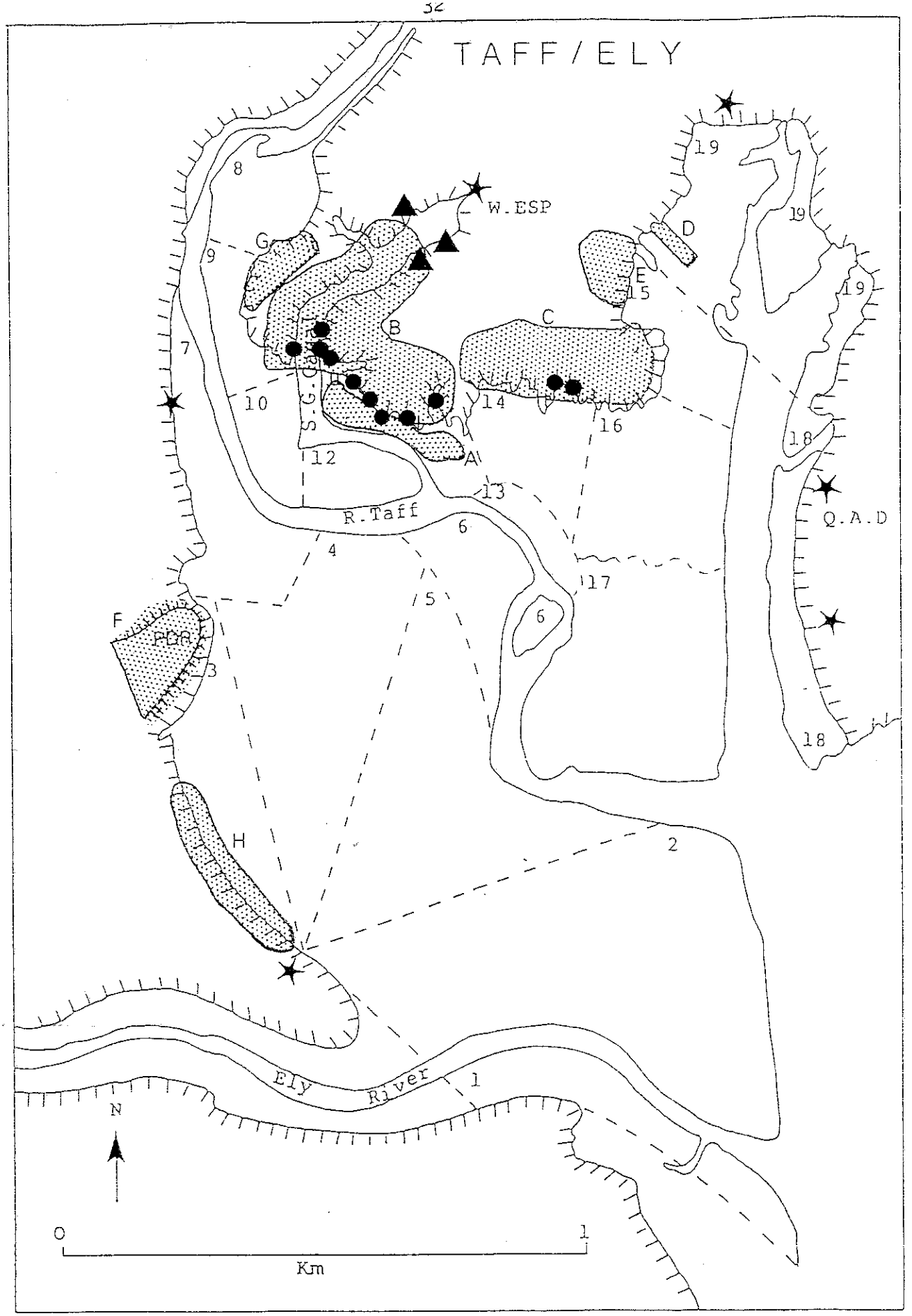


Figure 6 The Distribution of roosting Dunlin flocks in Cardiff Bay. All high-tide roost observations are shown. Triangles represent night roosts.

CURLEW

Position of Roosting Flocks at High Tide

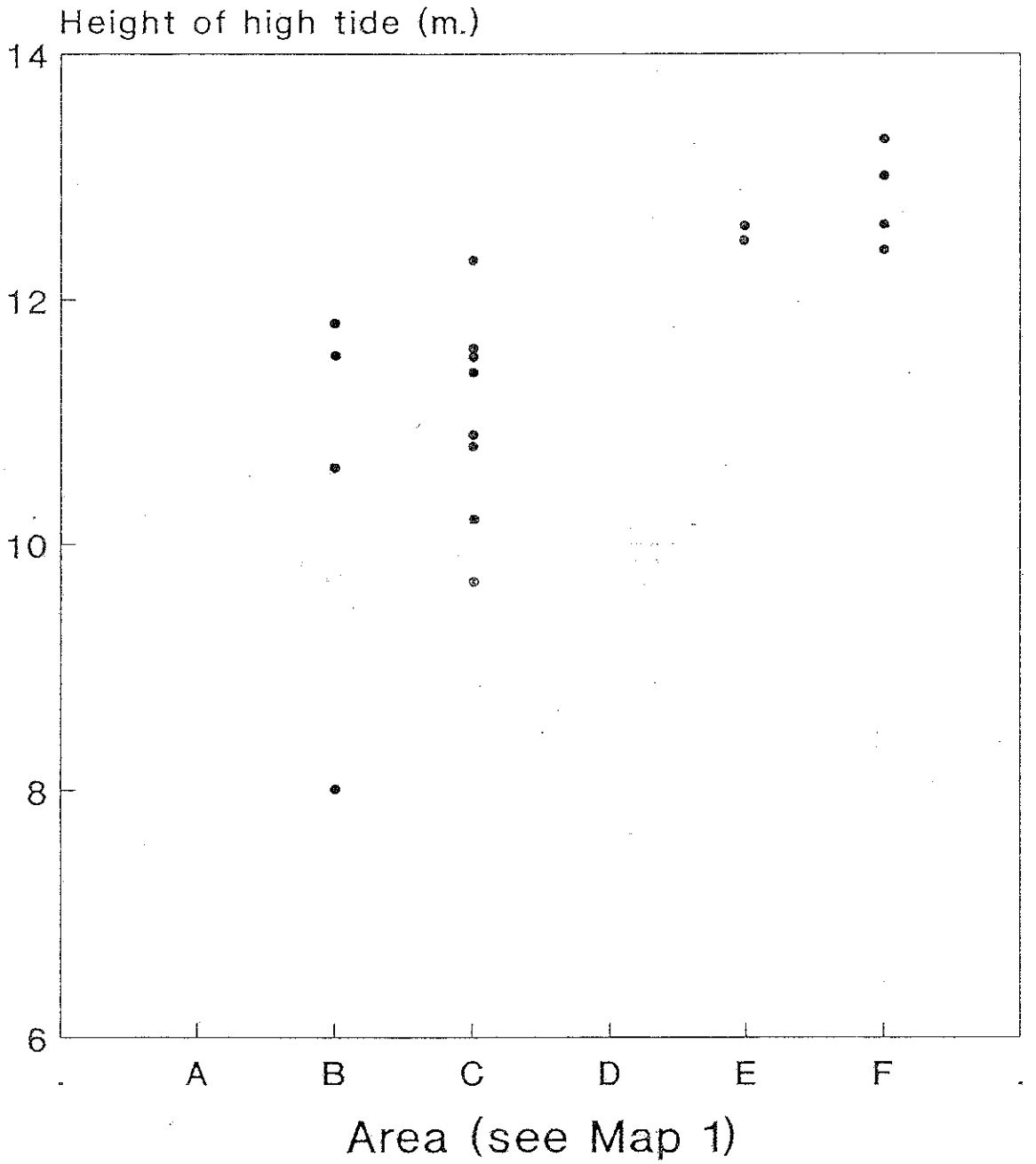


Figure 7 The distribution of roosting Curlew in relation to tide height.

REDSHANK

Number of Birds Roosting in Cardiff Bay

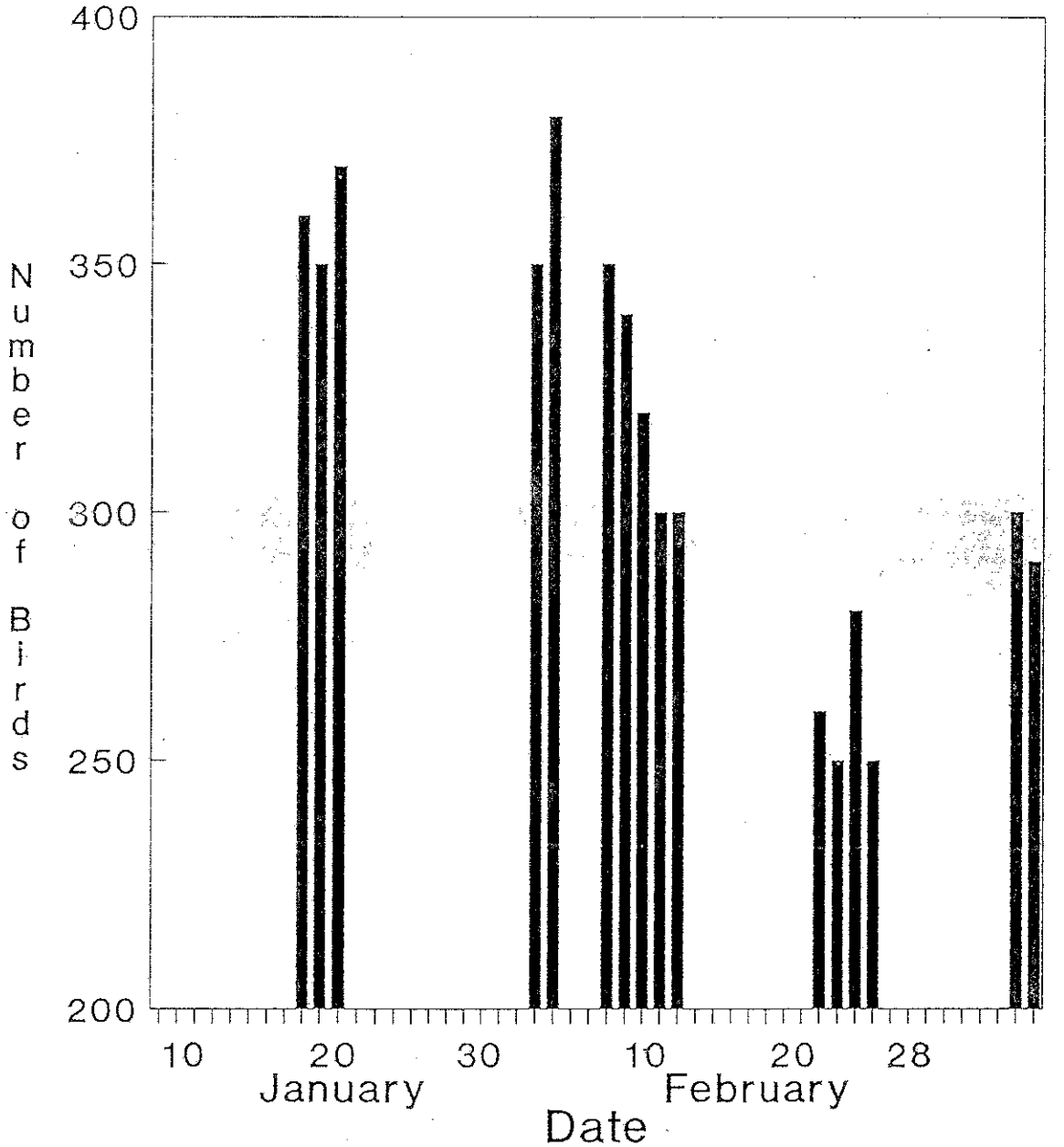


Figure 8 The number of Redshank roosting in Cardiff Bay. Only numbers noted during the intensive observation period are shown.

REDSHANK

Position of Roosting Flocks at High Tide

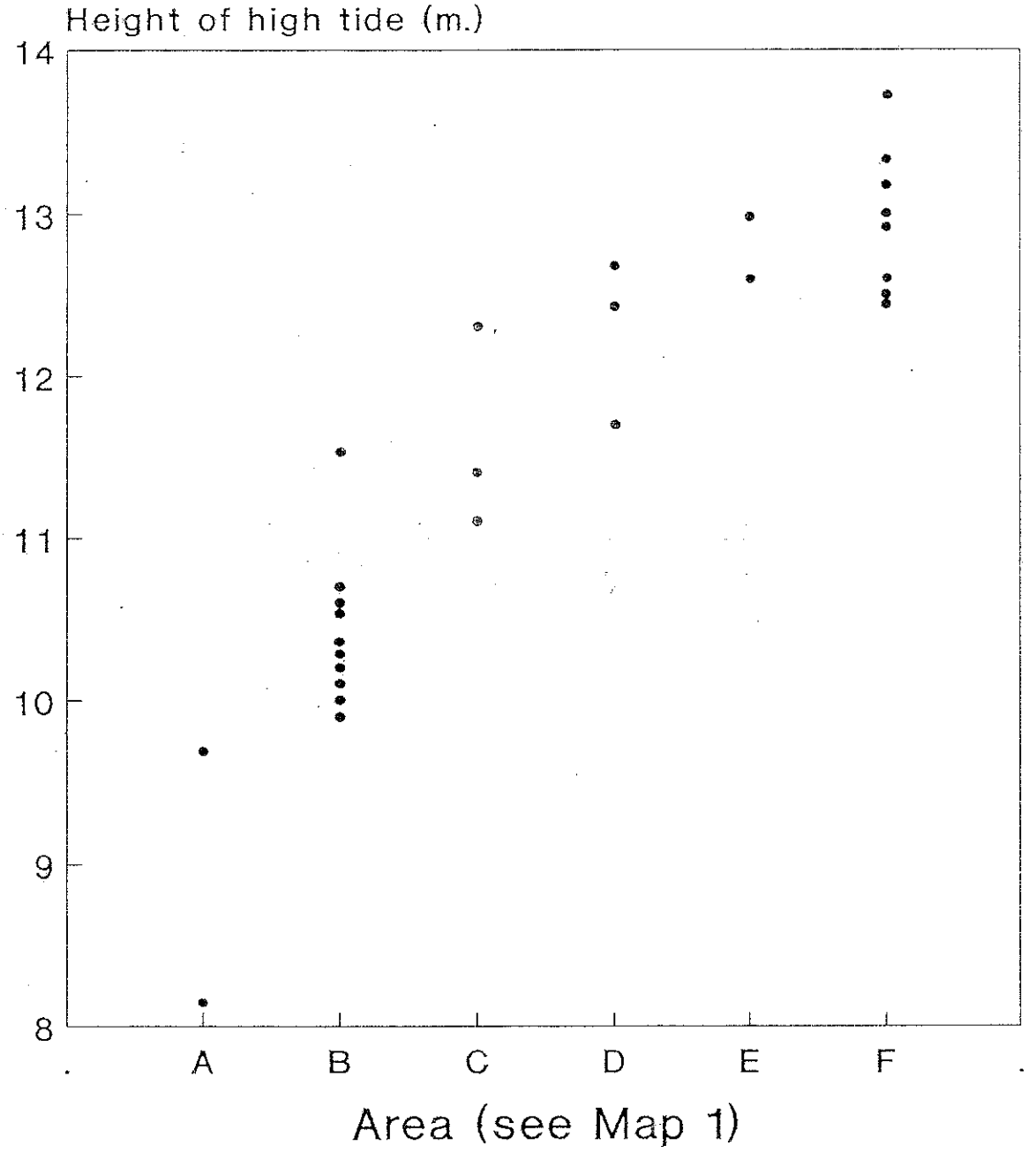


Figure 9 The distribution of roosting Redshank in relation to tide height.

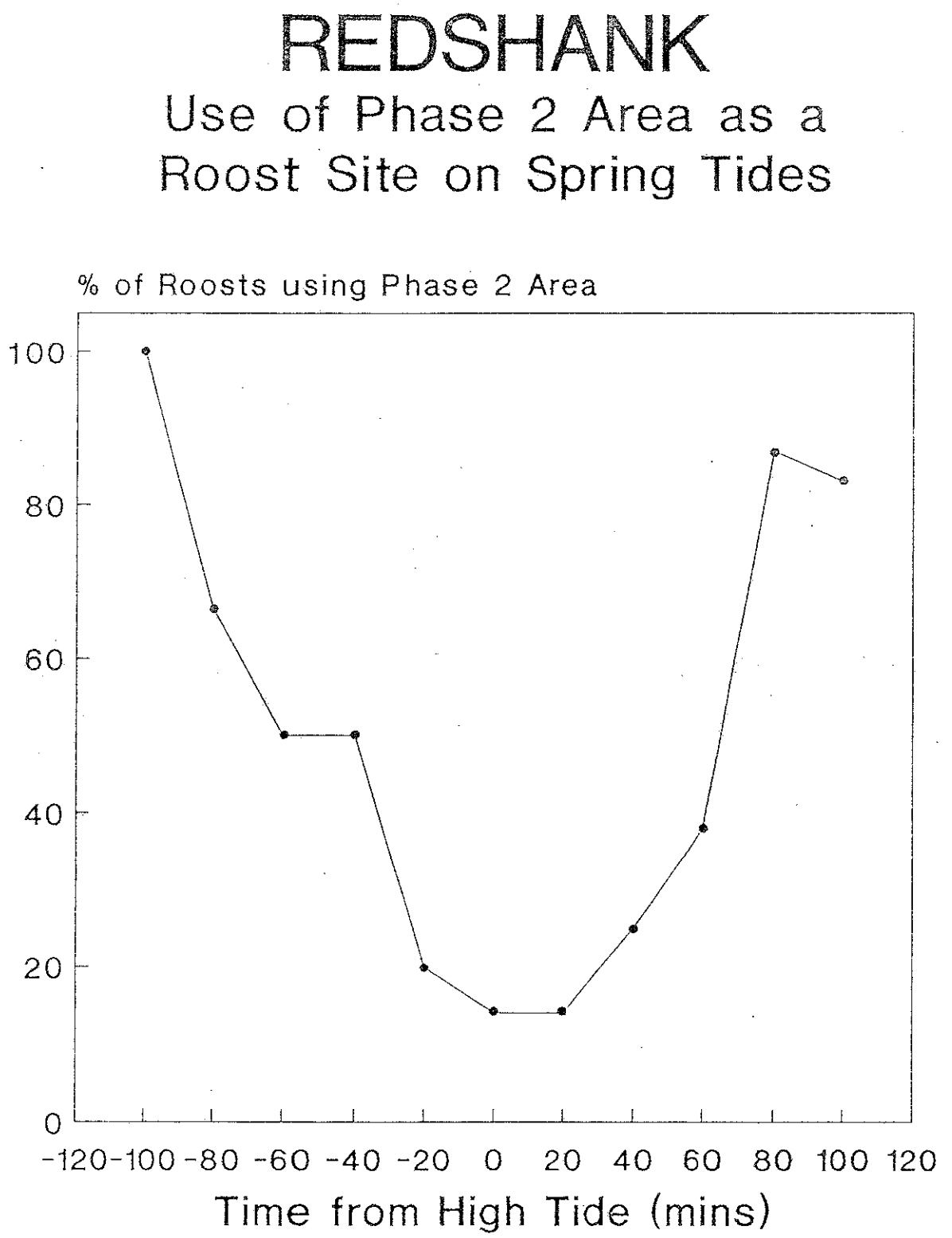


Figure 10 Use of the Phase 2 area by roosting Redshank on spring tides.

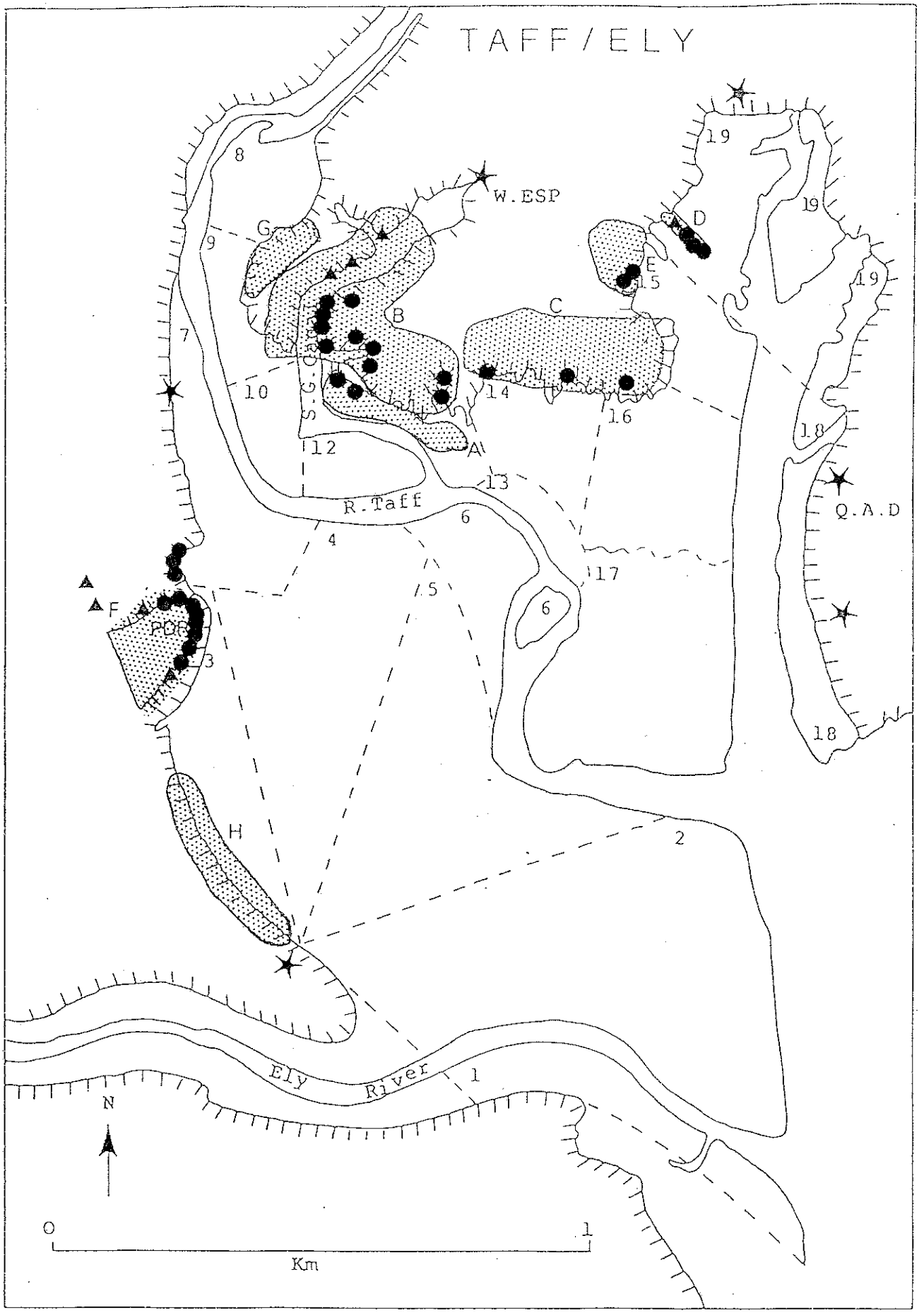
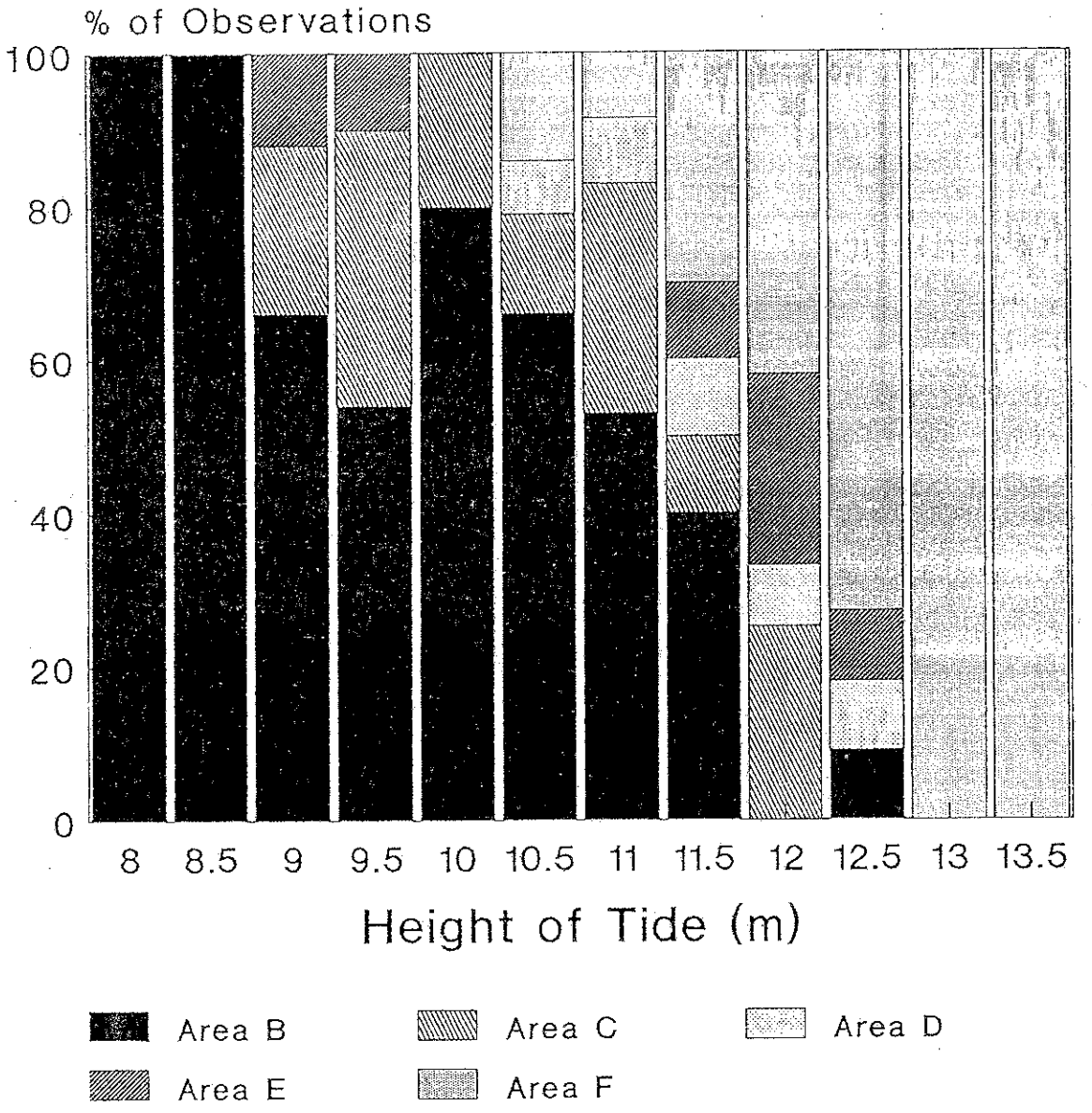


Figure 11 The distribution of roosting Redshank flocks in Cardiff Bay. All high tide roost observations are shown. Triangle represent night roosts.

REDSHANK

The Distribution of the Roosting Flock on Different Heights of Tide



(Areas follow those shown in Figure 1)

Figure 12 The distribution of roosting Redshank on different heights of tide in Cardiff Bay.
Observations are drawn from both neap and high tides, up to 100 minutes either side of high tide.

REDSHANK

The Proportion of Observations in Each Tide Height Class

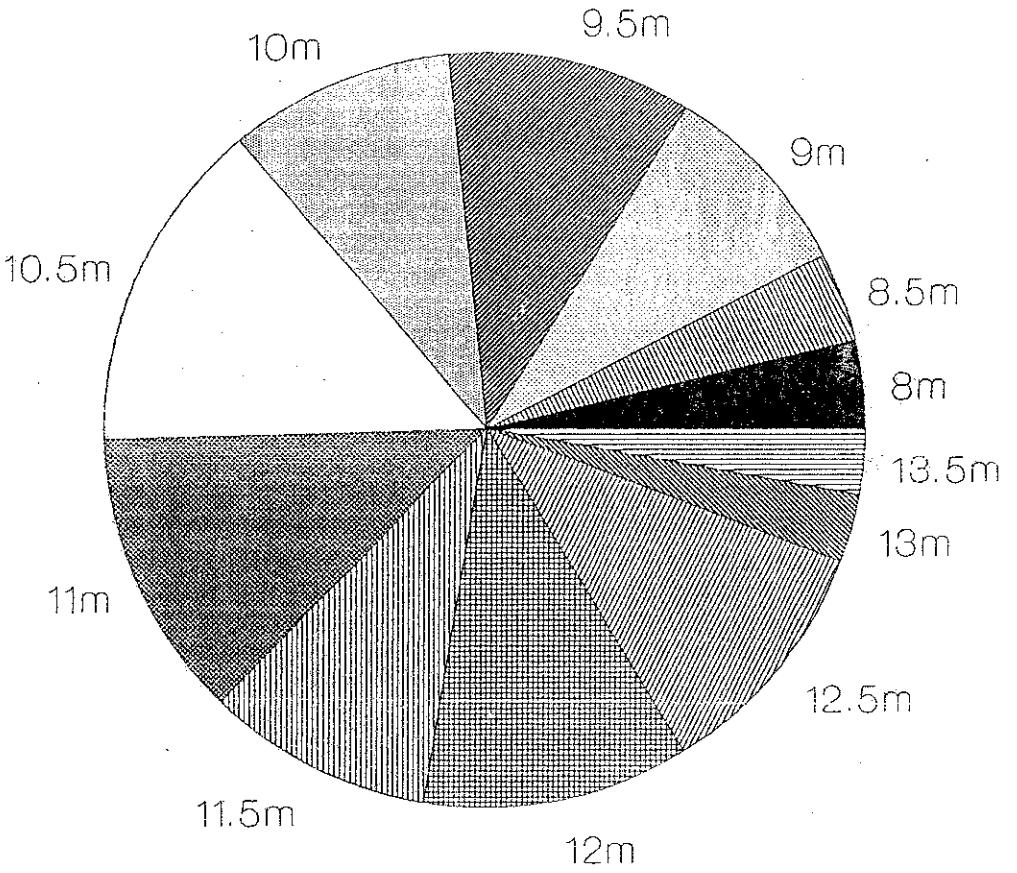


Figure 13 The frequency of tide height classes used in the production of Figure 12.

n=106