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MIGRATION

CLUES TOWARDS THE MIGRATION ROUTE FOR GREATER AND LESSER SAND PLOVERS SPENDING THE NON-BREEDING SEASON IN KENYA

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INTRODUCTION

The Lesser Sand Plover *Charadrius mongolus* and Greater Sand Plover *C. leschenaultii* are closely-related medium-sized, long-distance migrant waders. They both breed across central Asia and spend the non-breeding season in Africa, the Middle East, southern Asia and Australasia (Cramp & Simmons 1983, Higgins & Davies 1996, Balachandran 1998, Hirschfield et al. 2000). Despite often being common and occurring in large numbers surprisingly little is known about their breeding and non-breeding distribution or migration routes, particularly for those migrating west to the Middle East and Africa (Hirschfield et al. 2000; Delany et al. 2009).

Lesser Sand Plovers spending the non-breeding season the East African coast are considered to be the race *C. m. pamirensis* which breed in the high altitude mountainous regions of Kyrgyzstan, Tajikistan and Tibet (Cramp & Simmons 1983, Hirschfield et al. 2000, Delany et al. 2009). The Greater Sand Plovers which migrate to Kenya and the East African coast were previously considered to be the race formerly known as *C. l. crassirostris*, now reclassified as *C. l. scythicus* (Carlos et al. 2012). However careful analysis of museum specimens has shown that in fact East African birds are of the nominate race that breeds in north-western China (Hirschfield et al. 2000, Delany et al. 2009).

In both species the adults return to their breeding grounds annually. Young birds, however, mostly remain on the non-breeding grounds at the end of their first year and only migrate back to breed at the end of their second year (Cramp & Simmons 1983, del Hoyo et al. 1996, Higgins & Davies 1996).

The migration timing and route for Lesser and Greater Sand Plovers following the East Asia/Australasia Flyway into Australia are relatively well-known, in particular for the latter species for which geo-locator results have been obtained (Minton et al. 2011, 2013). However, migration routes remain a mystery for those populations following the Central Asia/South Asia Flyway to move south and west into south Asia, and the Central Asia/East Africa Flyway to the Middle East and onwards south to the east coast of Africa.

This paper presents new ringing recovery information relating to both species and suggests some possible options for their migration route between Kenya and their breeding grounds.

METHODS

Lesser Sand Plovers and Greater Sand Plovers were caught, ringed and released in Kenya during regular wader-ringing sessions at Mida Creek, Watamu (3°19′S 39°57′E), between 1977 and 2014. Birds were trapped using mist-nets and each one ringed with a uniquely numbered metal ring and from 2010 all Lesser Sand Plovers, Greater Sand Plovers and Terek Sandpipers *Xenus cinereus* had a coloured leg flag with a unique two-letter inscription placed above the ‘knee’ of the right leg.

Each bird was aged where possible, to 'first year' and ‘sub-adult’ (those finishing their first year of life and entering the second year) and 'adult' (defined as ‘more than one year old’) by plumage characteristics described by Prater et al. (1977) and from personal observation (DJ

Pearson pers. comm. & own observations). On most birds the wing-length, 'head' (bill + skull), tarsus, mass and primary moult score were measured.

RESULTS

Over 10,000 waders were ringed at Mida Creek of which 1,097 were Lesser Sand Plovers and 1,262 Greater Sand Plovers, each therefore making up c.10% of the birds caught. Over 300 of each species were marked with colour flags.

In the fattening period before migration (January-May), adult Lesser Sand Plovers increased in mean monthly weight from 51.5 g in January to 68.7 g in May with the maximum recorded individual mass of 82 g (Table 1). For Greater Sand Plovers, the mean monthly mass for adults started at 74.7 g in January and peaked at 94.8 g in March with a maximum individual mass of 112 g (Table 1).

Table 1 *– Maximum and mean mass per month for adult Lesser and Greater Sand Plovers ringed at Mida Creek, Kenya, in the period leading up to migration, January–May.*

	Lesser Sand Plover			Greater Sand Plover		
Month	**Av mass**	**Max mass**	**n**	**Av mass**	**Max mass**	**n**
Jan	51.5	60	55	74.7	99	41
Feb	53.2	63	92	81.2	104	134
Mar	55.5	71	99	94.8	112	130
Apr	63.2	82	88	92.2	110	58
May	68.7	81	15	89.5	101	5

Ringing recoveries

Until 2015 there had only been two recoveries of ringed birds from all waders ringed on the East African coast: a Lesser Sand Plover recovered on the Pakistan coast in 1985 and a Terek Sandpiper controlled on its nest in Finland in 2008 (Ringing Scheme of East Africa unpubl. data). Over 150 re-sightings of flagged birds have been made at Mida Creek and the adjacent Watamu beach spanning all years since 2010. Three Greater Sand Plovers have been seen with colour flags at Sabaki River Mouth c. 27 km to the north and one colour-flagged Terek Sandpiper was observed at a roost on saltworks at Gongoni c. 45 km north of Mida Creek.

Figure 1 - Greater Sand Plover with flag 'TA' photographed at Modhava Beach, Mandvi, India, 10 April 2015. Photo: Prashant Tewari

On 10 April 2015 a Greater Sand Plover with an orange leg flag and the inscription 'TA' was photographed on Modhava beach near Mandvi, Gajarat, India (22°46'N 69°26'E) (Fig.1). This was ringed as Nairobi Museum A70821 on 8 November 2004 at Mida Creek by A Rocha Kenya as an adult. It was then retrapped on 16 September 2013 at Mida Creek also by A Rocha Kenya when the leg flag was attached. Remarkably, a year later on 29 March 2016 the same Greater Sand Plover—orange flag 'TA'—was photographed again at the same Modhava beach, Mandvi, India (Table 1, Fig 1). This was the first recovery of a Greater Sand Plover from the East African coast. There is one other recovery of this species in Africa—one ringed on the Sudanese Red Sea coast in September 1981 and killed on its nest in Syria the following April (Nikolaus & Backhurst 1982).

Figure 2 - Greater Sand Plover with flag 'TA' photographed on Modhava Beach, Mandvi, India on 29 March 2016. Photo: Suman Parekh

Table 2 *- Ringing and recovery details of Lesser and Greater Sand Plovers involving East Africa*.

Lesser Sand Plover *Charadrius mongolus*			
A43250	12.12.1982	Mida Creek, Kenya	
	3.9.1985	Shadi Kor, Pasni, Baluchistan, Pakistan, 25° 13N, 63° 30E	4,065 km; 2y, 8m, 22d
F00344	20.1.2013	Mida Creek, Kenya	
	22.5.2016	Modhava, Mandvi, Gujarat, India; 22°46'N 69°26'E	4,318 km; 3y, 4m, 1d
Greater Sand Plover *Charadrius leschenaultii*			
A42779	7.9.1981	Suakin, Red Sea coast, Sudan; 19°08'N 37°17'E	
	3.4.1982	Habara, Syria; 35°40'N, 37°45'E	1,838 km;
A70821	8.11.2004	Mida Creek, Watamu, Kenya	
	16.9.2013	Mida Creek, Watamu, Kenya	0 km; 8y, 10m, 10d,
	10.4.2015	Modhava, Mandvi, Gujarat, India; 22°46'N 69°26'E	4,318 km; 10y, 5m, 3d
	29.3.2016	Modhava, Mandvi, Gujarat, India	4,318 km; 11y, 4m, 22d

On 22 May 2016 a Lesser Sand Plover with a white leg flag 'S0' was also photographed on the same Modhava beach near Mandvi, India as the March record of the Greater Sand Plover, by the same photographer, Mr Suman Parekh. This is only the second recovery of

this species in Africa. Details of all recoveries to date for Lesser and Greater Sand Plovers relating to East Africa are given in Table 2.

DISCUSSION

Lesser Sand Plovers spending the boreal winter in Kenya are of the race *pamirensis* that breed in the Pamir Mountains with a westerly limit of Tajikistan and Kyrgyzstan. The bird recovered in September 1985 on the Pakistan coast fits well for a migrant stopping en route from these more westerly breeding grounds to its non-breeding grounds in Kenya. From Pakistan a natural route south would follow the eastern coastline of the Arabian Peninsula and from there across the Horn of Africa, down the Somali coast and to Kenya. Similarly, the recovery during the northward migration in May from Mandvi, India, is from the same general area being c. 650 km west of the Pakistan site, perhaps suiting a route to the more easterly breeding areas for *pamirensis* in north-west China, a maximum distance of 2,500-2,900 km from Mandvi. The relatively late date of the Indian recovery fits with other observations of Lesser Sand Plovers having a delayed northward migration (Pearson & Britton 1980, Keijl et al. 1998). The likely reason for this being that Lesser Sand Plovers, whilst not breeding in the high arctic, breed at high altitude where climatic conditions conducive to breeding such as warmer temperatures and melt of snow cover occur later than at lower altitude (Keijl et al. 1998).

The Greater Sand Plover ringed on the Sudanese coastline of the Red Sea and recovered breeding in Syria (Table 2) confirms that at least some birds of the race *columbinus* spend the non-breeding season along the Red Sea. Greater Sand Plovers spending the non-breeding season in Kenya are of the nominate race *leschenaultia,* most likely from the western end of the *leschenaultii* breeding range in north-west China because birds from the east are known to migrate south-east to Australia (Minton et al. 2013). While there are yet to be any recoveries during the southward migration, it is not unlikely that they follow a similar route as Lesser Sand Plovers given that the breeding grounds more-or-less overlap. Evidence from the recovery at the same location on the northward migration of both Lesser and Greater Sand Plover would reinforce the probability of both species using a similar route. The Greater Sand Plover 2016 recovery in India was eight weeks earlier than the subsequent sighting of the Lesser Sand Plover which matches the lower altitude that Greater Sand Plovers breed at, where breeding conditions are reached at an earlier date than on the high altitude steppe where the Lesser Sand Plovers breed.

The sightings of flagged birds both at the ringing site on Mida Creek and at the nearby Watamu beach (c. 3 km from the ringing site) confirm the level of site fidelity Lesser and Greater Sand Plover have during the non-breeding season. The sightings of birds at Sabaki River Mouth are indications that local movements occur of birds from Mida to other foraging and roosting sites in the area.

Perhaps of particular interest is the attempt to understand the more specific route that the Lesser and Greater Sand Plovers take to reach the stopover site on the Indian coast. More information is available for Greater Sand Plovers which we shall focus on in this discussion. From work done in Australia, Greater Sand Plovers leave Broome in north-western Australia and fly non-stop to Vietnam or the Philippines, a distance of 3,800 km (Minton et al. 2013). The mean weight of Australian birds in March just before they depart in early April is 98.1 g and the maximum mass for an individual is 134 g with almost 10% of adults during this period weighing more than 110 g (Australasian Wader Studies Group unpubl. data). Kenyan birds, on the other hand, had a maximum monthly mean of 94.8 g (3.5 g less than Australian birds) and maximum mass of 112 g (22 g less than Australian birds), and yet the distance to the stopover site in India is c. 500 km farther (4,300 km). If the fat load necessary for Australian birds to reach

Vietnam is the full load of up to 130 g, then it should mean that Kenyan birds would fall short of the stopover site in India. The alternatives are:

1) Australian birds fatten up more than is needed to reach the first stopover (e.g. Vietnam) site in order to reduce the time necessary to fatten further for the next 3,100-4,500 km flight to the breeding grounds.
2) Kenyan birds use an intermediary stopover site which the lower fat load will enable them to reach and where they can fatten further for the leg to India.

The first alternative is unlikely. Birds will always minimise the amount of weight they need to carry for flight (Newton 2010). If Kenyan birds fatten to around 100–110 g before departure to take them 4,300 km, then Australian birds are carrying probably 30 g or more of additional weight which is unlikely to be worth the effort. This might only be so if foraging conditions at stopover sites on the southern Asian coast are particularly poor. But all indications are that these foraging sites are rich for shorebirds with many thousands using them for passage and for the non-breeding season (Buckton & Safford 2004, Zou et al. 2008).

Fig 3 - Lesser Sand Plover with flag 'S0' photographed on Modhava Beach, Mandvi, India on 22 May 2016. Photo: Suman Parekh

More likely is the second alternative. On the east coast of the Arabian Peninsula, one place stands out as the most likely stopover site. This is Barr al Hikman in Oman (20°30'N 58°12'E) which is a known non-breeding and stopover site for many thousands of waders (Evans & Keijl 1993, Green et al. 1994, Green & Harrison 2008, Klaassen & de Fouw 2008, Delany et al. 2009). The distance from Mida Creek to Barr al Hikman is 3,350 km and from Barr al Hikman to Mandvi, India, c. 1,200 km. Flying at an average speed of 50 km/h (Minton et al. 2013) the first leg would take approximately three days and the second leg just 24 hours. With good feeding conditions in Oman, birds could probably gain sufficient fat to make this second leg in just 7–10 days. Pearson & Britton (1980) suggested that Greater Sand Plovers depart Kenya in the second half of April. However this does not fit the dates of the recoveries in India (29 March and 10 April). Regular counts in every five-day period (pentade) over two years at Mida Creek suggested that in fact Greater Sand Plovers start to leave as early as the first week of March (C. Jackson in press). A bird leaving Mida, therefore, on 10 March would reach Barr al Hikman after three days, on 13 March. The 1,200 km flight to India would take just 24 hours, thus to reach there by 29 March, a bird would have a good 10–14 days in which to feed and put on sufficient fat to make the next leg of the journey which is more than enough; a week would probably be sufficient.

To test this, I applied the flight range estimation formula proposed by (Castro & Myers 1989):

$$\text{Range} = 26.88 * S * L^{1.614}(M_1^{-0.464} - M_2^{-0.464})$$

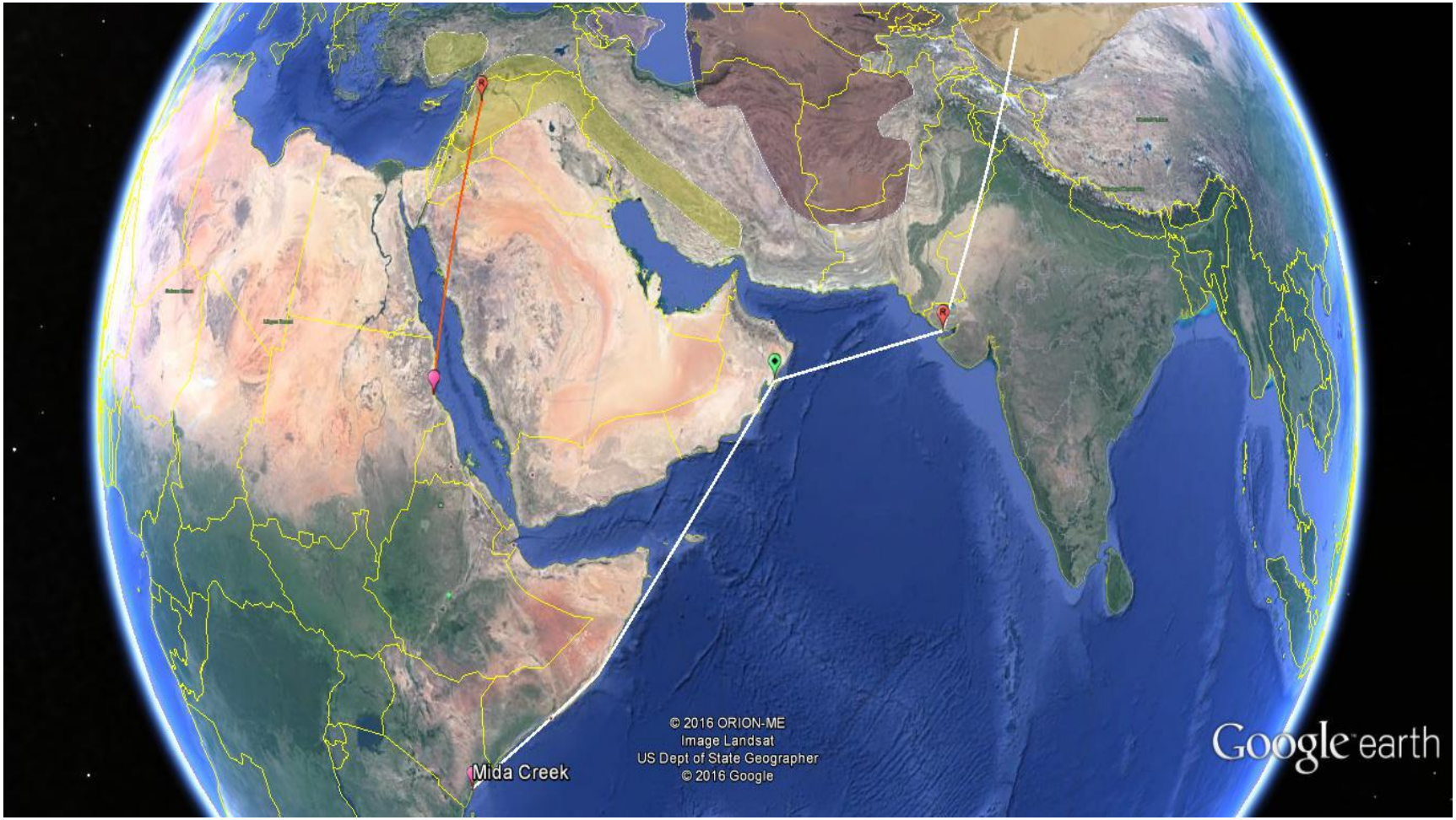

Fig 4 - Presumed route (white line) of Greater Sand Plovers *Charadrius leschenaultii leschenaultii* returning to breeding grounds (orange block) from non-breeding grounds in Kenya via Barr al Hikman, Oman, (green marker) and Mandvi, India (red marker). The red line connects the ringing site of a Greater Sand Plover on the Red Sea to its nesting site in Syria where it was recovered. The yellow block marks the breeding range of *C. l. columbinus* and brown the range of *C. l. scythicus*.

Taking S (flight speed) to be 50 km/h, L (wing-length) = 14.6 cm, M_1 (mass at end of flight) = 60 g and M_2 (mass at start of flight) = 105 g gave an estimated range of 3,482 km. This is an almost perfect match for the distance from Mida Creek to Barr al Hikman particularly because birds will tend to add extra fat as 'insurance' against encounters with unexpected delays such as poor weather and headwinds (Newton 2010).

It would therefore seem plausible that the return migration strategy for the Greater Sand Plovers (and the likely strategy for Lesser Sand Plovers as well) which spend the non-breeding season on the East African coast, is to make a single flight north to Barr al Hikman where they fatten briefly for a further shorter flight to the north-west Indian coast. Here they stop for sufficient time to fatten again in order to make the remaining leg to the breeding grounds in west and north-western China between 2,000–3,000 km to the north-east.

Further recoveries of flagged or ringed birds are needed to confirm this strategy, particularly at Barr al Hikman, Oman. Unfortunately, much of the wader study fieldwork which has been done there has focused on the months of the northern winter, rather than on the passage migration period of March to May. Thus there have not been observers present to watch for marked birds. Ideally, focused ringing should be carried out at Barr al Hikman over these months, together with a diligent search for flagged birds. The beaches near Mandvi in India would also appear to be an important location to survey with ringing and further observations in order to better understand the full migration strategy of these two handsome species.

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