THE DISTRIBUTION OF MIGRATORY WADERS IN SOUTH-WEST SARAWAK

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The first complete survey of waders to be undertaken on the south-west coast of Sarawak was carried out between Santubong and Kuala Igan during the period of southward migration in 1985. Combining the results of a ground and an aerial survey gives a minimum usage for this stretch of coast of 30 757 waders plus 357 at two inland sites. Thirty-four species of wader were observed including two new records for Sarawak. The distribution of waders was found to be heavily influenced by the presence of healthy mangrove systems. One site of international importance was discovered - Pulau Bruit. This held almost 60% of all the waders recorded during the survey including over 1% of the world populations of Asian Dowitcher *Limnodromus semipalmatus* and Eastern Curlew *Numenius madagascariensis*.

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INTRODUCTION

Of all the wetlands of the world, least is known about those of South-east Asia while concurrently there is perhaps most human pressure upon them. In addition to their commercial value, these coastal wetlands are important to large numbers of waders migrating between their breeding grounds in northern China and Russia and their non-breeding grounds in Australia. In order to elucidate the routes these waders use, their major refuelling stops, and the numbers involved, the East Asia/Pacific Shorebird Study Programme (INTERWADER) was established in 1983. As part of its 1985 programme, a survey of the major mangrove and mudflat areas of the Sarawak coast was undertaken.

Utilization of coastal areas by migrant waders in Sarawak has previously been little studied. Limited observations were made by Smythies (1957), Fogden (1965, 1966), Croxall (1969), and Burton (1978) and some collections were made by Banks (1935) and Harrison (1950, 1957). However, no comprehensive survey was completed. This paper provides details of the first complete survey of waders to be undertaken on the south-west coast of Sarawak, carried out between Santubong and Kuala Igan from 28 September to 1 November 1985 and of an aerial survey conducted on 8 November 1985.

STUDY AREA AND HABITATS

Sarawak, one of the two East Malaysian states, is situated on the northern side of the island of Borneo. The coastline is approximately 1 050 km long and is orientated generally in a SW-NE direction. Much of this length comprises sandy beaches but two areas of extensive mangrove and mudflats occur in a large bay east of Kuching in the south-west of the state, and in Brunei Bay in the north-east. The majority of the sandy coast is vegetated with *Casurina equestifolia* and backed by ribbon development of agriculture. The mangrove areas are dominated by *Rhizophora* spp. and, where the coast is actively accreting, by *Avicennia marina*. The palm *Nipa fruticans* predominates along the banks of the estuarine rivers.

METHODS

Before undertaking the field surveys, topographic and land-use maps of the entire Sarawak coastline were examined together with oblique colour aerial photographs taken as part of the National Coastal Erosion Survey (Stanley Consultants 1985). These enabled easy identification of areas with extensive mangroves and mudflats, those with sandy substrate, and those sections which are eroding. These studies indicated that the only areas with wide mudflats were in the two large bays at either end of the state. The bay immediately east of Kuching was selected for the first survey (Figure 1) and a later study looked at Brunei Bay (Howes and NPWO 1986b).

Ground surveys were undertaken using 10 x 40 binoculars and 20 x 60 telescopes mounted on tripods. Beaches and mudflats were surveyed either from small fishing boats or, more satisfactorily, after landing from small speed boats. In the case of sand or hard mud, the area could be traversed easily on foot. Where extensive areas of soft mud were encountered, landing was possible only from the numerous rivers that bisected the flats, and counts were made, therefore, only from these places. Surveys were made for the most part by two people, one identifying and counting, the other recording. Checks were made at random intervals by reversing the roles. In cases where only one person was able to survey, counts were made into a pocket tape-recorder and transcribed later in the day.

All stages of the tidal cycle were encountered during the survey period. By consulting tide-tables it was attempted to survey sandy coasts near high tide in order to identify high-tide roosts. Muddy coasts were counted near mid-tide, where possible, and preferably on the flood so that boats did not get stranded. Time allowed only one count along each part of the coast with the exception of Jerijeh North Sands (counted at both high and low tide on the same day) and a small section of Pulau Bruit (counted twice, 3 weeks apart).

Aerial surveys were made using helicopters provided by the RMAF. One was flown between

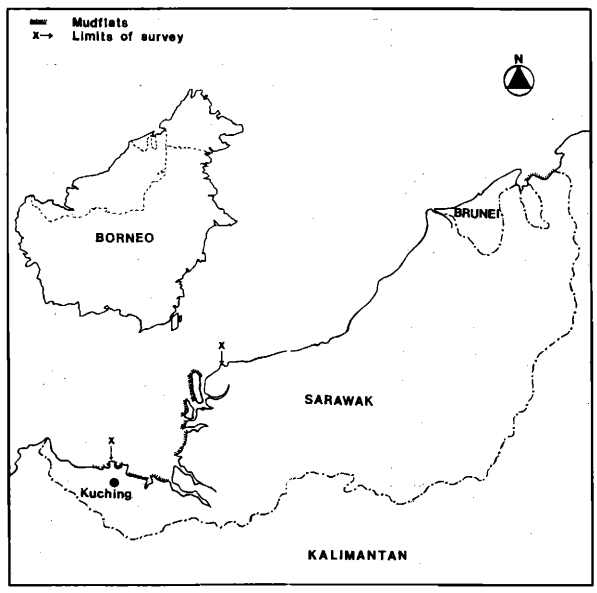

Figure 1. Location of the survey area.

Kuching and Samunsan (to the west) at 1 000 ft and at 1 000 ft in a Sikorsky 61. No waders were recorded, possibly because the altitude was too great. The aerial survey coinciding with most of the area covered on the ground was flown in an Allouette Mk 3 at 60-100 knots below 500 ft. Count data were recorded on tape together with information on habitat. Photographs were taken at important sites.

RESULTS

A total of 28 694 waders were recorded during the ground survey while the subsequent aerial survey produced a count of almost 23 000. The difference between these totals may be accounted for by difficulties in counting birds from the air, e.g. high speed and in places high altitude, leading to under-estimation. Differences may also be due to the onward migration of some birds between the ground surveys in September and October and the aerial survey in November. Not all the aerial counts were, however, lower than the corresponding ground ones. In some sectors, where the ground counts were hampered by poor access or bad weather, the aerial counts revealed larger concentrations of waders. The figures have been combined, therefore, to give a maximum count. This reveals 30 757 waders on this part of the coastline with another 357 found on the two inland sites (Table 1).

Of the 28 694 waders observed during the ground survey, 20 576 (71.7%) were identified to genus or species. Thirty-four species were recognised of which two were new records for Sarawak, namely Black-winged (or Pied) Stilt *Himantopus himantopus leucocephalus* and Sharp-tailed Sandpiper *Calidris acuminata* (Edwards and Polshek 1987). Table 2 provides a breakdown of the numbers recorded by species and by survey sector. It shows that the five most abundant species were Redshank *Tringa totanus* (18.4%), Greater Sandplover *Charadrius leschenaulti* (15.3%), Terek Sandpiper *Xenus cinereus* (13.6%), Red-necked Stint *Calidris ruficollis* (8.0%), and Curlew Sandpiper *Calidris ferruginae* (7.7%).

Coastal Sites

Figure 2 illustrates the distribution of waders over the 14 coastal sectors surveyed. No particular pattern emerges from this although

Table 1. Distribution of waders by sector along the Sarawak coast, recorded during ground and aerial surveys in September - November 1985.

Sector	Ground Survey	Aerial Survey	Max. Count	% Max. Count
S. Buntal - S. Bako	1 161	270	1 161	3.73
West coast Bako NP	149	NS	149	0.48
East coast Bako NP	98	211	211	0.68
M. Tebas - K. Samarahan	34	46	46	0.15
K. Samarahan - K. Sadong	4 054P	5 372	5 372	17.27
K. Sadong - K. Lupar	154	151	154	0.50
K. Lupar - K. Saribas	622	473	622	2.00
K. Saribas - K. Kabong	1 263	145	1 263	4.06
K. Kabong - K. Rajang	600	913	913	2.94
K. Rajang - K. Belawai	746	94	746	2.40
K. Belawai - K. Paloh	368P	940	940	3.02
Pulau Bruit	18 597	14 300	18 597	59.77
Pulau Patok	256	NS	256	0.82
Maura Lassa - K. Igan	317	NS	317	1.02
Sub-total	28 331	22 943	30 757	98.81
Tekajong marsh and rice paddies	134	NS	134	0.43
Kuching Airport	223	NS	223	0.75
TOTAL	28 688	22 943	31 114	

NS = Not surveyed, P = Partial count, S = Sungai, K = Kuala, M = Muara
The maximum count column contains the number of birds recorded on either the ground or aerial surveys - whichever is the highest.
The % maximum count is the percentage of birds recorded in each sector, based on totals in the maximum count column.

Table 2. Distribution of different wader species by sector along the Sarawak coast.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	TOTAL	%
Black-winged Stilt	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3	0.01
Oriental Pratincole	.	.	.	.	.	.	.	1	2	.	.	1	.	.	.	105	109	0.38
Grey-headed Lapwing	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	0.01
Pacific Golden Plover	4	.	.	.	2	.	.	.	.	7	1	34	34	.	.	75	157	0.55
Grey Plover	17	.	.	.	3	2	.	5	17	51	13	246	.	.	18	.	372	1.30
Little Ringed Plover	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	16	17	0.06
Kentish Plover	.	.	.	.	.	.	.	12	11	14	11	3	.	.	4	.	55	0.19
Malaysian Plover	.	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	4	0.01
Mongolian Plover	1	.	.	.	.	.	.	50	9	51	6	1148	1	.	.	.	1266	4.41
Greater Sandplover	303	.	.	.	415	.	23	741	191	179	49	1179	.	2	55	.	3137	10.93
Black-tailed Godwit	2	.	.	.	.	.	.	4	1	.	3	1074	.	.	.	.	1084	3.78
Bar-tailed Godwit	16	.	.	.	11	.	.	.	22	24	25	581	.	.	16	.	695	2.42
Limosa sp.	.	.	.	.	.	.	.	.	.	.	.	191	.	.	.	.	191	0.66
Whimbrel	41	147	.	.	110	15	8	78	55	55	8	175	.	.	9	.	701	2.44
Curlew	1	2	.	.	3	.	.	6	.	8	2	89	.	.	.	.	111	0.38
Eastern Curlew	.	.	.	.	1	.	3	23	.	6	.	246	.	.	.	.	279	0.97
Numenius sp.	.	.	1	.	53	2	29	.	13	.	.	589	.	.	3	.	690	2.40
Redshank	160	.	3	21	510	74	195	14	66	16	.	2698	.	.	32	.	3789	13.21
Marsh Sandpiper	.	.	.	.	.	.	.	.	.	.	.	137	1	.	.	.	138	0.48
Greenshank	.	.	.	.	14	.	3	48	.	1	.	536	2	1	23	.	628	2.19
Green Sandpiper	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	6	0.02
Wood Sandpiper	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	4	6	0.02
Terek Sandpiper	20	.	.	.	438	9	95	128	89	177	33	1696	.	2	110	.	2797	9.75
Common Sandpiper	36	.	.	.	30	1	.	.	1	13	5	151	.	.	4	17	258	0.90
Grey-tailed Tatler	11	.	.	.	1	.	.	4	24	16	5	10	.	.	1	.	72	0.25
Turnstone	19	.	.	.	2	.	.	.	6	20	9	31	.	.	.	.	87	0.30
Galinago sp.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	6	31	0.11
Asian Dowitcher	.	.	.	.	.	.	.	.	.	.	.	470	.	.	.	.	470	1.64
Red Knot	.	.	.	.	.	.	.	.	.	.	5	125	.	.	.	.	130	0.45
Great Knot	.	.	.	.	3	.	.	.	.	.	.	12	.	.	.	.	15	0.05
Sanderling	.	.	.	.	.	.	.	5	3	17	6	4	.	.	.	.	35	0.12
Red-necked Stint	.	.	.	.	.	.	4	90	15	57	2	1454	14	.	1	.	1637	5.71
Temminck's Stint	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	2	0.01
Long-toed Stint	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	2	0.01
Sharp-tailed Sandpiper	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	0.01
Curlew Sandpiper	.	.	.	.	2	.	.	3	.	1	10	1515	48	1	.	.	1580	5.51
Broad-billed Sandpiper	.	.	.	.	.	.	.	.	.	2	2	22	.	.	.	.	26	0.09
Unidentified waders	530	.	5	13	2456	51	262	51	72	29	173	4178	.	251	41	.	8112	28.27
Total	1161	149	9	34	4054	154	622	1263	600	746	368	18602	135	257	317	223	28694	100.00

A = Sungai Buntal – Sungai Bako.
B = West coast Bako Nat. Park.
C = East coast Bako Nat. Park.
D = Muara Tebas – Batang Samarahan.
E = Batang Samarahan – Kuala Sadong.
F = Kuala Sadong – Batang Lupar.
G = Batang Lupar – Kuala Saribas.
H = Kuala Saribas – Kuala Kabong.
I = Kuala Kabong – Kuala Rajang.
J = Kuala Rajang – Kuala Belawai.
K = Kuala Belawai – Kuala Paloh.
L = Pulau Bruit.
M = Tekajong Marshes, Pulau Bruit.
N = Pulau Patok.
O = Muara Lassa – Kuala Igan.
P = Kuching Airport.

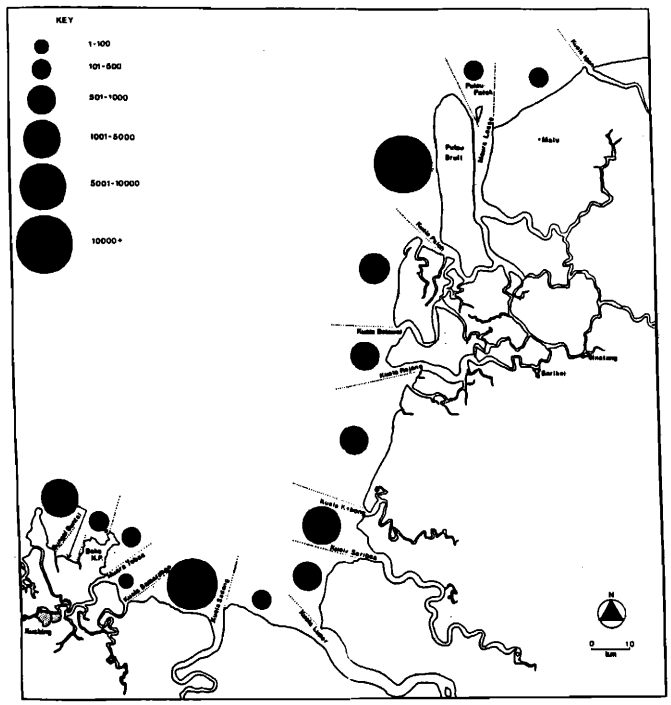

Figure 2. Distribution by sector of waders recorded by ground and aerial survey along southwest coast of Sarawak, September-November 1985.

those sectors holding large numbers of waders contained extensive mudflats. However, the reverse did not hold since several muddy sectors held only low numbers of waders. Two main sites held over 77% of all the waders recorded, these were Pulau Bruit (59.8%) and Kuala Samarahan to K. Sadong (17.3%). All other sectors supported under 5% of the total.

Excluding Pulau Bruit, the wader community of all the coastal sectors combined was dominated by three species - Greater Sandplover (20.1%), Terek Sandpiper (11.3%), and Redshank (11.2%) with Whimbrel *Numenius phaeopus* (5.4%) and Red-necked Stint (1.9%) the fourth and fifth most common species. Twenty other species were present, the most numerous of which was Grey Plover *Pluvialis squatarola* making up less than 1.3% of the total. However, in contrast, Pulau Bruit supported a much richer and more diverse community. The five commonest species were similar to those elsewhere but in a different order - Redshank (14.5%), Terek Sandpiper (9.1%), Curlew Sandpiper (8.1%), Red-necked Stint (7.8%), and Greater Sandplover (6.3%). Twenty-five other species were present of which seven each formed over 1.3% of the total. An annotated list of species recorded is given in Edwards & Polshek (1987).

Differences in community structure between sectors according to substrate was also evident from the differing proportions of Redshank and Greater Sandplover on silty and sandy coasts. Figure 3 shows that a significant negative correlation exists between these two species, with the Redshank preferring the silty sectors ($r = -0.645$, $n = 12$, $p < 0.05$). In this analysis one mainly rocky sector and one where the majority of the birds remained unidentified have been omitted.

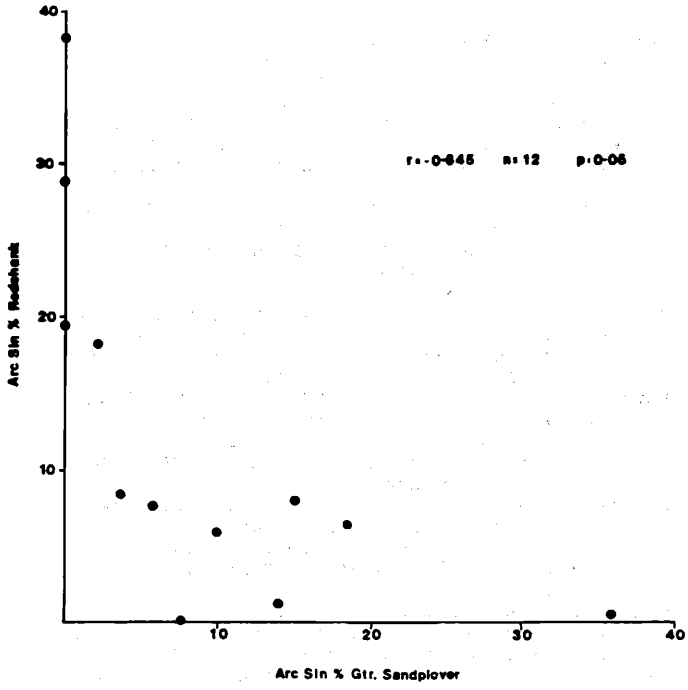

Figure 3. Proportions of Redshank and Greater Sand Plover in the wader population of different coastal sectors in south-west Sarawak demonstrating differential habitat preference. Data has been arc-sin transformed before analysis.

While the distribution of wader numbers is influenced by a wide range of factors, existence of an adequate food supply is probably the most important. In order to make some assessment of the species composition and biomass of the zoo-benthic fauna available, cores of substrate were taken, sieved and the invertebrates found were collected for later identification. Unfortunately, time pressure did not allow the full sampling programme to be completed.

There is considerable variation between the zoo-benthic biomass of intertidal wetlands in South-east Asia (Swennen & Marteijn 1985). Since high productivity within healthy mangrove areas provides the major nutrient flow into the mudflats (Odum & Heald 1972) which in turn affects the zoo-benthic production, as indicated by the use of stable isotope tracers (Rodelli *et al.* 1984), the zoo-benthic biomass of a section of coast is likely to be influenced by the health of the mangrove system along it. Thus, the distribution of wader numbers could be expected to be related to the distribution of healthy mangrove. Following the aerial survey, maps were therefore compiled from photographs and notes made from the helicopter on the extent and health of the mangrove system. The results show that there is significant positive correlation between the proportion of coast in each sub-sector made up by accreting mangrove (its most healthy state) and the number of waders recorded in each sub-sector during the ground survey ($r = 0.725$, $n = 29$, $p < 0.001$). Only those sub-sectors surveyed at low-tide were used. Data were transformed to normalise their distribution before analysis. Other factors are clearly important in influencing the distribution of waders, e.g. the area of mudflat along any section of coast, the amount of time the flats are exposed during a tidal cycle, the proximity of an adequate high tide roost, and the amount of human disturbance by fishermen and shellfish collectors. However, even these fairly crude estimations indicate the importance of healthy mangroves to populations of migrating waders.

Inland Sites

Two inland sites were also surveyed, each very different from the other. One was a freshwater marsh and abandoned paddi fields adjacent to Kampong Tekaong, a small village on the northwest side of Pulau Bruit, less than a mile from the coast. The other was Kuching International Airport. Here the land around the runways is a mixture of dry and damp short grassland with some areas of bare sand. Not surprisingly, the species composition of the waders present was markedly different from that of the coastal sites.

The Tekajong marshes supported a wide variety of herons, bitterns, rails and raptors as well as 134 waders (see Table 2). This proved to be the only site during the survey where three species were recorded, namely Black-winged Stilt (first Sarawak record), Grey-headed Lapwing *Vanellus cinereus* (second Sarawak record) and Green Sandpiper *Tringa ochropus*.

Three visits were made to Kuching Airport during October and November which resulted in a maximum count of 223 waders (Table 2). Oriental Pratincole *Glareola maldivarum* numbers declined from 105 individuals on 5 October to 61 on 22 October and 28 on 5 November, while Asian Golden Plover *Pluvialis fulva* increased from 12 to 51 to 75 birds over the same dates. The two maximum counts were the highest numbers of these species recorded during the entire survey, as were counts of 16 Little Ringed Plover *Charadrius dubius* and 4 Wood Sandpipers *Tringa glareola* made on 5 November.

Pulau Bruit

The survey discovered the north and west coasts of Pulau Bruit to be of major importance to birds both in an international and national context. Indeed, the results suggested that this site is the most important coastal wetland in all of Malaysia. A follow-up study was undertaken in April 1986 to ascertain the numbers using it during the northward migration (Howes & NPWO 1986a). Since at the time of both surveys Pulau Bruit was unprotected, strong recommendations were made that it be gazetted as a wildlife sanctuary (Edwards *et al.* 1986, Howes & NPWO 1986a) under the provisions made by the Wildlife Protection Ordinance 1958 (Sarawak Chap. 128). Pulau Bruit qualifies as a wetland of international importance of the Ramsar Convention on the Conservation of Wetlands especially as waterfowl habitat, for several reasons:

1. During southward migration, 18 602 waders were recorded, together with 3 541 terns, 380 Garganey *Anas querquedula*, 234 egrets and 40 Lesser Adjutant Storks *Leptoptilos javanicus*; a total of 22 797 waterbirds. During northward migration these totals were 15 231 waders, 14 505 terns, 1 Garganey, 504 egrets and 11 storks; a total of 30 342 waterbirds. Furthermore studies in Sabah (Parish, Beadle & Whittaker, unpubl.) and in Morocco (Kersten & Smit 1984) indicate that the total number of waders using a site during a complete migratory season is between 3 and 4.5 times the peak count. These figures suggest that the total number of waders using Pulau Bruit during both migration periods is somewhere between 45 000-84 000 birds.

2. The count of 470 Asian Dowitchers *Limnodromus semipalmatus* in October 1985 at the time represented the fifth highest count of this species anywhere in the world, and formed about 5% of the world population of this ICBP Red Data Book "endangered" species. Counts of 411 (April 1986) and 246 (October 1985) Eastern Curlew *Numenius madagascarensis* represent over 4% and 2.5% of the currently estimated world population of this species.

3. The presence of Chinese Egret *Egretta eulophotes*, an ICBP Red Data Book "vulnerable" species. 2 birds were seen in October 1985 and 5 in April 1986.

In a national context, Pulau Bruit is the most important site in Malaysia for waders and terns. It is also the most important site in Sarawak for ducks, egrets and the Lesser Adjutant Stork. In addition, the following additional species, all of which are protected by the Malaysian Government under the First Schedule of the Wildlife Protection Ordinance (Sarawak Cap. 128): Eastern Reef Egret *Egretta sacra*, Cattle Egret *Bubulcus coromandus*, White-bellied Sea Eagle *Halialetus leucogaster*, and Proboscis Monkey *Nasalis larvatus*.

After recommendations made in Edwards *et al.* (1986) and Howes & NPWO (1986a), the Sarawak State Government agreed to a specific proposal by the National Parks and Wildlife Office (NPWO) in 1987 to formally gazetteer the site and, through the NPWO, in early 1988 was implementing the required procedures vigorously. Although slightly different to those originally suggested, boundaries of the new Wildlife Sanctuary are presently being marked out on the ground and the local populace are being informed of the restrictions placed upon activities within them. Such a positive response by the State Government to protect this important site is to be applauded.

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