A method for assessing the quality of roosts used by waders during high tide

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We present a method for assessing the quality of roosts used by waders. We tested it using data on wintering Dunlins at Ria de Aveiro, Portugal. We suggest that it is a useful tool for classifying roost sites and their conservation importance.

INTRODUCTION

The Ria de Aveiro is a lagoon located on the west coast of Portugal at 40°50'N. People have used the lagoon and the surrounding area for centuries. As a result the Ria may be considered an artificial wetland comprising mainly artificial habitats, such as saltpans, agricultural land and rice fields. However, there are some natural areas, such as the Canal de Mira. Despite its modification by man, the Ria is an important wintering, stop-over and breeding site for waders and waterfowl (Luís 1999, Ribeiro *et al.* 2001).

In an attempt to understand how birds use the lagoon, a study of wintering dunlin *Calidris alpina* was carried out in an artificial area (the saltpan area) and a natural area (Canal de Mira) (Luís 1999). One of the aims of this work was to determine and compare the quality of the high-tide roosts used by the birds in the two habitats. However, we were unable to find a published method suitable for measuring the quality of a roost. Ideally, this attribute should be assessed by measuring the contribution of each site to the fitness of the birds. We therefore developed a method that allowed us to score roost quality. The quality of the high-tide roosts used by dunlin in the two study areas was determined using this method and, as it was being used for the first time, we also tested it.

THE METHOD

The method considers roosts according to nine characteristics, or attributes, grouped into three categories: disturbance, predation risk and energetics (Table 1).

Predation can be an important cause of mortality in dunlin during winter (Cresswell & Whitfield 1994, Dekker 1998, Hötker 2000). Therefore, the presence or absence of predators is an important attribute. However, the impact of a predator's activities will depend on a number of factors, such as the waders' conspicuousness, and therefore the difficulty experienced by the predator in finding the prey, and the difficulty experienced by the prey in spotting the predator in time to avoid being captured. Thus, the background colour of the roost and the length of the sight-lines should be significant factors in determining the quality of a roost.

The quality of a roost will also depend on energetic factors. Flight is a very energy consuming activity and the distance of the roost from the feeding ground is likely to be one of its essential attributes. The shorter the distance to the feed-

Table 1. Classification method for the roosts and their attributes.

		Scale			
Category	**Attribute**	**High**	**Medium**	**Low**	**Very low/nil**
Predation risk	Predation (presence of predators)	0	1	2	3
	Difficulty in spotting predators	0	1	2	3
	Birds' conspicuousness	0	1	2	3
Energetics	Distance to the feeding grounds	0	1	2	3
	Difficulty in obtaining food	0	1	2	3
	Exposure (wind, rain)	0	1	2	3
Disturbance	Disturbance (presence of people)	0	1	2	3
	Distance to alternative roosts	0	1	2	3
	Spatial limitation	0	1	2	3
	Score	0	9	18	27

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Table 2. Roost scores at the Canal de Mira and the average number of birds (±1SE) using each roost (n = 26 counts).

Roost	A	B	C	D	E
Score	7	9	9	10	7
Number of birds	74	407	280	1060	12
(mean ±1SE)	±30.9	±97.6	±93.3	±151.8	±6.0

ing areas, the better the roost. In addition, waders are known to feed over high-tide, particularly in cold weather (Davidson & Evans 1986) and the presence of available food during high-tide, as provided by active salt pans, for example, should also be an important attribute. Moreover, heat losses increase when birds are exposed to strong winds (Evans & Dugan 1984), so a sheltered roost should be preferred to an exposed one.

Even if a roost has all these attributes, the birds will not use it if disturbance is high, and they will use alternatives (Townshend & O'Connor 1993). This implies that both the level of disturbance and the distance of the roost to an alternative roost should also be important attributes.

Finally, a site will not be used as a roost unless there is enough available space, so any limitation of space (due to the area of the site and/or to the presence of other birds, such as gulls) must also be taken into account.

These nine attributes were grouped into three categories, according to their nature. Each roost was then rated for each attribute on a scale from zero to three where "0" corresponds to "high", "1" to "medium", "2" to "low" and "3" to "very low/nil". Attributes such as distance to the feeding grounds can be scored objectively by measuring, on a map, the distance from the central point of the roost to the central point of the nearest feeding ground. Similarly the conspicuousness of roosting birds can be assessed by reference to the time an untrained observer takes to spot them. Scoring other attributes, such as human disturbance, is less objective. This is the reason why we have adopted a short scale (0–3). Human disturbance, for example, was found to be difficult to score and its impact was evaluated on the basis of our knowledge of the activities of people, together with their number and the frequency of their visits to the roost site.

The global quality of a roost is measured simply as the sum of the scores given to each attribute, so that the maximum score of 27 points corresponds to a very good roost. The attributes were therefore all given the same relative weight because it was not possible to decide which are the most important, especially as their relative importance may change with factors such as weather conditions.

USING AND TESTING THE METHOD

If the scores adequately captured the quality of the roost as perceived by the birds, we would expect more birds to use roosts with high scores than with low scores. As the two study areas (the Canal de Mira and a saltpan area) are separate and there is evidence that no interchange occurs between the two groups of wintering dunlin (Luís, 1999), this was tested by relating bird numbers to roost score in each of the study areas separately.

The sediment at the roosts in the Canal de Mira was sandy,

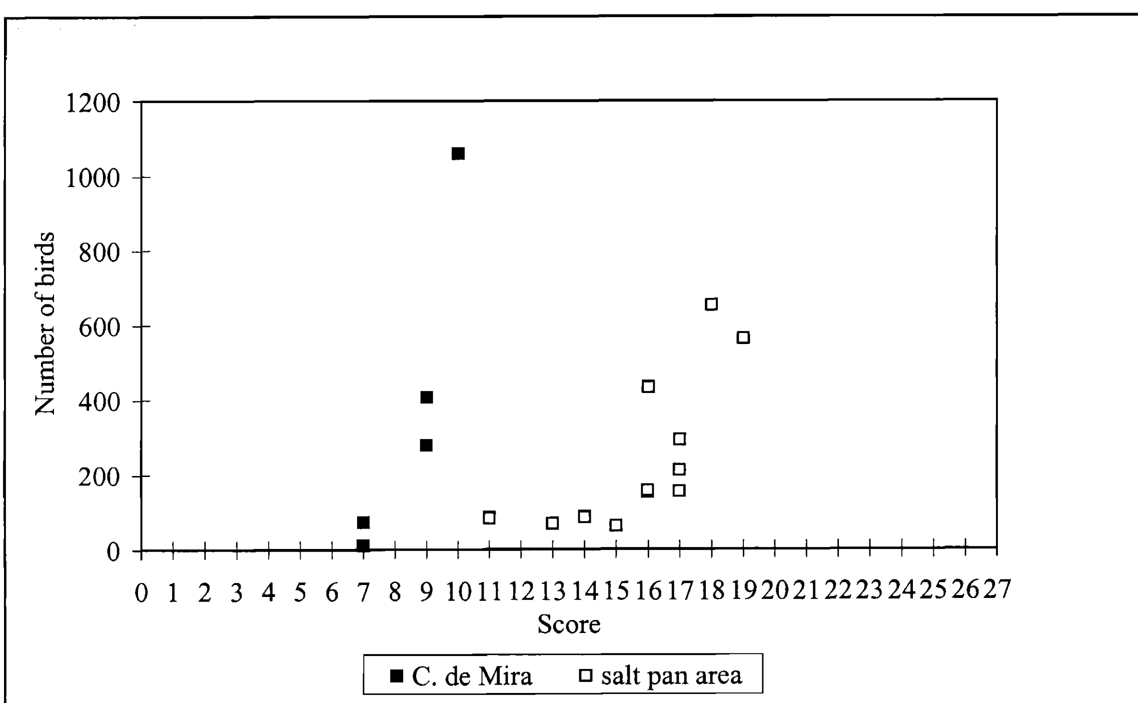

Figure 1. Dunlin roost scores in the Canal de Mira and saltpan area. Roost scores are plotted against the average number of birds that used each roost. (Canal de Mira: $r_s = 0.949$ $p<0.05$ n=5) (saltpan area: $r_s = 0.845$; $p<0.001$ n=14).

Table 3. Roost scores in the saltpan area and the average number of birds (±1SE) using each roost (n= 31 counts). As: active saltpan; ab: abandoned salt pan; F: fishpond.

Roost	B1	D	E	F	F1	H	I	I1	I3	J	J1	L2	N	CP
	As	As	As	As	As	As	As	As	F	F	ab	As	ab	As
Score	11	16	16	18	17	17	19	16	15	14	13	17	11	14
Number of birds	86	153	157	653	213	294	563	434	62	87	69	155	83	86
(mean ±1SE)	±50.0	±54.9	±47.4	±146.5	±82.5	±72.0	±134.1	±120.0	±59.6	±35.4	±44.9	±43.1	±39.4	±29.7

whitish in colour and dry. Most of the roosts were located on a sand barrier and, at first sight, appeared to be very similar to one another. The main differences between them were the distances to the feeding grounds, the amount of disturbance and available space, and the topography, and thus shelter. The scores for the five Canal de Mira roosts are presented in Table 2 (average score: 8.4 ± 0.60) and plotted against the average number of birds that used the roosts in Figure 1. As expected, there was a significant correlation between roost scores and the number of birds using them ($r_s = 0.949$, $p<0.05$).

Most waders in the saltpan area roost in active saltpans, although some roost in abandoned saltpans and fishponds. The perimeters of active saltpans are protected by thick walls. The inner ponds are divided by small walls, built with a brownish-grey muddy sediment that is often colonized by vegetation. The walls offer protection from wind and rain, the vegetation and sediment colour provide camouflage and, because the water levels inside these active saltpans are kept low, birds can feed there during high tide.

Table 3 shows the scores for fourteen roosts in the saltpan area, and includes values for both active and abandoned pans and fishponds (average score: 15.3 ± 0.65). The scores for the saltpan area roosts are higher and significantly different from the scores for the Canal de Mira roosts (Mann-Whitney, $U = 70$, $p<0.001$; $n_1=5$, $n_2=14$) and this shows that the method discriminates between the roosts in the two study sites. Thus, these roosts are different and presumably of better quality than the ones in Canal de Mira.

For the saltpan area, the correlation between the roost scores and the number of birds using each roost is significant ($r_s = 0.845$, $p<0.001$), as in Canal de Mira (Figure 1, Table 3).

DISCUSSION

There are, we think, two main sources of inaccuracy in this quantitative assessment of roost quality. One is that all attributes are given the same weight yet some may have more importance than others in affecting bird fitness. Furthermore, the relative importance of an attribute will depend not only on the attribute itself but also on the other attributes. If, for instance, predation pressure is very low and weather conditions are usually bad, camouflage and the possibility of spotting a predator well in advance will have a low weight, while shelter and, probably, high tide feeding will be of greater importance. On the other hand, if predation pressure is very high and weather conditions good, shelter will have a low weight and camouflage and the possibility of spotting predators will be essential for survival. Clearly roost quality will vary according to the trade-off made by birds under different conditions between reducing the risks of predation and of starvation.

The other source of inaccuracy is the difficulty of scoring each attribute objectively. The effect of the presence of people, for instance, will depend not only on what people are doing but also on the extent to which birds may have habituated to such activities.

However, in the absence of any direct measure of the influence of roost attributes on bird fitness, we suggest that this method is a useful tool for the classification of roosts and that it will contribute to our ability to evaluate the conservation importance of such sites.

It is likely that, as a result of future studies, other attributes may be added. Also, the ability to score attributes objectively will probably improve. However, it will be convenient to retain a standard method suitable for scoring all types of roost.

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