The populations and distribution of the breeding birds of the Socotra archipelago, Yemen: 2. Shearwaters to Terns

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This, the second of two papers on the distribution and population of the breeding birds of the Socotra archipelago, covers the 24 species of seabirds, waterbirds, herons, birds of prey, waders, gulls and terns that breed or may breed. It is the result of studies since 1999 and complements the paper covering Sandgrouse to Buntings (Porter & Suleiman 2013a). For each species there is a map showing breeding distribution and, when available, an estimate of the population, and brief notes on habitat and breeding biology. In the case of most seabirds population estimates are crude because of the difficulties of surveying inaccessible nesting areas. The only globally threatened species covered in this paper are Socotra Cormorant *Phalacrocorax nigrogularis* (vulnerable), Egyptian Vulture *Neophron percnopterus* (endangered) and Socotra Buzzard *Buteo socotraensis* (vulnerable), whilst the breeding endemic Jouanin's Petrel *Bulweria fallax* is classified as near threatened. In addition a further three species have been identified as regionally threatened, Yellow Bittern *Ixobrychus sinensis*, Masked Booby *Sula dactylatra* and Peregrine Falcon *Falco peregrinus*. Eight species have globally important breeding populations in the archipelago, namely Persian Shearwater *Puffinus persicus*, Jouanin's Petrel, Red-billed Tropicbird *Phaethon aethereus*, Brown Booby *Sula leucogaster*, Socotra Cormorant, Egyptian Vulture, Socotra Buzzard, Sooty Gull *Larus hemprichii* and possibly Saunders's Tern *Sternula saundersi*. Three species of heron, previously vagrants, may now have colonised the main island, Socotra. Threats and conservation issues are discussed.

INTRODUCTION

The Socotra archipelago (12.30° N, 54.00° E) is part of the Republic of Yemen. Situated east of the Horn of Africa and *c*350 km south of the Yemen mainland in the Arabian sea, it comprises the main island (Socotra, *c*3700 km^2, Plates 1–4), three satellite islands (Abd Al Kuri, Samha and Darsa, Plates 5–7) and the sea stacks of Sabuniya (a small sea stack of three peaks, the highest *c*80 m asl, 35 km to the west of Socotra, Plate 8) and Kal Farun (two sea-stacks, also known as Ka'l Pharoehs or The Brothers, 30 km north of Abd Al Kuri). For further details see Porter & Suleiman (2013a). The archipelago is internationally acclaimed for its unique flora and fauna, with over 350 species of endemic plants, at least 21 endemic reptiles and eleven species of endemic birds (Cheung & DeVantier 2006, Porter & Suleiman 2013b). This biological richness of the islands encouraged UNESCO to declare the Socotra archipelago a World Heritage Site in 2008.

Dedicated visits to study the avifauna of the Socotra archipelago have been made since the late 19th century: *eg* Sclater & Hartlaub (1881), Forbes (1903) and Ripley & Bond (1966). However, the first population studies were attempted during the OSME survey of 1993 (Davidson 1996, Kirwan *et al* 1996, Porter & Martins 1996). Then between 1999 and 2011

Figure 1. The Socotra archipelago showing the islands and sea stacks.

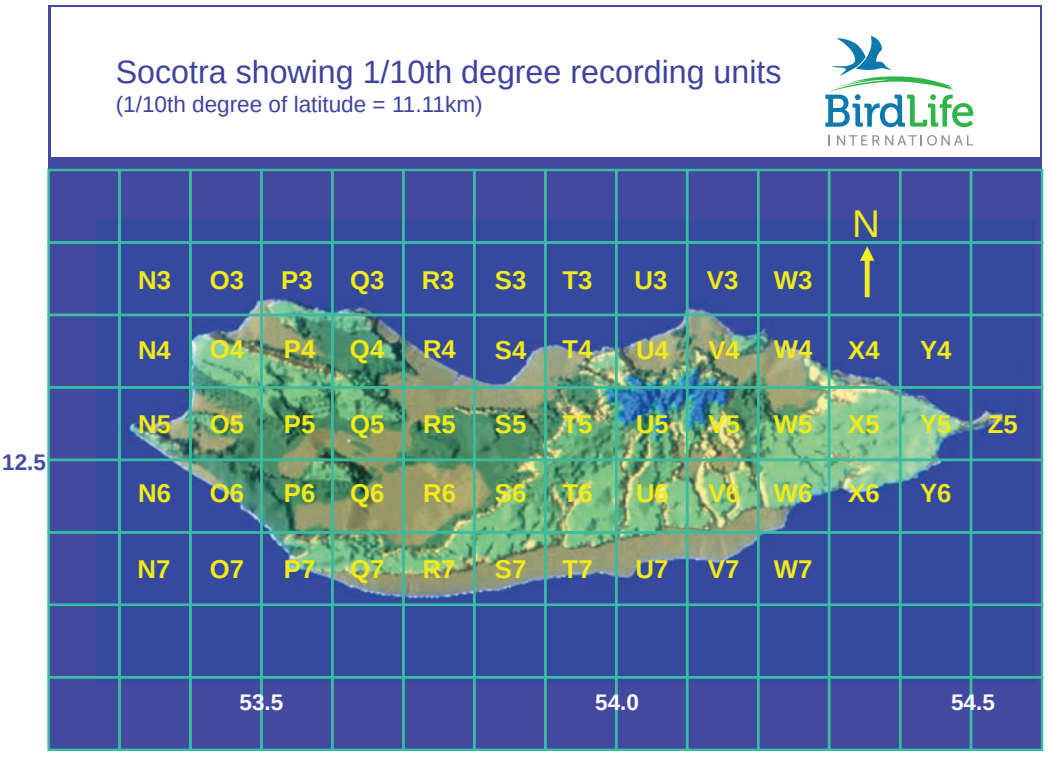

Figure 2. Socotra showing 1/10th degree recording 'squares' (see text).

Plate 1 (left)**.** The southeastern cliffs of Socotra, a nesting site for seabirds, November 2011. © *RF Porter*

Plate 2 (right)**.** Limestone cliffs, central Socotra, which provide nesting sites for Egyptian Vultures *Neophron percnopterus*, Socotra Buzzards *Buteo socotraensis*, Common Kestrels *Falco tinnunculus* and Peregrine Falcons *F. peregrinus*, February 2007. © *RF Porter*

nine surveys (all between October and March) were undertaken by BirdLife International together with the then Socotra Conservation and Development Programme SCDP and Yemen's Environment Protection Authority EPA to assess the distribution and population of the breeding birds of the main island of Socotra. In addition, from 1999–2007, six visits were made to the outer islands (Abd Al Kuri, Samha and Darsa) and the sea stacks of Sabuniya and Kal Farun under the auspices of the EPA and SCDP. In 2009 Sabuniya was visited again (Holmstrom & Stahle 2010).

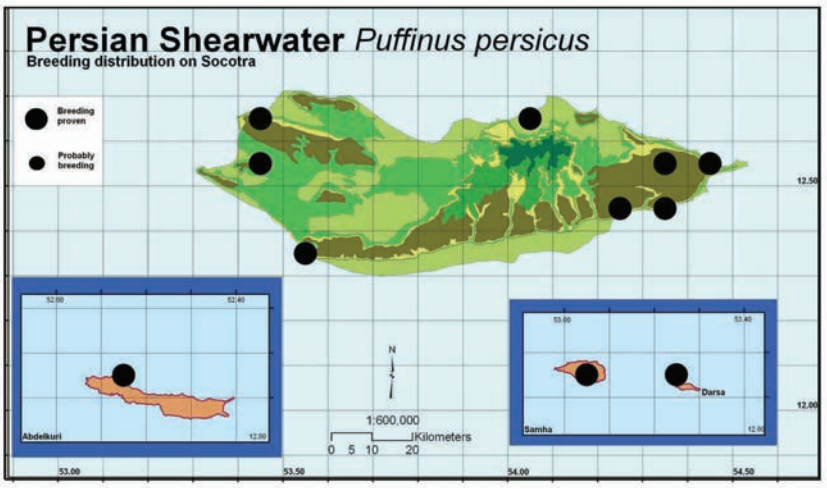

Figure 3. Persian Shearwater: Socotran breeding distribution.

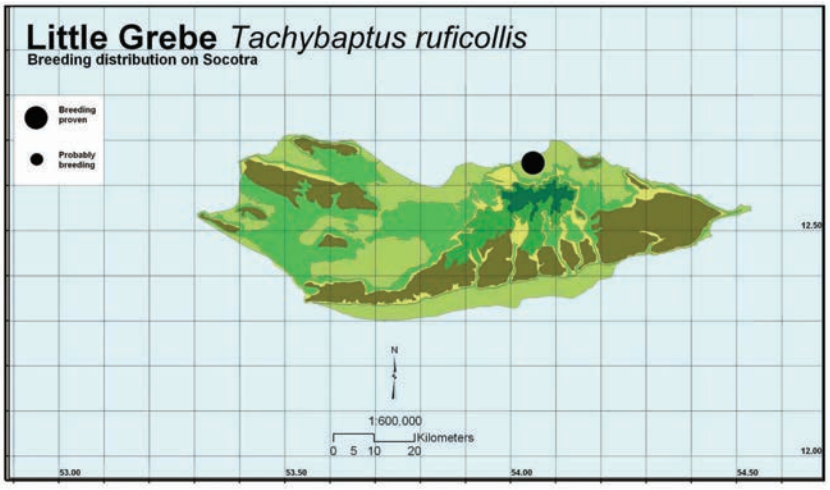

Figure 4. Little Grebe: Socotran breeding distribution.

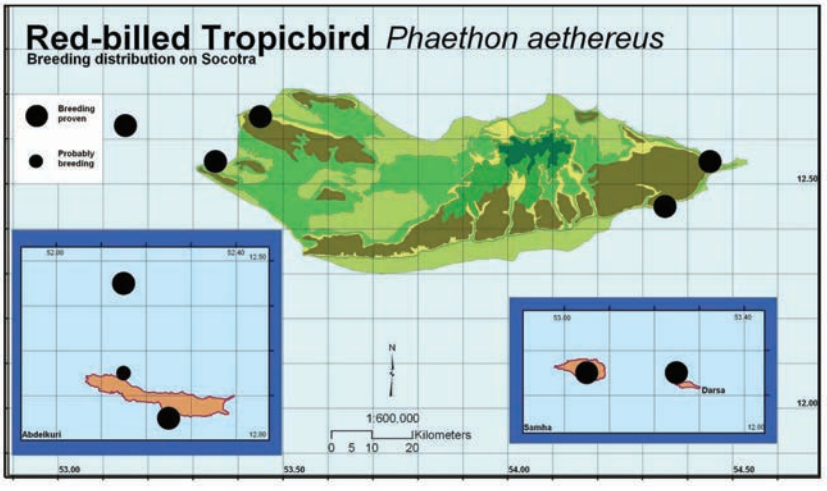

Figure 5. Red-billed Tropicbird: Socotran breeding distribution. The large dot west of the main island is over Sabuniyah sea stack. The large dot north of Abd Al Kuri is over Kal Farun.

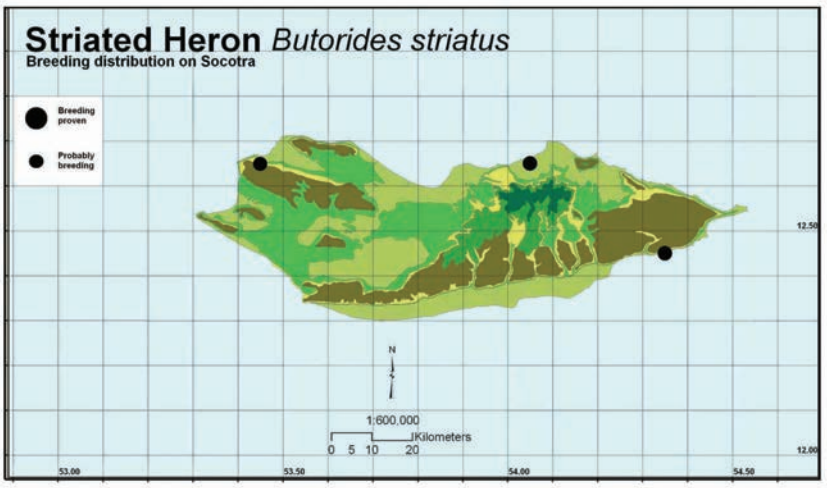

Figure 6.
Striated Heron: Socotran breeding distribution.

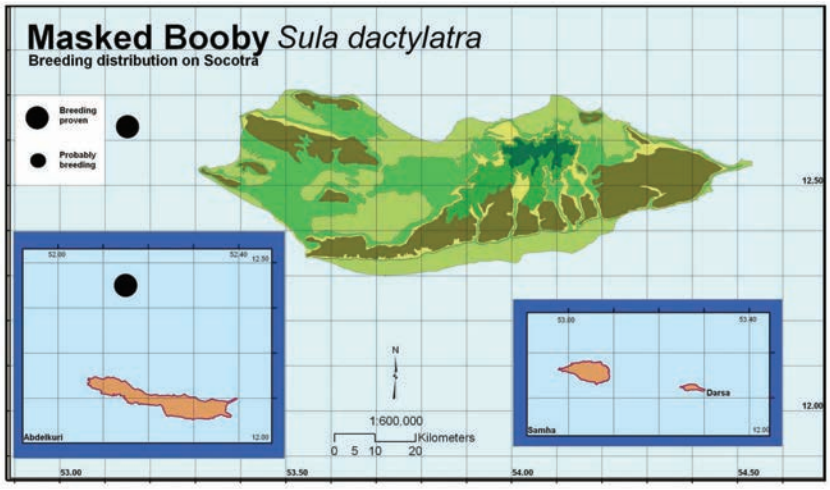

Figure 7.
Masked Booby: Socotran breeding distribution.

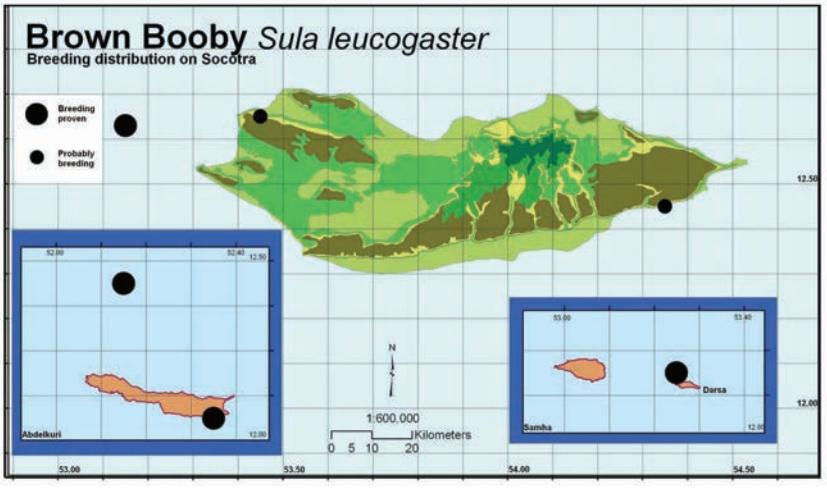

Figure 8.
Brown Booby: Socotran breeding distribution.

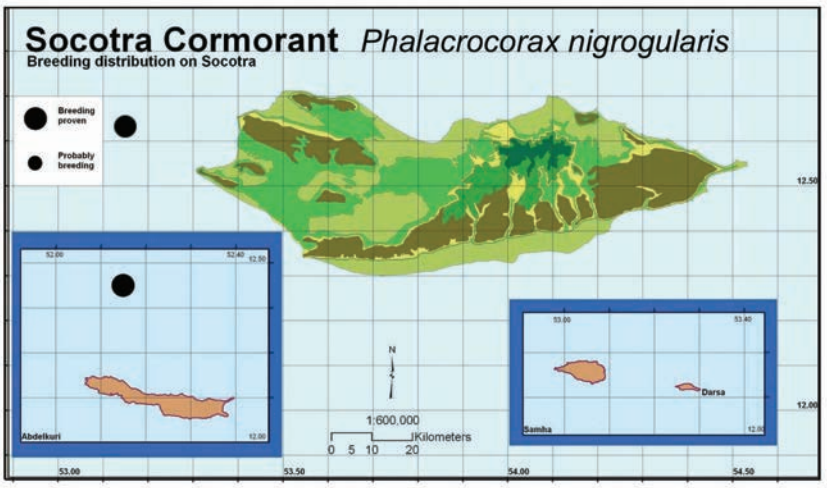

Figure 9. Socotra Cormorant: Socotran breeding distribution.

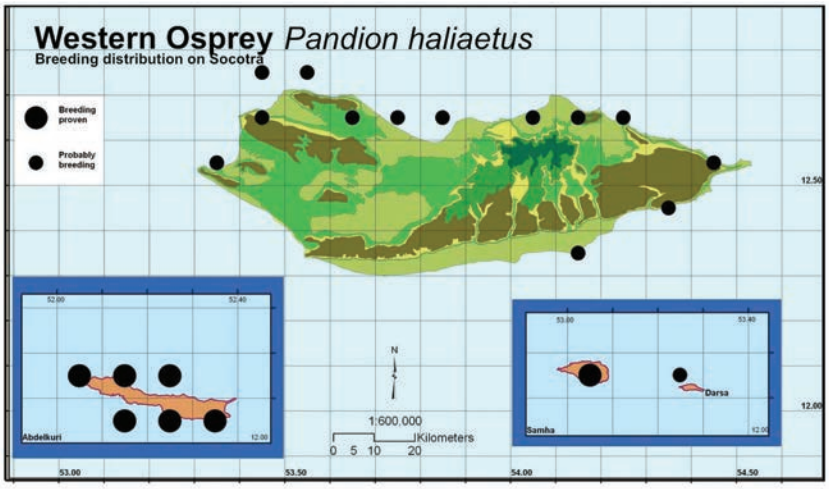

Figure 10. Western Osprey: Socotran breeding distribution.

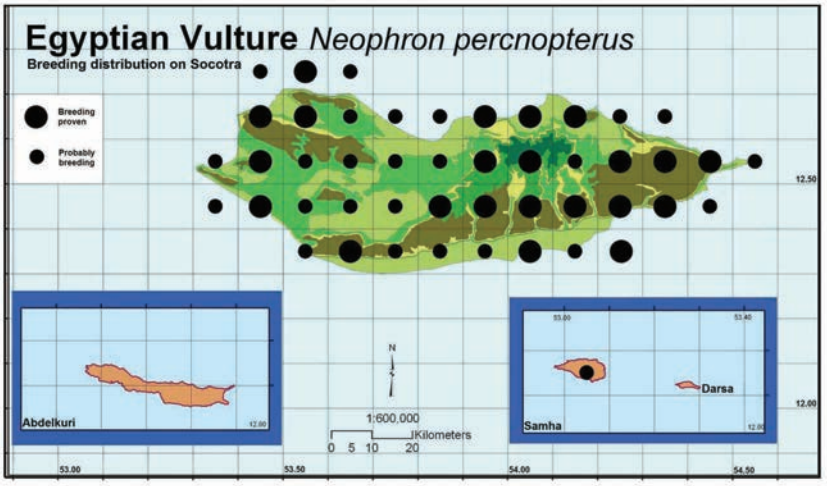

Figure 11. Egyptian Vulture: Socotran breeding distribution.

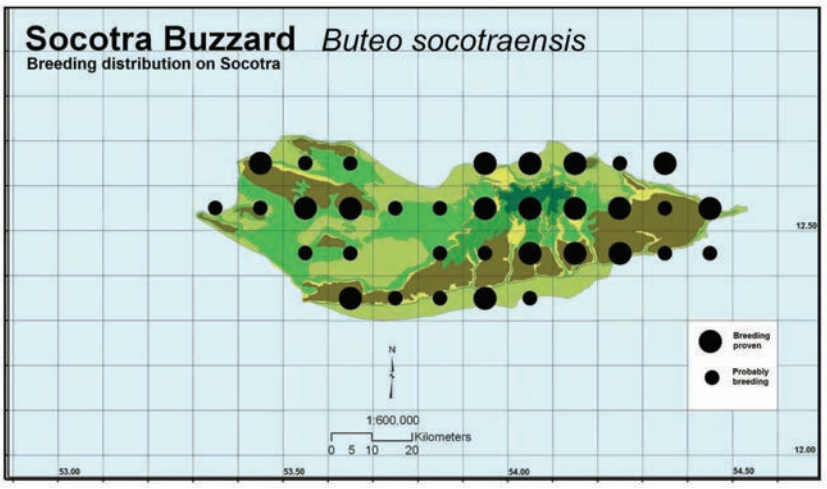

Figure 12. Socotra Buzzard: Socotran breeding distribution.

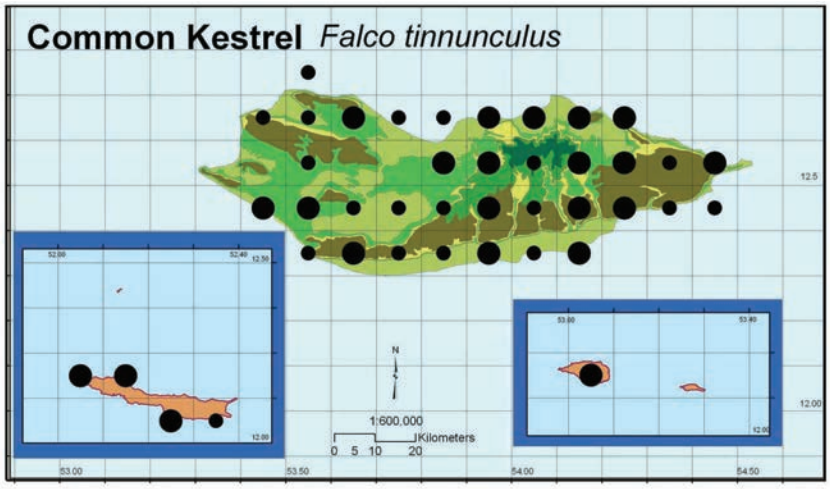

Figure 13. Common Kestrel: Socotran breeding distribution. Large dots indicate breeding proven, small dots probably breeding.

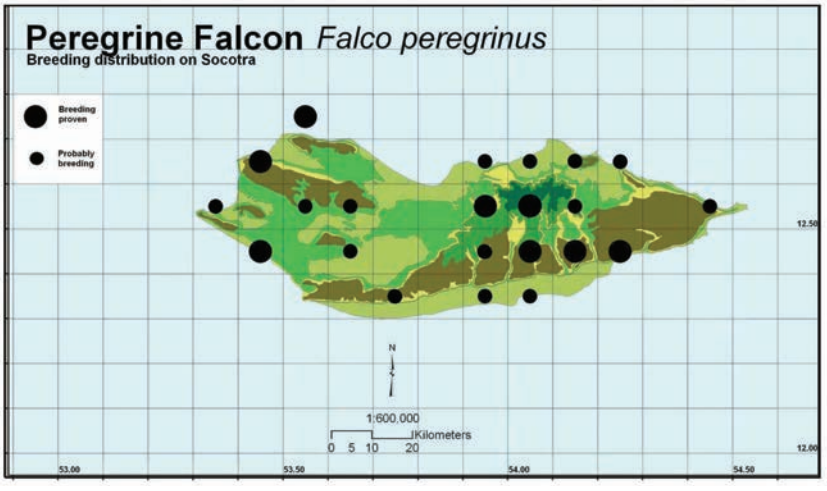

Figure 14. Peregrine Falcon: Socotran breeding distribution.

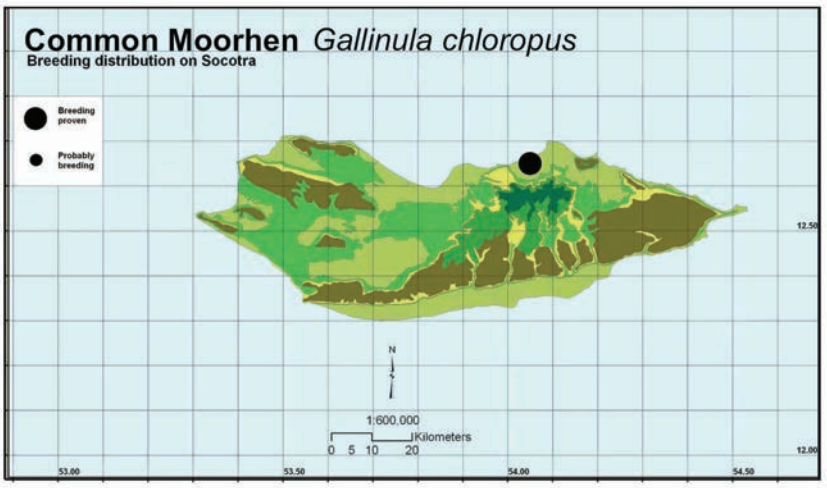

Figure 15. Common Moorhen: Socotran breeding distribution.

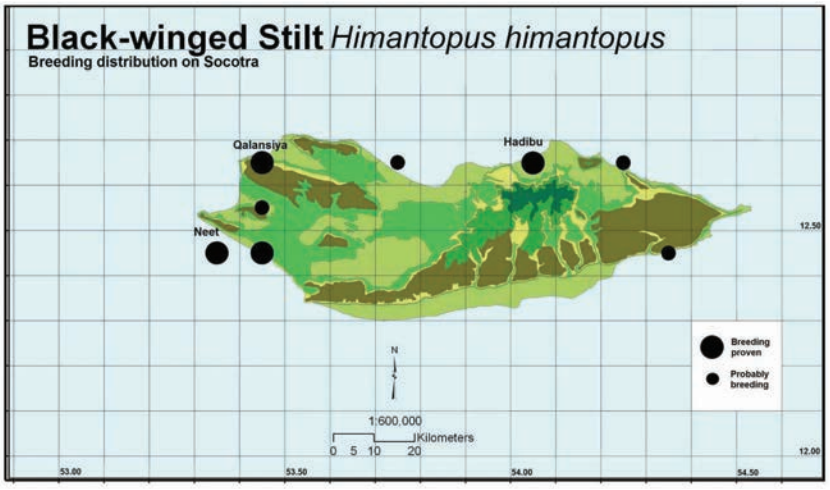

Figure 16. Black-winged Stilt: Socotran breeding distribution. The place names are relevant to the account in Suleiman (2009).

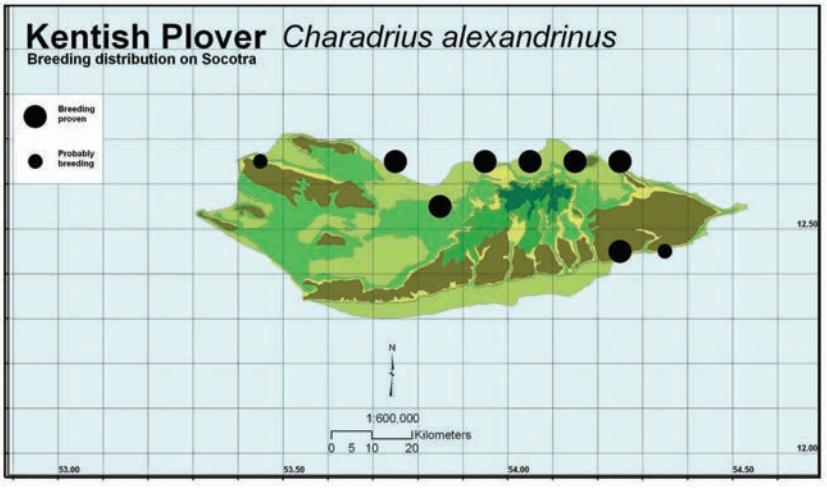

Figure 17. Kentish Plover: Socotran breeding distribution.

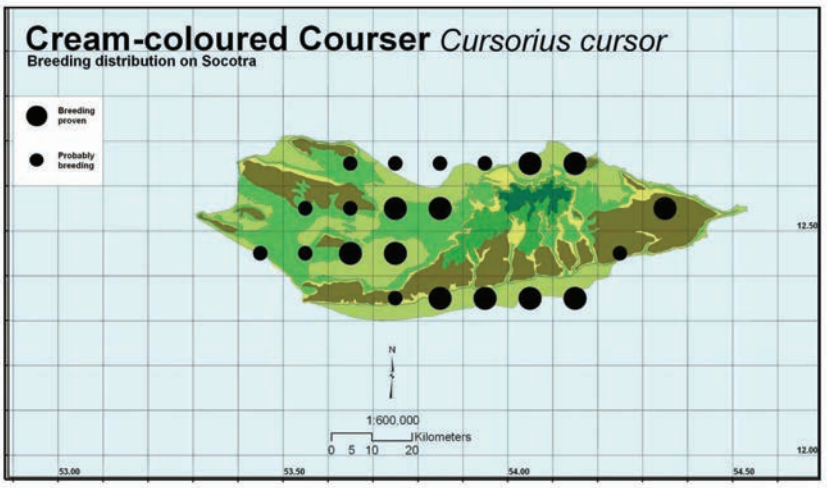

Figure 18. Cream-coloured Courser: Socotran breeding distribution.

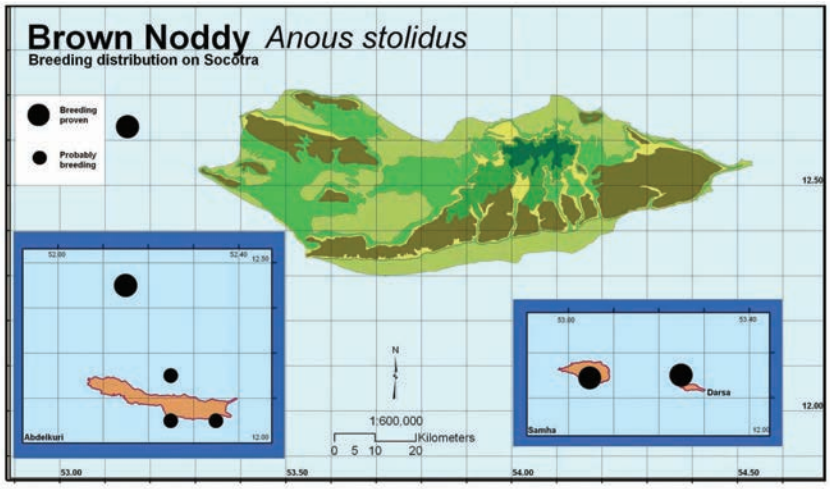

Figure 19. Brown Noddy: Socotran breeding distribution.

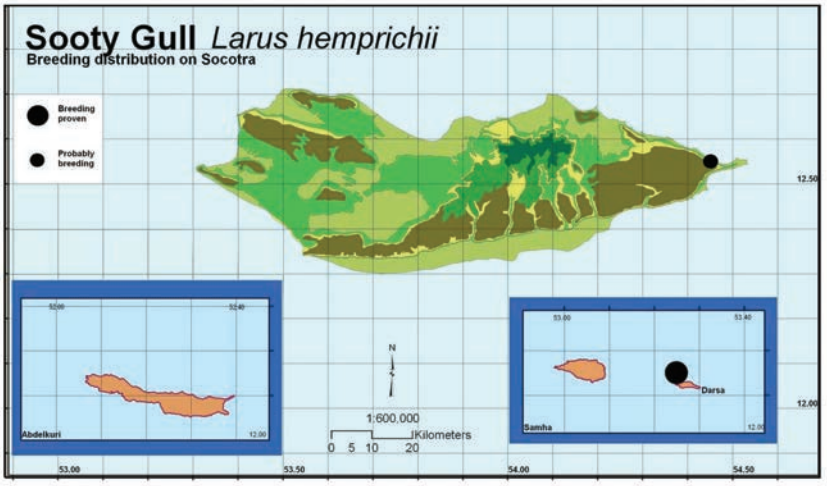

Figure 20. Sooty Gull: Socotran breeding distribution.

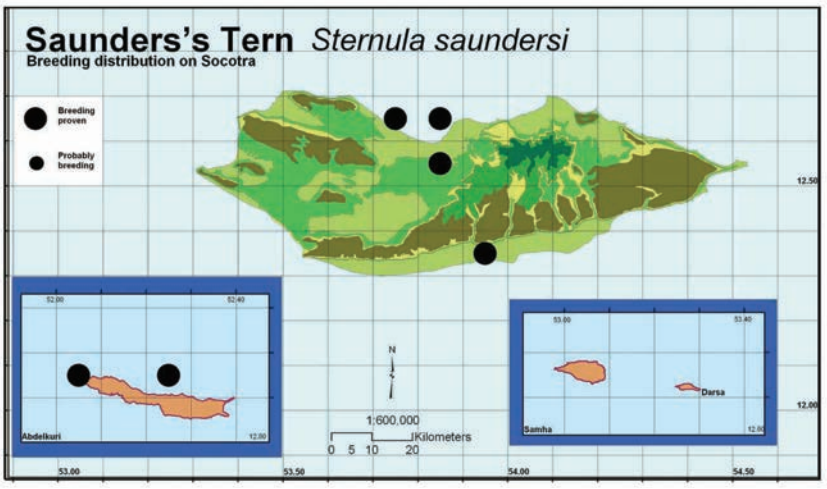

Figure 21. Saunders's Tern: Socotran breeding distribution.

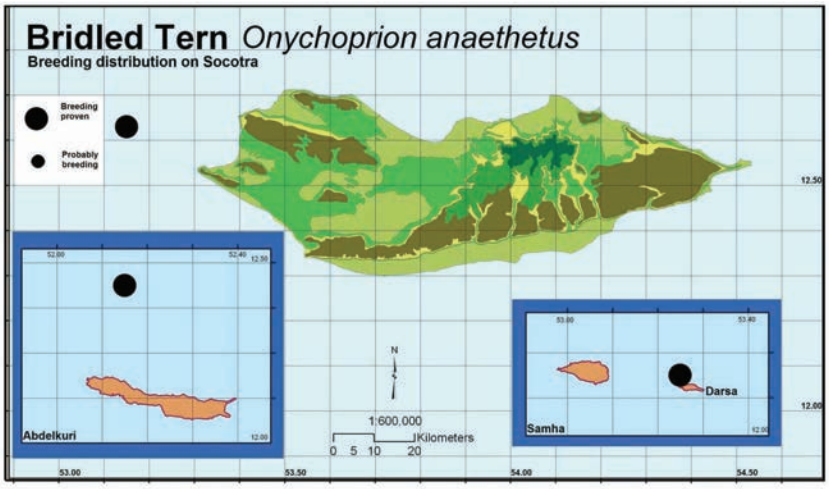

Figure 22. Bridled Tern: Socotran breeding distribution.

Plate 3. Estuary at Qalansiya, Socotra—a breeding site for Black-winged Stilts *Himantopus himantopus*, February 2011. © *RF Porter*

Plate 4. Open plain with mosaic of woody herbs in eastern Socotra, a breeding habitat for Cream-coloured Coursers *Cursorius cursor*, February 2004. © *RF Porter*

Plate 5. Abd Al Kuri, February 1992. © *Tony Miller*

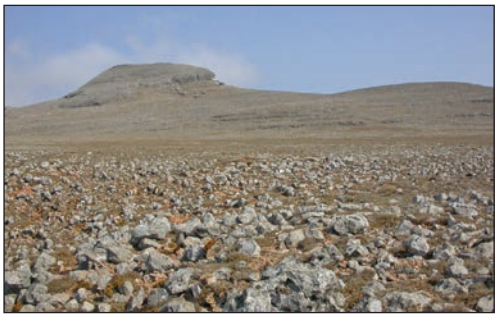

Plate 6. Samha, April 2007. © *Lisa Banfield*

In this, the second of two papers that catalogue the populations and distributions of the breeding species, we cover 24 species of non-passerines: shearwaters (Procellariidae) to terns (Sternidae). These are listed in Table 1. Habitats and ecology for all species have been adequately summarised in Jennings (2010) and for Egyptian Vulture *Neophron percnopterus*, Socotra Buzzard *Buteo socotraensis* and Black-winged Stilt *Himantopus himantopus* in Porter & Suleiman (2012), Porter & Kirwan (2010) and Suleiman (2009) respectively. In addition to the seabirds that breed in the archipelago, four others that breed regularly on islands of the Red sea could potentially nest as they were regularly observed during the surveys, namely White-eyed Gull *Larus leucophthalmus*, Swift Tern *Sterna bergii*, Lesser Crested Tern *S. bengalensis* and White-cheeked Tern *S. repressa*. However we failed to establish any indication of breeding by any of these. It is noteworthy that three species of herons, Yellow Bittern *Ixobrychus sinensis*, Indian Pond Heron *Ardeola grayii* and Western Cattle Egret *Bubulcus ibis*, which prior to the last decade were vagrants (see Kirwan *et al* 1996) are now probably resident and breeding. Two, Yellow Bittern and Indian Pond Heron, probably originated from the Indian subcontinent where they are widespread breeders (Grimmett *et al* 1998).

Table 1. Breeding and probable breeding species covered in this paper. Species endemic to the Socotra archipelago and also those that have been classified as globally threatened (endangered EN or vulnerable VU) or near threatened NT by IUCN (BirdLife 2013a) are indicated. Those with globally important populations in the archipelago are marked with an asterisk.

Persian Shearwater *Puffinus persicus**
Jouanin's Petrel *Bulweria fallax* (endemic breeder, NT)*
Little Grebe *Tachybaptus ruficollis* (probably has bred)
Red-billed Tropicbird *Phaethon aethereus**
Yellow Bittern *Ixobrychus sinensis* (probably breeds)
Striated Heron *Butorides striata* (probably breeds)
Indian Pond Heron *Ardeola grayii* (probably breeds)
Western Cattle Egret *Bubulcus ibis* (probably breeds)
Masked Booby *Sula dactylatra*
Brown Booby *Sula leucogaster**
Socotra Cormorant *Phalacrocorax nigrogularis* (VU)*
Western Osprey *Pandion haliaetus*
Egyptian Vulture *Neophron percnopterus* (EN)*
Socotra Buzzard *Buteo socotraensis* (endemic, VU)*
Common Kestrel *Falco tinnunculus*
Peregrine Falcon *Falco peregrinus*
Common Moorhen *Gallinula chloropus* (has bred at least once)
Black-winged Stilt *Himantopus himantopus*
Kentish Plover *Charadrius alexandrinus*
Cream-coloured Courser *Cursorius cursor*
Brown Noddy *Anous stolidus*
Sooty Gull *Larus hemprichii**
Saunders's Tern *Sternula saundersi*
Bridled Tern *Onychoprion anaethetus*

Plate 7. Darsa, February 1992. © *Tony Miller*

Plate 8. Sabuniya, October 2009. © *Ulf Stahle*

METHODS

Breeding distribution

The method for determining breeding distribution is described in detail in Porter & Suleiman (2013a). In summary, the islands were divided into 1/10th degree recording 'squares', each *c*120 km^2 and these are shown for Socotra island in Figure 2. From 1999–2011 each square was visited at least twice (and at least half on over ten occasions) to search for proof of breeding of all species. All visits were made between October and May. Six visits were made to each of Abd Al Kuri, Samha and Darsa islands and the sea stacks (Figure 1) to survey breeding seabirds. ASS led four that were undertaken in March and April. We have also relied on data from the May seabird survey undertaken in 1999 (Al-Saghier *et al* 2000) and the visit to Sabuniya in October 2009 (Holmstrom & Stahle 2010).

Following Gibbons *et al* (1993) two categories of breeding were adopted and are shown on the distribution maps, Figures 3–22, as: (1) large dots, breeding proven, that indicate evidence of breeding was obtained, including both the 'confirmed' and 'probable' categories of the BTO (see BTO 2012) and (2) small dots, probably breeding, where birds were present in potential breeding habitat but without more direct evidence of breeding. A breeding distribution map is given for each species except those where breeding was considered only probable and, for security reasons, Jouanin's Petrel *Bulweria fallax*. Maps for Abd Al Kuri, Samha and Darsa islands are included only when breeding has been proven or is probable on at least one of these islands or on Kal Farun.

Population size assessments

A second aim was to assess the populations of breeding birds. In Porter & Suleiman (2013a), which covered the passerines and near-passerines, we relied heavily on the data collected by transects of a fixed band width as the basis for estimating populations. However, the only species that we used the transect techniques for in this paper were Common Kestrel *Falco tinnunculus*, using a transect width of 200 m and Cream-coloured Courser *Cursorius cursor*, using a transect width of 100 m. See Porter & Suleiman (2013a) for transect methodology and calculations for estimating the population. For all other species the transect census technique was not appropriate for estimating the population and more targeted methods were used, details of which are given in the species accounts. However for several species of seabirds, because of the difficulty of surveying, population figures are often 'best guesses'.

We provided provisional population estimates for several of the species in this paper for Jennings (2010). However we have since re-examined these data and, in several cases, have revised our estimates. Therefore the population data given in this paper supersedes those in Jennings (2010).

Plate 9. Persian Shearwater *Puffinus persicus* off Socotra, October 2009. © *Ulf Stahle*

SPECIES ACCOUNTS

In the species accounts below we have indicated species endemic to the archipelago, those classified as globally threatened (endangered EN or vulnerable VU) or near-threatened (NT) as determined by IUCN (BirdLife 2013a), those which are regionally threatened and those with globally important populations, including where one or more Important Bird Areas (Evans 1994) in the archipelago holds >1% of the world population.

Persian Shearwater *Puffinus persicus* (Figure 3, Plate 9). Accurate assessment of the size of the breeding population was impossible. The remoteness of nesting sites, their inaccessibility and the fact the species visits its nests under the cover of darkness make even a crude population estimate very difficult. Whilst the breeding population is unknown it is clear from counts from the shore of the main island and transects at sea that this is not an uncommon seabird. Highest counts are 1544 in March 2007 at sea from Socotra to Abd Al Kuri (Suleiman *et al* 2007) and *c*3000 off the northeast coast of the main island in November 2007 (RFP, ASS). In a dedicated seabird survey in 1999, Al-Saghier *et al* (2000) put the breeding population of the archipelago at 'tens of thousands' with birds coming to every sea cliff visited after dark. It is clear that the Socotra archipelago is the most important site (see Jennings 2010) for this Middle East endemic breeder, probably holding over 50% of the world breeding population, thus making it of global importance for this species. Adults have been observed coming to cliffs at night in May and June and local people report eating fatty young in June. Apart from this little is known about its breeding biology in the archipelago.

Jouanin's Petrel *Bulweria fallax* (endemic breeder, NT, Plates 10, 11). The discovery of the first (and still only) nest in the world, containing eggs in a cave high on a sea-facing cliff on 22 July 2001 was on Socotra on virtually inaccessible cliffs (Taleb 2002, Plate 10). The size of the colony is not known but over 1000 birds have been observed offshore from the colony during the breeding season. This petrel is commonly observed in the seas around Socotra throughout the year, with often 40 or more in a seawatch for a few hours from one

Plate 10 (left)**.** Jouanin's Petrel *Bulweria fallax* at nest, Socotra, July 2001. © *AS Suleiman & Nadim Taleb*

Plate 11 (right)**.** Jouanin's Petrel *Bulweria fallax*, Socotra, October 2009. © *Ulf Stahle*

of the headlands. They are always seen on pelagic trips with *eg* 260 recorded 4–20 km off northeast Socotra (55/hr) in April 1993 (Kirwan *et al* 1996) and 60 (5.2/hr) between Socotra and Abd Al Kuri in March/April 2007 (Suleiman *et al* 2007). These counts over a small area of the archipelago's seas suggest that the Socotran population could be several thousand pairs. Socotra is globally important for Jouanin's Petrel as it holds the only known breeding colony. Little is known about the breeding biology of this petrel. Downy chicks have been observed through to November (Taleb 2002).

Little Grebe *Tachybaptus ruficollis* (Figure 4). Breeding witnessed in 1998 and 1999; not observed previously or subsequently. In 1998 four present at Sirhan lagoon, near Hadiboh, July–December when one immature was seen (M Lipperi & D Stanton pers comm). In November 1999 a pair (presumably the 1998 birds) was present with one young at the same lagoon.

Red-billed Tropicbird *Phaethon aethereus* (Figure 5, Plate 12). Nesting places for Red-billed Tropicbirds are often difficult to observe as they are located in crevices high on cliffs that are mostly inaccessible. However the adult birds are obvious and population assessments have proved possible for most islands in the archipelago. The following gives the maximum count of adults (individuals, unless stated otherwise) at each major breeding locality:

Socotra: Falang cliffs (Y5) 300 March/April 2011, Ras Shuab (N5) 75 October, other sites combined perhaps 30 mostly February–April.

Outer islands and sea stacks: Abd Al Kuri 134 March 2004, Darsa 400–500 pairs May 1999, Samha 6 adults March 2004, Sabuniya 50 March/April 2005, Kal Farun 150 March 2004 (Al-Saghier *et al* 2000, Suleiman *et al* 2005, Suleiman *et al* 2007).

If counts of individuals are converted to pairs, this would suggest a minimum population of *c*800 pairs which is >12% of the world population (BirdLife International 2013b) thus making the Socotra archipelago of global importance for this species. Red-billed Tropicbird adults have been observed in aerial displays, notably synchronised flying in pairs, around

Plate 12. Red-billed Tropicbird *Phaethon aethereus*, Darsa, May 1999. © *Omar Al-Saghier*

Plate 13. Juvenile Yellow Bittern *Ixobrychus sinensis*, Socotra, October 2011. © *RF Porter*

breeding cliffs in late February, March and October, adults on nests in May/June and with chicks (one chick/pair) on 5 July.

Yellow Bittern *Ixobrychus sinensis* (Plate 13). Recorded in U4 where breeding suspected but not proven. First observed in November 1999 when a juvenile was found at Wadi Shek, near Hadiboh. At nearby Sirhan lagoon, juveniles were recorded March–December 2008 with two in December and an adult in April, and again in February 2009. Finally a juvenile or winter plumage adult was observed at Sirhan in February 2011. All observations have been on the fringes of freshwater wadi estuaries with dense palms, a suitable breeding habitat. The Yellow Bittern has recently been assigned regionally threatened status (Sharjah Environment and Protected Areas Authority in prep).

Striated Heron *Butorides striata* (Figure 6). This secretive heron has been recorded on less than ten occasions, all singles February–April in habitat on Socotra considered suitable for nesting—coastal lagoons with dense palms.

Indian Pond Heron *Ardeola grayii* (Plate 14). Although breeding has not been proven it is strongly suspected to have occurred in the last ten years. First recorded in September 2000 when an adult in breeding plumage was observed at Wadi Schek (U4, MI Evans *in litt*). Then, 2006–2011, birds were seen regularly in increasing numbers on Socotra, throughout the year, with eight in March 2011 at two sites (Sirhan lagoon, Qalansiyah estuary), two in breeding plumage.

Plate 14. Indian Pond Heron *Ardeola grayii*, Socotra, October 2008. © *RF Porter*

Plate 15. Cattle Egrets *Bubulcus ibis*, Socotra, February 2006. © *RF Porter*

Western Cattle Egret *Bubulcus ibis* (Plate 15). Although breeding has not been proven it is strongly suspected. Birds present in increasing numbers on Socotra, throughout the year, from at least 1999, with <10 until 2006 when 34 recorded, a flock of 26 at Sirhan lagoon (U4) and 8 at Qalansiyah (O4). In February 2007, a flock of 23 near Sirhan lagoon had many adults coming into breeding plumage; in February 2011 a flock of 23 was observed there including a pair in breeding plumage. The dense palm groves around Sirhan and Hadibu lagoons and at Qalansiya estuary are ideal breeding habitat, but no nests have been found.

Plate 16. Nearly-fledged Masked Booby *Sula dactylatra*, Sabuniya, October 2009. © *Ulf Stahle*

Masked Booby *Sula dactylatra* (Figure 7, Plate 16). Found breeding only on the sea stacks of Sabuniya and Kal Farun. Accurate counts were made on Sabuniya in 2005 and Kal Farun in 2005 and 2007 (Suleiman *et al* 2005, Suleiman *et al* 2007). On Sabuniya on 2 February a total of 309 nests were counted whilst in late March 809 adults were observed. This might suggest a breeding population of 400 pairs. On Kal Farun on 23 March 2005 a total of 735 nests were counted whilst on 28 March 2007 the number of nests was 900–950. These counts for Sabuniya are similar to those in May 1999 (Al-Saghier *et al* 2000) and in October 2009 (Holmstrom & Stahle 2010). Based on these nest counts in 2005 and 2007 the breeding population in the archipelago is >1300 pairs, 10% of the Arabian breeding population (see Jennings 2010). Masked Booby has recently been assigned regionally threatened status (Sharjah EPAA in prep). This booby has a large global range (del Hoyo *et al* 1992) and it is unlikely that the Socotran population is globally significant.

Nests with eggs, and adults incubating, have been recorded in February, March and October (to 29 October in 2009). Nests with young have also been observed February–October, and on 29 October nearly-fledged young and adults incubating eggs were recorded (Holmstrom & Stahle 2010). Detailed nest counts in 2005 showed that Sabuniya (2 February) had 26 nests with C/1 eggs, 278 nests with C/2 eggs and five nests had one egg and one chick. On Kal Farun (23 March 2005) a sample of 46 nests showed eight with one egg, four with two eggs, 32 with one chick and two with two chicks (Suleiman *et al* 2005). On 28 March 2007 on Kal Farun, of 610 active nests about half had eggs and small chicks and half had large chicks and fledglings; examination of 67 nests with eggs showed the average clutch size was 1.64 with 25 C/1, 41 C/2 and a single C/3 (Suleiman *et al* 2007). This booby has a long breeding season in the archipelago with nesting activity recorded February–end October. Indeed adults incubating eggs at end October would mean that the young would probably not fledge until end December. Because of the infrequency of visits to the outer islands it is not known if the breeding season varies annually.

Brown Booby *Sula leucogaster* (Figure 8, Plate 17). Only proved breeding on the outer islands where the most comprehensive survey was made in 1999 (Al-Saghier *et al* 2000): Samha (100–150 pairs), Darsa (1500 pairs), Kal Farun (250–300 pairs) and Sabuniya (10 pairs). Further surveys, notably Suleiman *et al* (2005) support these counts and suggest a population of *c*1900 pairs. Birds have been recorded on suitable nesting cliffs on the main island but breeding has not been proven. Jennings (2010) estimated the Arabian (Red sea and Socotra archipelago) breeding population to be *c*18 000 pairs, thus the Socotran population represents *c*10% of the regional population. It is possible that the Socotran population exceeds 2% of the world population, estimated at >*c*200 000 individuals (del Hoyo *et al* 1992), thus making the archipelago of global importance for this species. Adults have been observed displaying in May, when also nests with eggs have been found. Thus, given fledging time, the breeding season is probably May–August.

Plate 17. Brown Booby *Sula leucogaster*, Sabuniya, October 2009. © *Ulf Stahle*

Socotra Cormorant *Phalacrocorax nigrogularis* (VU, Figure 9, Plates 18, 19). Whilst Socotra Cormorants are commonly observed, often in large numbers, throughout the archipelago, the only confirmed breeding has been on Kal Farun and Sabuniya. It is interesting to note that no evidence of breeding was recorded in May 1999 by Al-Saghier *et al* (2000) who visited all the outer isles and islets and who stated "There has been a lot of speculation on whether or not the Socotra Cormorant breeds within the archipelago. Although we frequently encountered flocks of 10 to 100 cormorants in the coastal waters of all islands and approximately 500 birds sitting between the breeding boobies on Kal Farun, we found no indication whatsoever of breeding activities."

Evidence of breeding on Kal Farun was obtained in November 2001 when '5000 birds with 2–3 eggs' were recorded by Nadim Taleb (Mike Jennings *in litt*). Visits to this sea stack between February and April, 2004–2007 by Suleiman *et al* (2005, 2007) recorded no evidence of breeding then, though up to 300 were observed sitting on the cliff ledges; Suleiman *et al* (2005) report breeding on Kal Farun in 2002 and 2003, but dates and counts are not available. Evidence of breeding was also found on Sabuniya where 500 adults on nesting ledges and one chick in a nest were recorded in February 2005 (Suleiman *et al* 2005). Because of the steep terrain only part of the stack was surveyed, thus the number of birds was probably much higher. Then on 28 October 2009 over 500 were observed of which the vast majority were newly-fledged birds, though some birds were also incubating eggs (Holmstrom & Stahle 2010). The counts on Sabuniya suggest a population there of *c*250 pairs, whilst it is

Plate 18. Socotra Cormorant *Phalacrocorax nigrogularis* on nest with egg, Sabuniya, October 2009. © *Ulf Stahle*

Plate 19. Socotra Cormorants *Phalacrocorax nigrogularis* (most are recently fledged), Sabuniya, October 2009. © *Ulf Stahle*

probable that at least 2500 pairs breed on Kal Farun. Thus the total archipelago population is probably >2750 pairs, some 2.5% of the world population (see Jennings 2010), making the archipelago of global importance for this species. No evidence of breeding was found on Socotra, Abd Al Kuri, Samha and Darsa, though loafing birds were always present. Counts between October and March (1999–2011) have shown congregations and rafts of up to 11 000 birds in at least four sea areas around the coast of Socotra. Also many observed sitting on ledges on cliff faces on the northwest coast during the same period. One can only speculate as to whether these indicate a breeding population on Socotra or whether they are largely immigrants from breeding grounds elsewhere. The breeding season in the archipelago would appear to be perhaps August–February (birds incubating eggs October and November, nests with 'chicks' February and recently-fledged young October), though clearly there is still much to be learned about the timing of breeding.

Western Osprey *Pandion haliaetus* (Figure 10, Plate 20). Breeding has not been confirmed on the main island but counts of pairs and individuals suggest a population of <10 pairs. Counts on the outer islands notably in 2005 (Suleiman *et al* 2005) are: Abd Al Kuri (35 birds, 14 nests), Samha (3 birds, 3 nests), Darsa (3 birds) and Kal Farun (2 birds). This suggests a total population of <75 individuals. Adults with nests and young have been observed in February and March.

Plate 20. Western Osprey *Pandion haliaetus*, Socotra, October 2009. © *Ulf Stahle*

Egyptian Vulture *Neophron percnopterus* (EN, Figure 11, Plate 21). The distribution, population and general ecology are presented in Porter & Suleiman (2012) which estimated the Socotra population to be *c*1900 individuals (*c*800 pairs), based on detailed censuses. This represents over 45% of the Arabian (including Socotra) population using the figure in Jennings (2010) and *c*3–9% of the global population, thus making Socotra of global importance for this species.

On Socotra the Egyptian Vulture breeds typically on the widespread limestone cliffs and escarpments which provide a host of nesting caves. Display has been recorded October–March with no obvious peak, copulation end October–end February, nests with eggs February–late March, nests with young February–late March, nests with incubating birds (eggs or young) end October–May, with most nesting activity observed in February and March. Thus the breeding season extends October–at least May. For full details see Porter & Suleiman (2012).

Plate 21. Egyptian Vulture *Neophron percnopterus* chick and egg, Socotra, March 2009. © *AS Suleiman*

Socotra Buzzard *Buteo socotraensis* (endemic, VU, Figure 12, Plate 22). The naming, taxonomy, population and distribution and general ecology is discussed in detail in Porter & Kirwan (2010). This Socotran endemic only occurs on the main island where it is a widespread but not common resident breeder. Surveys between 1999 and 2008, which attempted to plot birds and pairs observed in 1/10th degree squares, suggest that the population is <250 pairs.

The following is summarised from Porter & Kirwan (2010): display, notably aerial tumbling and talon grappling, observed October–December and February; copulation in November; nest building late October; nest with eggs November, nests with young 28 October, when chick *c*15 days old and tended by both adults (in this case egg laying would have been in mid September); also nests with young in January (young *c*1 month old) and early April, to which adults were bringing food. A juvenile in captivity 2 March was just a few weeks out of the nest, suggesting egg laying in January; discussions with the 'owners' of three other captive juveniles suggested laying dates in October–January. Two other juveniles in captivity had apparently been taken from a nest in November, thus indicating egg laying commencing in October. One instance of a pair nest building in April and May was not followed by egg-laying. Fully-fledged young, still with a strong parental bond, have been observed mid February–early April. All the above observations suggest that the breeding season extends September–April (perhaps into May), with egg-laying September–January.

Common Kestrel *Falco tinnunculus* (Figure 13, Plate 23). For this species birds were counted on transects using a 200 m band width but most encounters were of birds in flight. The calculations may thus be open to error but nevertheless show a population of 682 individuals (95% confidence interval 935–2441), which we believe to be a fair indication of the number on the island. We have not attempted to translate this into pairs. Display has been recorded 27 October–27 February, nests with eggs (c/4) 25 November–3 March (both male and female sitting), and nests with young 25 February–18 March. Thus the known breeding season is November–March, but probably to at least April.

Plate 22. Juvenile Socotra Buzzard *Buteo socotraensis*, Socotra, February 2007. © *RF Porter*

Plate 23. Common Kestrel *Falco tinnunculus*, Socotra, November 2007. © *RF Porter*

Plate 24. Juvenile Peregrine Falcon *Falco peregrinus*, Socotra, January 2006. © *Hanne & Jens Eriksen*

Peregrine Falcon *Falco peregrinus* (Figure 14, Plate 24). Birds were recorded in 24 localities on the main island 1999–2011, with 13 with nests or displaying. However as this species was very difficult to census, being uncommon and often in remote parts of the high mountains, it would not be unreasonable to assume the Socotran population was *c*30 pairs, which is over 90% of the Arabian breeding population (see Jennings 2010). Peregrine Falcon has recently been assigned regionally threatened status in the Arabian peninsula (includes Socotra, Sharjah EPAA in prep). Display has been recorded 15 November–26 February and in May, copulation on 20 February and birds present at nests (contents unknown) 22 February–3 July.

The taxonomic position of this isolated island population is unclear. Prior to 1999 both Peregrine Falcon and Barbary Falcon *F. pelegrinoides* had been recorded (see *eg* Kirwan *et al* 1996) but in the subsequent years only birds resembling *F. peregrinus* were observed. Jennings (2010) considered these to be of the race *minor* though he also speculated that the Socotran population might turn out to be a new taxon. We have always considered that the birds most resembled *minor* though more relevant views and photographs are required for a more robust opinion. However examination of a recent photograph of an adult male suggests traits of *pelegrinoides* (Dick Forsman pers comm). The taxonomic position of these falcons is now the subject of a critical examination of all the photographic and other material from the island (Porter & Forsman in prep).

Common Moorhen *Gallinula chloropus* (Figure 15). Although 1–2 recorded 1999–2001, it was in 2006 that breeding almost certainly occurred on the main island with adults and a juvenile on Sirhan lagoon on 24 February. In 2011 breeding was proved, also on Sirhan lagoon, when, from 16 February–5 March at least four adults and four immatures were seen. One of the adults had a dependent juvenile, which it frequently fed.

Black-winged Stilt *Himantopus himantopus* (Figure 16, Plate 25). Only found on the main island, Socotra. The colonisation, distribution and population is given in Suleiman (2009) with the first proven breeding recorded in 2007 and the population at 2008 was considered to be in excess of 150 pairs. Copulation has been observed in February, nests with eggs in April and May, and downy young in April and May. For full details see Suleiman (2009). Figure 16 shows breeding distribution in 2007 and 2008. Breeding may have occurred subsequently but has not been recorded.

Kentish Plover *Charadrius alexandrinus* (Figure 17, Plate 26). All potential breeding areas on Socotra were counted regularly between 1999 and 2011 providing a total population estimate of 200 birds, perhaps 100 potential breeding pairs. Counts over the 12 years were fairly consistent with birds in pairs or small groups, suggesting a resident population with few, if any migrants. Most were recorded on the coastal stretch from the airport to Di Selmeho (R4, S5) where the highest count was 47. At Qariyah lagoon (W4) the highest count was 39 and Hadiboh/Sirhan lagoons (U4) the highest count was 22. Birds were occasionally recorded on Abd Al Kuri, but not suspected of breeding. Display has been recorded on 15 November, nests with eggs 31 March–13 April, adults with chicks/unfledged juveniles 23 February–29 May. Thus the known breeding season appears to be mid November–end May.

Plate 25. Black-winged Stilt *Himantopus himantopus*, Socotra, October 2007. © *RF Porter*

Plate 26. Kentish Plover *Charadrius alexandrinus*, Socotra, February 2004. © *RF Porter*

Cream-coloured Courser *Cursorius cursor* (Figure 18, Plate 27). This is the commonest of the three waders that breed on Socotra. It is mainly confined to the coastal and inland plains from 0–*c*100 m asl. Analysis of transect data (using a band-width of 100 m) shows a population of 1048 individuals, with the highest density, 1.1 birds/km^2, in the coastal plains with *Croton* shrubland—habitat type D (see Porter & Suleiman 2013a). It would appear that the Socotran population is *c*1% of the Arabian population, including Socotra, which Jennings (2010) puts at *c*40 000 pairs. Display has been recorded on 26 February, nest with eggs 12 June, adults with recently-hatched young 2 November (egg-laying would have been in September)–26 February and adults with a nearly fully-grown juvenile on 2 March and with a fully-grown juvenile 13 June. Thus the known breeding season is September–July, the longest of any of the Socotra archipelago breeding species.

Plate 27. Juvenile Cream-coloured Courser *Cursorius cursor*, age 4–5 weeks, Socotra, November 2008. © *RF Porter*

Brown Noddy *Anous stolidus* (Figure 19, Plate 28). This summer breeder does not start breeding until May and thus the only survey that was able to census the breeding population was that by Al-Saghier *et al* (2000), who visited the islands during the whole of May 1999. They recorded the following pairs: Darsa 1000–1500, Samha 100–200, Sabuniya 250–300, Kal Farun 150–250, suggesting a total archipelago population of *c*1900 pairs. This is *c*17% of the Arabian breeding population of 11 000 pairs (Jennings 2010), making the archipelago of regional importance for this species. With the world population possibly exceeding

Plate 28. Brown Noddy *Anous stolidus* and juvenile Sooty Gull *Larus hemprichii*, eastern Socotra, November 2007. © *RF Porter*

Plate 29. Adult and juvenile Sooty Gulls *Larus hemprichii* Socotra, November 2007. © *RF Porter*

one million individuals (BirdLife International 2013c), the numbers breeding are probably not of global significance. Little information is available on breeding activities, but birds have been seen entering nesting caves in May, and earlier visits to nesting islands in March and April have recorded very few suggesting a mass arrival and commencement of breeding at the start of May.

Sooty Gull *Larus hemprichii* (Figure 20, Plates 28, 29). The only proven breeding is on the rat-infested island of Darsa, where 1000 pairs were present in May 1999. Birds were not nesting at the time but eggshells, feathers and bones in what was clearly a large colony were found (Al-Saghier *et al* 2000). Subsequently, there was evidence of breeding on Darsa in 2005 (Suleiman *et al* 2005) and in 2008 when many pairs with 5–20 days old chicks were found on 16 October (Nadim Taleb *in litt*). The Socotran breeding population is *c*4% of the Arabian breeding population and *c*1–2% of the world population (see Jennings 2010), thus making the archipelago of global importance for this species. There is no proof of breeding away from Darsa, though loafing birds are often present on all islands including around the coast of Socotra (see *eg* Suleiman 2007). Adults with recently fledged juveniles in early November in eastern Socotra were suspected of having nested locally. There is little information on the breeding season but the evidence of Taleb *in litt*, suggests that it is a late breeder, nesting in September and October.

Saunders's Tern *Sternula saundersi* (Figure 21). Breeds on the main island, where the population is provisionally estimated at *c*300 pairs (colony counts 1999–2012) and Abd Al Kuri where breeding was proven in 1999 and the population estimated at 150–250 pairs (Al-Saghier *et al* 2000). The breeding population of the Socotra archipelago of *c*500 pairs is therefore *c*12% of the Arabian breeding population of 4000 pairs (see Jennings 2010). Outside Arabia Saunders's Terns breed in northeast Africa, Iran and the northern Indian Ocean, but the species is poorly known and there are no population estimates (see BirdLife International 2013d). Therefore it is not known if the Socotran population is of global importance. Saunders's Terns breed on coastal gravel plains; display and mating has been observed in May; incubation of eggs from mid May–June (five nests examined 14 May had C/1); adults feeding juveniles observed on 7 August. Thus the breeding season is May–August.

Bridled Tern *Onychoprion anaethetus* (Figure 22). A breeding summer visitor that would appear to arrive on its breeding grounds on the outer islands in May as earlier visits in

February–April failed to record any. The May 1999 survey (Al-Saghier *et al* 2000) assessed the breeding population on the outer islands as: Darsa 200–300 pairs, Kal Farun 200–300 pairs and Sabuniya 300–500 pairs. This suggests a total population of *c*900 pairs, which is *c*0.3% of the total Arabian population (see Jennings 2010). With the world population estimated at *c*610 000–1 500 000 individuals (BirdLife International 2013e), it is clear that the Socotran population is not of global significance. Unlike most colonies in Arabia those in the Socotra archipelago are on cliff ledges. Pairs have been recorded displaying in May, so the probable breeding season is May–July/August.

THREATS AND CONSERVATION

Major threats to the wildlife of Socotra have been listed recently by Van Damme & Banfield (2011) and most of these are known to have a direct impact on birds of the main island, although specific studies on the islands of the archipelago remain to be carried out. Degradation of rangeland and desertification (Pietsch & Morris 2010) and destruction of habitat, notably woodland, adversely impacts land bird populations (Van Damme & Banfield 2011, Porter & Suleiman 2013a). In addition, threats that we consider have a potential impact on the non-passerine species of this paper are rats, cats, the use of rat poisons, the use of veterinary drugs, collecting seabird chicks for food, built development, including road building, and oil pollution.

Rats are found on all islands but appear to be absent from the sea stacks of Kal Farun and Sabuniya. Darsa is particularly rat-infested. Rats are known to seriously impact seabird breeding populations (Jones *et al* 2008, Hilton & Cuthbert 2010) though their effect on the populations nesting in the Socotra archipelago has not been studied. Cats on Abd Al Kuri might also be impacting nesting seabirds (Suleiman *et al* 2005). These two invasives (rats and cats), are known to have a catastrophic impact on bird populations from the extensive studies undertaken throughout the world (*eg* Hilton & Cuthbert 2010). While rats are not, apparently, a threat to the Egyptian Vulture, the use of rat poison, if not carefully controlled, must be a concern. This is discussed in Porter & Suleiman (2012) which also lists future urbanisation and greater sanitation as a threat to the internationally important population that Socotra holds. The veterinary drug diclofenac is not used on Socotra (Abdul Rahman Al-Iryani pers comm) although ongoing vilgilance is required. In Asia, and more recently Africa, diclofenac has been shown to be one of the main threats to *Gyps* vultures (Woodford *et al* 2008) with birds feeding on the carcasses of cattle that have been treated with the drug. Until we know whether the Egyptian Vulture is also susceptible, this and any other untested veterinary drugs may well pose a threat. Recent declines of the species in India have mirrored those of the resident *Gyps* vultures, further increasing speculation that they may well be adversely affected by diclofenac (C Bowden pers comm). The use of organochlorine pesticides such as temephos might also be a threat to the vulture and other top predators. The use of this pesticide and its potential harm to wildlife is chronicled in Van Damme & Banfield (2011).

The main conservation measure for the vulture and all birds of prey should be to continue to monitor the use of any pesticides and veterinary products used in sheep, goat and cattle husbandry. The impact of *eg* diclofenac on *Gyps* vulture populations elsewhere in the world must not be repeated on Socotra. In addition the national laws protecting wildlife and controlling the use of poisons, pesticides and veterinary products should be strengthened, in line with international legislation. All wildlife will benefit.

Fortunately Egyptian Vultures are not persecuted on Socotra; indeed they are highly respected (see Porter & Suleiman 2012). However Socotra Buzzards and Common Kestrels are occasionally taken as pets, but strict laws prevent any organism being removed from Socotra so there is no trade in them, which would be a potential threat. The fatty chicks

of seabirds, notably Persian Shearwaters and Jouanin's Petrels are collected for food (Taleb 2002). However, in view of the inaccessibility of the nesting areas this is unlikely to be having an impact on populations. Developments and road building on the low lying plains and coastal areas presents a threat to breeding Cream-coloured Coursers, and possibly Kentish Plovers. The Socotra island ring road, especially those sections that traverse the cliff tops will have a serious impact on seabird breeding sites, especially the globally important populations of Persian Shearwater, Jouanin's Petrel and Red-billed Tropicbird (Miller *et al* 2007). Any maritime islands and their waters are potentially threatened by oil pollution as a result of spills or discharge at sea. There have been minor incidents on the coast of Socotra and Abd Al Kuri (ASS pers obs).

FUTURE SURVEYS AND RESEARCH

Regular population monitoring of Socotra Buzzard, Egyptian Vulture and seabirds, including terns, is the top priority for future action. An assessment of the effects of rats and cats on seabird populations is recommended, but the logistics and methodology for undertaking such a study are clearly problematic. Determining whether rats have colonised the sea stacks of Kal Farun and Sabuniya is considered important. Monitoring of the use of poisons to control rats on the main island would be valuable and it is essential that any veterinary product or chemicals such as insecticides used in the archipelago are appropriately tested and screened. Whilst, it would appear that Egyptian Vultures have not been affected by rat poisons or veterinary drugs, this should be watched carefully and in the meantime, as detailed in Porter & Suleiman (2012), tissues of any dead vultures as well as other raptors should be collected for full chemical analysis including for pesticides. Finally, the data gathered during the present survey will be used extensively in reviewing and revising the Socotra IBAs catalogued in Evans (1994).

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