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Density and Distribution of Migratory Waders Along the Shores of Bahrain Islands

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ABSTRACT. Twenty seven sites around the islands of Bahrain were studied regarding the distribution and density of waders. Site features, such as slope, sediment grain size and dry intertidal area were examined. The biomass as dry weight per square metre was calculated for each site. A greater density of wading birds was shown in sites with a large dry intertidal area, a very gentle slope and high value of biomass which reached 16.84g/m^2 in Ras Hayan site. The high values of counts ranged between 100-145 birds/minute while the lowest was 2 birds/minute. Areas attractive to migratory waders are located mainly on the sheltered eastern shore of the main island of Bahrain. Twenty eight different species of waders were identified during the present field study. Human activities such as filling and land reclamation had influenced some of the important areas which previously attracted waders.

The relationship between bird species and habitat selection has received considerable attention in the literature (Cody 1985, Weins 1992). A decision made by an individual bird to select a place as a breeding site or wintering area is controlled by many factors including habitat structure, floristics, food resources, microclimate and competition with other species (Svardson 1949, Slagsvold 1980, Weins 1985). Habitat disturbance as well as other factors impose various changes on avian communities (Gill 1990). Birds are considered as indicator to monitor variations to the environment and particularly habitat alteration (Jarvis 1993). Human disturbance represents a major factor in the instability of bird communities among island avifauna (Abbott and Grant 1976). Annually, hundred thousands of birds, representing more than 300 different species including many waders, use the

Arabian Gulf as their migration route from their breeding sites in the north to spend the winter in the Gulf or continue their migration to Africa (Jennings 1981, Cramp 1985, Bundy *et al.* 1989, Nightingale and Hill 1993, Mohamed 1993, Hirschfeld 1995).

The coastal areas around Bahrain are dominated largely by sand and mud flats and to a lesser extent rocky areas in a few islands which are characterized by having cliffs (Vousden 1986). The coastal habitats around Bahrain islands support large numbers of wading birds which either spend the whole winter or stay for short periods as passage migrant (Tucker 1985, Saleh and Mohamed 1993, Hirschfeld *et al.* 1992, Hirschfeld 1995). During the last two decades, many coastal areas of the country witnessed major disturbances due to human activities reflected by land filling and reclamation which is associated to the rapid development such as expanding cities, establishing industrial estates and building new houses (Mohamed 1992).

The main objective of the present study is to monitor and examine the distribution and density of waders around the various shores of Bahrain during Autumn and Winter periods. The study also aims to examine the importance of different coastal sites for migrating waders.

Materials and Methods

Observations and bird counting were carried out during Autumn (October-November) 1992 and Winter (January-February) 1993. The main accessible areas were included in the study, therefore, twenty seven different sites around the shores of Bahrain islands were covered (Fig. 1). Observations and counting were made within two hours of the ebb tide when birds are expected to be present and active in the intertidal areas. Birds in the field were identified using the field guides by Heinzel *et al.* (1972) and Hayman *et al.* (1986). The area of coastal sites around Bahrain are varied considerably. Some sites have vast intertidal areas while others are represented by only small strip. This make it difficult to compare between the importance of sites for wading birds according to their areas. In order to do so, a comparison based on number of birds per time unit was used as index to reflect the total abundance of birds in any sampling area at a particular time (Bibby *et al.* 1992). Therefore, waders were counted as number of birds recorded in one minute at each site during their presence at low tide. A replicate of three readings were taken in each visit of the particular study area. Each site was visited three times in each season. Number of bird species were also counted for each sampling site. Estimate census for each species population was reported and figures were compiled for all

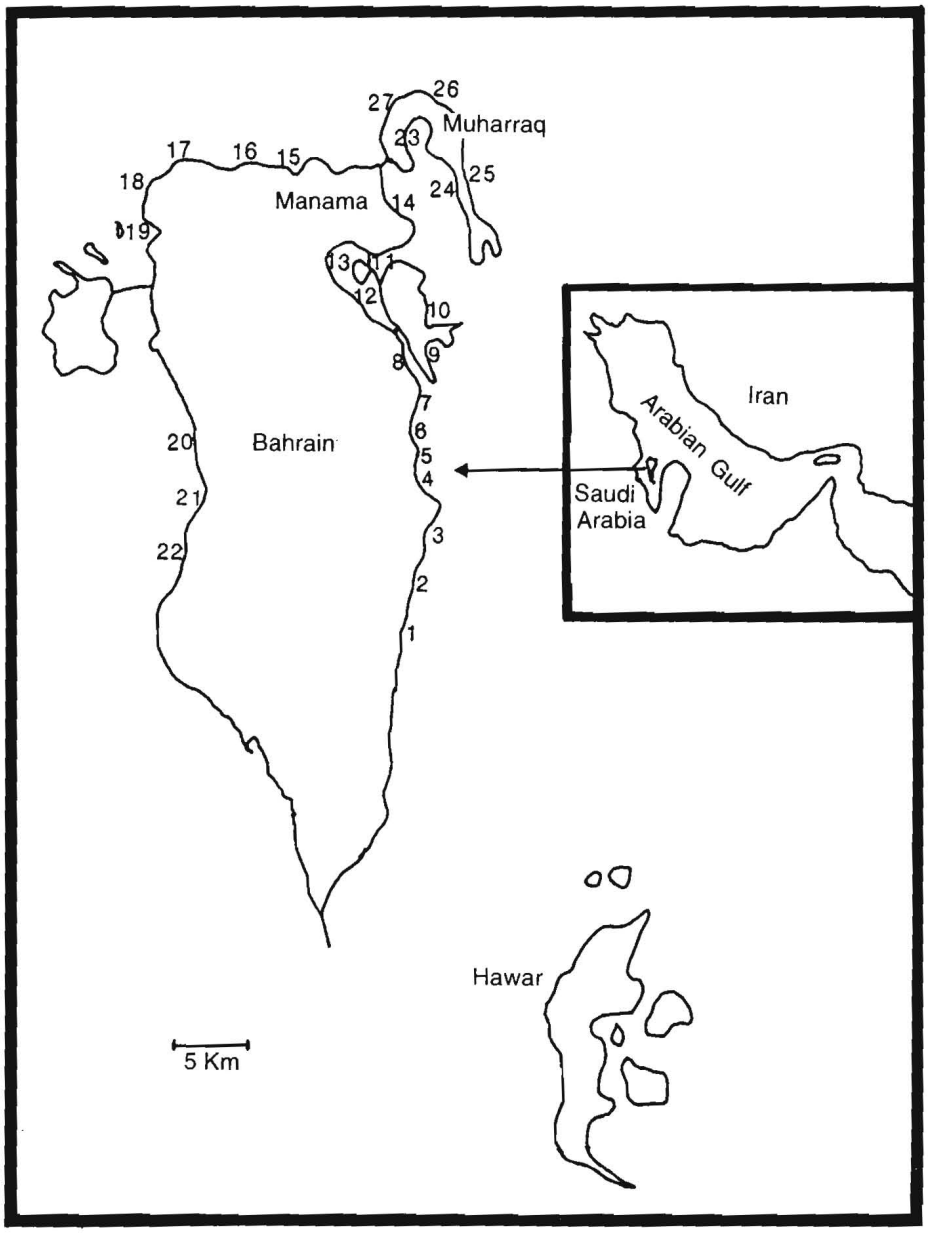

Fig. 1. Sites covered in the study.

studied areas. All observations were carried out by using 10x binoculars.

Features of the studied coastal sites such as slope and area of intertidal zone were examined. Samples of soil were taken to the laboratory for grain size measurements according to Gray 1981. Macrofaunal animals were collected by sieving the sample through 0.5 mm mesh and potential food available for waders was identified to the main taxon. Three samples of $0.1m^2$ quadrate were taken to a depth of 10 cm at the different areas. Sites were sampled at areas where birds have been seen feeding at the same tide level where they were counted. The biomass of dry weight was obtained after keeping wet weight samples in the oven for 48 hours at 60 °C. Disturbance of coastal areas by land filling and reclamation was also reported.

Results

Table 1 and Fig. 2 show the number of wading birds per minute in the studied coastal sites around the shores of Bahrain. The highest figures that exceeded 100 birds/min. were found in sites no. 3, 12, 13, 23 and 24, while the lowest counts of birds (less than 5/min) were recorded in stations no. 14, 20, 21 and 22. No significant difference was found between Autumn and Winter values when t-test was applied, however similar pattern of number of birds were noticed in all sampling sites. Examination of sediment feature and grain size revealed that sites of the eastern coast of the main island have a dominance of sandy and muddy soils, while those located around the northern and western areas are mainly associated with a mixture of sand and evaporite rocks. This also applied to the intertidal areas around the island of Muharraq. Regarding the slope of the coastal areas, it is clear that a steep slope is only found in the western coast of the main island of Bahrain, while the remaining studied sites have gentle or very gentle slope. The size of dry area which is uncovered during low tide is extracted from Vousden (1986) and shown in Table 1. Small areas are restricted to the western side of the main island, but are also found in site 8 and 14. Large dry areas are found in sites no. 3-6, 10, 12, 15-17 and 23-26.

Biomass, which is determined as dry weight per square meter, is shown for all studied sites in Table 1. The highest values of biomass that exceed 10 g/m^2 are found in sites number 3, 4, 12, 13, 15, 23 and 24.

Species of waders were identified during the field study. Twenty eight different species of waders were recorded. Fig. 2 shows waders abundance reflected by their number/min. while they were actively feeding around the coasts of Bahrain, while

Table 1. Number of birds counted per minute, site description, size of intertidal area, biomass and number of bird species for twenty seven sites around Bahrain.

Site No.	Site Name	No. of birds/min		Site Description		Dry area	Biomass (g/m^2)	No. of Bird Species
		Autumn	Winter	Sediment Feature	Slope			
1	Al-Door	8	7	sand	G	M	2.96	4
2	Jaw	27	35	fine sand	G	M	4.23	8
3	Ras Hayan	145	112	mud/sand	VG	L	16.84	21
4	Askar	50	65	fine sand	VG	L	10.9	12
5	Abu Jarjoor South	17	21	sand	G	L	3.23	6
6	Abu Jarjoor North	24.3	18	sand	G	L	2.13	7
7	East Refinary	12	6	sand	G	M	1.24	4
8	Alma'meer	20	15.4	fine sand	G	S	1.62	3
9	Sitra South	41.4	38.2	sand/rocks	G	M	2.85	10
10	Sitra North	65	51	sand/rocks	VG	L	5.64	15
11	Tubli Bay East	38.4	42	mud/sand	G	M	8.5	14
12	Tubli Bay West	140	112	mud	VG	L	13.45	22
13	Tubli Bay North	132	105	sand/mud	G	M	11.75	19
14	Manama East	2.4	4	sand/rocks	G	S	0.31	2
15	Bahrain Fort	88	67	mud	VG	L	10.62	12
16	Bar Bar	45	34	sand/rocks	G	L	4.85	9
17	Abu Subuh	58	61	sand rocks	G	L	5.42	13
18	Budaya	11.3	7.6	sand	S	S	1.23	4
19	Janabiah	52	62	sand/mud	G	M	6.84	12
20	Sadad	3	4.3	sand/rocks	S	S	0.38	1
21	Zallaq	3	2	sand/rocks	S	S	1.42	2
22	Wasmiah	6	4.6	sand/rocks	S	S	1.21	2
23	Arad Bay	124	132	mud/rocks	G	L	10.64	18
24	Asry West	105	120	sand	G	L	12.3	22
25	Asry East	54	62.5	sand	G	L	7.85	20
26	Samahij	28.6	37	sand/rocks	G	L	4.15	11
27	Busaiteen	15	9	sand/rocks	G	M	2.29	5

Type of Slope: Very Gentle (VG), Gentle (G), Steep (S).

Size of intertidal area (Dry Area) S: Small (less than 50 meters), M: Medium (50-500 metres), L: Large (more than 500 metres).

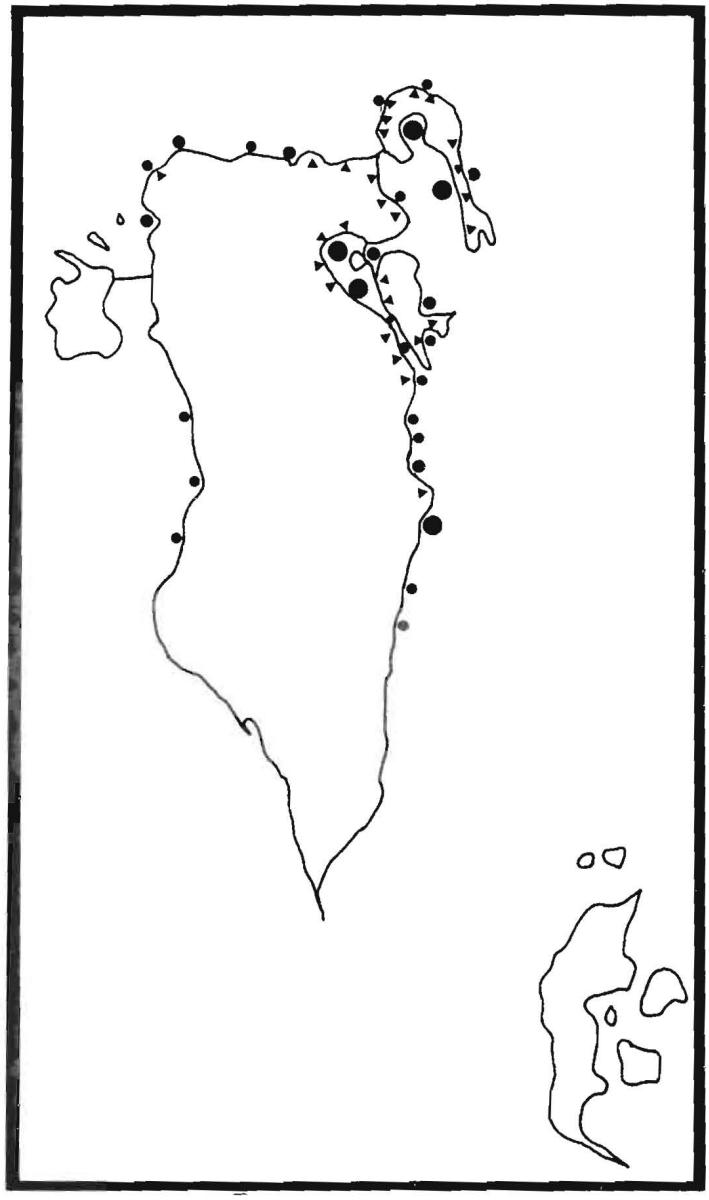

Fig. 2. Abundance of waders around the shores of Bahrain islands are shown as no./min. Disturbed areas are also pointed.

Table 2 includes a list of all bird species recorded during the present study and estimates of their total numbers as compiled from all sites covered by the survey.

Coastal areas which are affected by land filling and reclamation are shown in Fig. 2. Most areas around the coasts of Bahrain are disturbed by land filling and reclamation. Only south eastern and western coasts of the main island are still intact.

Discussion

The intertidal areas around the islands of Bahrain are surrounded mainly by sand or mud flats. This feature is more obvious in the eastern sheltered coast of the main island of Bahrain (Table 1). Such areas are seen to be highly attractive to many wading birds. Large number of migratory waders and other water fowl were reported to spend the winter in those areas (Perrenou *et al.* 1990, Evans 1994, Scott 1995). A high density of waders associated to mud flat areas was previously reported in Bahrain and elsewhere in the Arabian Gulf (Smart *et al.* 1983, Tucker 1985, Uttley 1988, Saleh and Mohamed 1993). Many authors have reported various factors that control the selection and preference of an area by birds for breeding or wintering (Svardson 1949, Slagsvold 1980, Weins 1985). It seems that areas around Bahrain, which can be considered as attractive for waders, are normally large intertidal mud or sand flats with very gentle slope and considerable high values of biomass. The high values of biomass reflects a good potential food for birds, which includes crustaceans like crabs and shrimps, molluscs and polychaetes. The correlation between biomass and bird species is high ($r = 0.9074$). This is more clear to stations number 3, 12, 13 and 23. These areas were reported previously as important sites for larger wading birds like Greater Flamingo and Reef Heron (Mohamed 1991, Saleh and Mohamed 1990). It is worth mentioning here that all these areas are sheltered when the prevailing wind comes from the North and North West (Issa 1989). Areas like no. 24 and 25 have high number of wader species but do not seem to support good potential food when their biomass values are not high. This could be related to their sheltered feature and the vast area of the intertidal zone which may attract more birds to visit such sites where competition seems to be less. Estimates of absolute number of wader species which were counted during the period of the study from all visited sites during winter indicates the high population of some waders in Bahrain. This reflects the importance of mudflats as important habitats for many migratory birds like Lesser Sandplover, Kentish Plover, Dunlin, Curlew Sandpiper and Broad-billed Sandpiper.

Due to the considerable impact on intertidal areas in Bahrain as result of land filling and reclamation activities around most of the coast during the last two

Table 2. List of different species of waders recorded in the studied areas. Estimate of absolute number for each species is reported. NR = No Record.

No.	Wader Species	Total Estimates	
		Autumn	Winter
1	*Haematopus ostralegus* Oystercatcher	55	45
2	*Himantopus himantopus* Black-winged Stilt	35	22
3	*Recurvirostra avosetta* Avocet	2	3
4	*Dromas ardeola* Crab Plover	2	0
5	*Charadrius dubis* Little Ringed Plover	25	32
6	*Charadrius hiaticula* Ringed Plover	1500	1300
7	*Charadrius alexandrinus* Kentish Plover	2700	2400
8	*Charadrius mongolus* Lesser Sand Plover	3100	2600
9	*Charadrius leschenaulti* Greater Sand Plover	300	260
10	*Pluvialis apricaria* Goldon Plover	0	10
11	*Pluvialis squatarola* Grey Plover	700	680
12	*Vanellus vanellus* Lapwing	0	3
13	*Calidris alba* Sanderling	15	6
14	*Calidris minuta* Little Stint	2500	2350
15	*Calidris ferruginea* Curlew Sandpiper	3200	3000
16	*Calidris alpina* Dunlin	3600	3250
17	*Limicola falcinellus* Broad-billed Sandpiper	165	NR
18	*Philomachus pugnax* Ruff	10	NR
19	*Gallinago gallinago* Snipe	120	145
20	*Limosa laponica* Bar-tailed Godwit	850	560
21	*Numenius phaeopus* Whimbrel	95	70
22	*Numenius arquata* Curlew	920	800
23	*Tringa totanus* Redshank	1200	1350
24	*Tringa stagnatilis* Marsh Sandpiper	5	20
25	*Tringa nebularia* Greenshank	350	390
26	*Xenus cinereus* Terek Sandpiper	265	85
27	*Actitis hypoleucos* Common Sandpiper	58	15
28	*Arenaria interpres* Turnstone	380	300

decades, many rich mudflat areas were shrunk or disappeared (Fig. 2). It is important to state here the necessity for conserving and protecting these critical and important habitats as feeding areas for migratory waders.

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كثافة الطيور الخواضة وتوزيعها في سواحل جزر البحرين

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قسم علوم الحياة - كلية العلوم - جامعة البحرين - ص .ب (٣٢٠٣٨) - البحرين

شملت الدراسة مسح ٢٧ منطقة ساحلية حول بعض جزر البحرين للتعرف على توزيع وكثافة الطيور الخواضة في تلك المناطق . لمقارنة كثافة الطيور في مناطق الدراسة المختلفة اعتمدت طريقة حساب عدد الطيور التي يمكن مشاهدتها في الدقيقة الواحدة . تمت كذلك معاينة مميزات المناطق التي خضعت للدراسة من حيث انحدار الساحل وحجم منطقة المد والجزر التي تنحسر عنها المياه ونوعية التربة . تم كذلك احتساب الوزن الجاف للكتلة الحيوية لكل متر مربع في كل منطقة .

بينت الدراسة أن الطيور الخواضة تزيد أعدادها في المناطق التي يكون فيها انحدار الساحل بسيط وتكون منطقة المد والجزر كبيرة والكتلة الحيوية فيها عالية والتي وصلت إلى ١٦,٨٤ جم/ م^{٢} في منطقة رأس حيان . تراوحت القيم العالية بالنسبة لعدد الطيور من ١٠٠ - ١٤٠ طائر في الدقيقة في حين أن أقل قيمة كانت طائرين في الدقيقة .

تقع المناطق التي تجتذب الكثير من الطيور الخواضة بشكل رئيسي في السواحل الشرقية من جزيرة البحرين الكبيرة التي تتميز بهدوء أمواجها

وتياراتها المائية وخلال الدراسة والمشاهدات الحقلية تم تسجيل ٢٨ نوعاً من الطيور الخواضة الصغيرة والمتوسطة الحجم ، أما الطيور الكبيرة مثل النحام الكبير وأنواع البلشون فقد تم استبعادها نظراً لتواجدها في المناطق الداخلية بعيداً عن بقية الطيور الخواضة .

بينت الدراسة كذلك تأثير نشاطات الانسان من دفن وردم على بعض المناطق الساحلية الهامة التي كانت في فترة سابقة تستقطب أعداداً كبيرة من الطيور الخواضة .