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# Breeding biology of the Kentish Plover *Charadrius alexandrinus* in the Sabkhat Al-Fasl Lagoons, Saudi Arabia (Aves: Charadriiformes)

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The breeding biology of the Kentish Plover *Charadrius alexandrinus* was studied in the Sabkhat Al-Fasl Lagoons of Saudi Arabia, where ground temperatures may exceed 55°C in summer. Although halophytic bushes are abundant, this species seems to prefer nesting at exposed sites. Biparental brood care was common: the females were absent in only three out of 24 families. Kentish Plovers attended their nests more than 80% over the full day and more than 90% of the time during day-time, and the number of change-overs increased during the hottest parts of the day which could be due to the possibility that a single parent cannot protect the eggs and itself from overheating.

**Keywords**: brood-rearing; incubation behaviour; predation risk; harsh environments; shorebirds



## Introduction

Kentish Plovers *Charadrius alexandrinus* have a very wide geographic range, breeding in temperate and subtropical environments (del Hoyo, Elliott, & Sargatal, 1996). It is a ground nester, nesting in shallow scrapes with little or no isolation materials. Similar to many other small ground-nesting birds, Kentish Plovers depend more on egg crypsis than aggressive anti-predator behaviours to protect their nests from predation (Gómez-Serrano, & López-López, 2014). Kentish Plover chicks are precocial, as they leave the nest immediately after hatching but continue to rely on one or both parents to lead them to food sources and safe places (Székely, & Cuthill, 1999). Kentish Plovers have an extraordinarily diverse mating system, as all types (monogamy, polygyny and polyandry) may occur within a single population (e.g., Lessells, 1984; Székely, & Cuthill, 1999; Amat, Fraga, & Arroyo, 2008).

Kentish Plovers are well-studied along the western coast of Saudi Arabia, with the total populations estimated at approximately 10,000 individuals (AlRashidi, Kosztolányi, Shobrak, & Székely, 2011a; AlRashidi, Kosztolányi, Shobrak, Küpper, & Székely, 2011b; AlRashidi, Long, O'Connell, Shobrak, & Székely, 2011c), whereas the most recent available data from Sabkhat Al-Fasl lagoons on the eastern coast of Saudi Arabia, covering the period 1992–1995, report up to 3,500 individuals on passage and up to 2,800 individuals in winter (BirdLife International, 2015). Moreover, little is known about its ecology, demography and behaviour along the eastern coast of Saudi Arabia. Thus the aims of this study were: to collect data on basic demography, life-history and behaviour of this species; to compare these data with those of other populations elsewhere, particularly Arabian Peninsula populations; and to determine threats that may face these birds on Sabkhat Al-Fasl Lagoons, if any.

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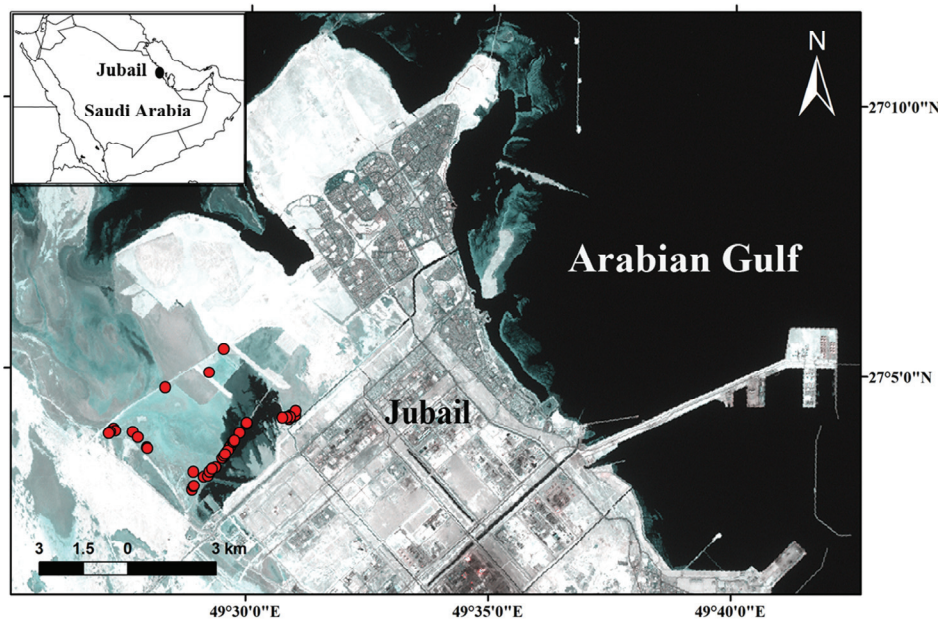


Figure 1. Map of Sabkhat Al-Fasl Lagoons showing the locations of Kentish Plover nests (circles), drawn using a false colour composite image of the Landsat-8 (OLI) satellite acquired in October 2015. The image was downloaded from the United States Geological Survey Earth Explorer gateway (http://earthexplorer.usgs.gov).



## Study Area

Sabkhat Al-Fasl Lagoons (salt marsh) are evaporation lagoons on the south-western border of Jubail Industrial City, Eastern Saudi Arabia. The lagoons are a protected area and categorised as an important bird area by BirdLife International. The area is about 6.5 km long and 4.7 km wide and is used for storing excess wastewater from Jubail Industrial City. The water level is very shallow, usually not exceeding 50 cm, except in the southern part of the lagoons where the water level may reach 1 m (BirdLife International, 2015). Vegetation is dominated by Common Reed *Phragmites australis* on the southern part of the Sabkhat and halophyte plant species such as *Halopeplis perfoliata* and *Zygophyllum coccineum* particularly in the eastern and the western parts of the Sabkhat. A Power Generating Station was built in 2013 in the south-eastern part of the Sabkhat with high voltage power lines stretched on an unpaved road running East-West of the lagoon, the road being used by some of the local companies' cars (Figure 1).

## Methods

***Fieldwork and breeding data collection.*** This study was carried out during the period between 22 and 29 March and between 30 May and 6 June 2015. Searching for nests was conducted by walking around the lagoons on the dikes, unpaved roads and the flat Sabkhat, either by spotting the nests directly, or observing with binoculars (8x42) the flushed incubating adults when they returned to their nests. Once a nest was located, it was photographed and its location was recorded using a hand held GPS unit, Garmin e-Trex. Clutch size was also recorded. Egg flotation was used to estimate the date of egg laying (see Székely, Kosztolányi, & Küpper, 2008). Most nests were visited every 2 days. The fate of the clutch was assigned to one of the following categories: (1) Hatched – when at least one egg hatched, (2) Predated – when the nest was destroyed by a predator, (3) Failed – when no eggs hatched but the reason of failure was not predation, or (4) Unknown – when the fate of the nest was not followed or the eggs disappeared although neither

predation nor hatching was confirmed. Kentish Plover parents were captured by funnel traps on the nest, or on their downy chicks, where the chicks were covered by a sieve large enough to accommodate them and the funnel trap was put around the sieve (see Székely et al., 2008). Adult plovers were ringed with metal rings provided by the Saudi Wildlife Authority (SWA). The ringed families were re-sighted and the sex, the number of attending parents and the number of chicks were recorded. Adult males and females were usually straightforward to distinguish.

A muted Bushnell 8MP Trophy Cam Black Led Trail Camera was used to record the incubation behaviour of adults for at least 24 hours at their nests. The cameras were set up at least 1.5m from each nest and programmed to record images at one-minute intervals. The cameras recorded all the nocturnal activity as they are all equipped with infrared sensors. Each camera was installed with the minimal amount of disturbance that allowed the adults to return to the nest only few minutes later, with the total consumed time of about 10 minutes. The ground surface temperature was also measured at one-minute intervals at each nest for at least 24 hours using a HOBO U10 data logger. The data logger was positioned on the ground surface in an open area about 1m from each nest scrape. In total, 9,758 images of seven nests were analysed (the average was 1394±47.6). The first two hours of data for each nest were excluded from the analyses to ensure that the cameras did not affect the parental behaviour of incubating birds, and to give the parents more time to become accustomed to the camera's presence. The minimum ground temperature at night was 26.3°C, whereas the maximum day-time temperature was 58.4°C.

***Statistical procedures.*** For incubation behavioural data, twenty-four hour recordings were considered as the unit of analysis for each nest. Each day was divided into 12 two-hour time periods. Following AlRashidi et al. (2010), four behavioural variables were calculated for each period: (1) total incubation – the percentage of the clutch incubation time by either parent; (2) male incubation – the percentage of the clutch incubation time by the male parent, (3) female incubation – the percentage of the clutch incubation time by the female parent, (4) number of change-overs – the number of times when one parent relieved the other parent from incubation duty. The average temperature outside the nests was taken as the ground temperature for each period. The statistical package R version 3.2.1 (R Development Core Team, 2015) was used for statistical analyses and drawing figures.



## Results

***Egg-laying dates and nest locations.*** In total 45 Kentish Plover nests were found. The first nest was found on 24.03.2015, and the first young was encountered on 25.03.2015. The breeding season may start as early as late February and it may last until the middle of August. Most nests were found on the dikes or on the unpaved road where no or only scattered Common Reed was present (Figure 1). Four nests were found under halophytic bushes, whereas 41 nests were on fully exposed sites. Nest distances from the water ranged from 2 to 500 m.

Out of 37 Kentish Plover completed nests, 56.8% had three eggs (N=21), 40.5% had two eggs (N=15) and 2.7% had one egg (N=1). The fate was known for 12 nests: 75% of the nests (N=9) were predated, 16.7% of nests (N=2) produced chicks and 8.3% of nests failed (N=1).

***Brood-rearing.*** Kentish Plovers have biparental brood care in Sabkhat Al-Fasl Lagoons. Twenty-four families were re-sighted daily from the first encounter, and the chicks' age for all families ranged from one day at hatching to about 35 days. In all families, both parents were observed or captured together with their chicks, except in three families where the females were absent (these were checked daily for 1 hour per day over the course of the study). The age of the young of these three families ranged between 30 to about 35 days.

***Daily routine of incubation behaviour.*** The camera system was set up on nine nests (two nests were under small bushes and seven were in exposed sites). However, only the

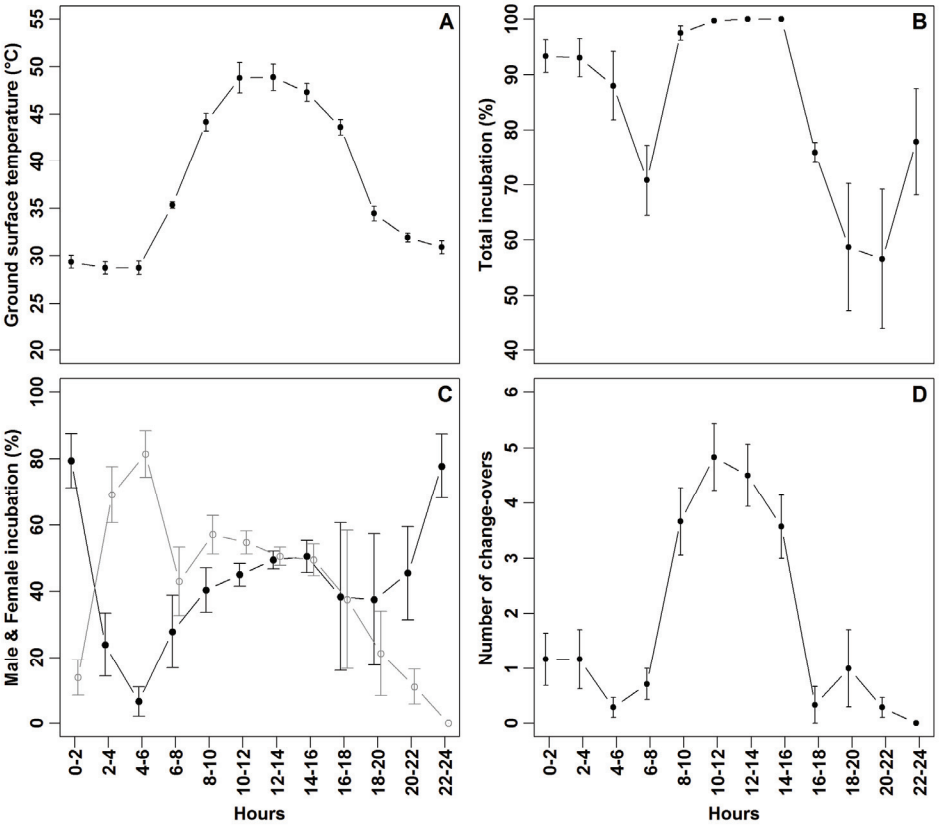


Figure 2. (A) Ground surface temperature in an open area about one metre from each nest scrape; (B) Total incubation (the percentage of the clutch incubation time by either parent); (C) Male incubation (black line with solid circles) and female incubation (grey line with open circles); and (D) Number of change-overs (the number of times when one parent relieved the other parent from the incubation duty) at exposed Kentish Plover nests in relation to ground surface temperature (°C) in 2-hour periods (n = 7 nests); mean ± SE are given for each 2-hour time period.

exposed nest data were analysed because a Red Fox pulled out the camera at one covered nest and the bush movement by wind made it difficult to analyse the data of the other nest. The mean total incubation was 84.9 ±1.3% over the full day period (n = 7 nests). Females attended the nests 43.5±3.2% of the time, whereas males attended the nests 41.4±3.9% of the time. Male and female incubation routines were different: females incubated the eggs mostly in the morning and males in the evening and at night (Figure 2). At night, 18:00–6:00 h, the total incubation was 78.0±2.6%, with females and males spending 37.1 ±4.66% and 40.9 ±5.7% of their time respectively. In contrast, during day-time, 6:00–18:00 h, the nests were attended 91.5 ±1.4% of the time, with females and males spending 50.2±2.3% and 41.3±3.4% of their time respectively attending the nests (Figure 2). The mean of the total number of change-overs was 18.7±2.3% over the full day. At night, 18:00–6:00 h, mean of change-over total number was 3.1±0.6% whereas it was 15.6±2.4% during day-time. The highest number of change-over was in the period 10:00–12:00 h, whereas the lowest was in the period 22:00–24:00 h where no change-over happened at all (Figure 2).

The highest attendance of nests was during the hottest parts of the day (12:00–16:00 h) with nest attendance reaching 100% of the time, whereas the lowest attendance was in the evening (18:00–22:00 h) when nest attendance was under 60% of the time (Figure 2).

***Threats.*** Predation risk and human disturbance are the main threats that may reduce the reproductive success for Kentish Plovers and other avian species at Sabkhat Al-Fasl Lagoons. The main cause of predation was the terrestrial predators, which included stray Domestic Cats *Felis domesticus* and Red Fox *Vulpes vulpes*, identified from their footprints found around predated nests. Up to five domestic cats were observed near some nests. On the first visit, a Red Fox burrow was found in the north-eastern part of the lagoons, which contained a fox family (female with 3 cubs). On the second visit the burrow was vacant but the fox tracks were everywhere. The nest cameras also showed a large predatory bird, possibly the Western Marsh Harrier *Circus aeruginosus*, flying near a Kentish Plover nest, which led the plovers to display the feigning-injured behaviour to distract the raptor away from their nests. At many nests, however, the predators did not leave tracks, and thus their identification was not possible. Only one adult Kentish Plover male was found predated by possibly a Red Fox. Although Sabkhat Al-Fasl Lagoons are nature reserves and many cautionary signs are present in the area warning that hunting and people entry are prohibited, human disturbance is high. Large numbers of empty bullet cases were seen all over the lagoon shorelines, indicating that bird hunting is very extensive. Kentish Plovers are not preferred by bird hunters, but driving cars on the dikes and the unpaved roads along the lagoon shorelines may trample nests, killing the crouching young and flushing the incubating birds, thus causing nest failures. Moreover, some golf players were observed collecting their golf balls close to some of the nests.



## Discussion

The predation risk for eggs was very high and could be attributed to the terrestrial predators, mainly Red Fox and domestic cats. The predation rate is almost equal to that on the Farasan Islands, Saudi Arabia (AlRashidi et al., 2011a) but is much higher than that for another Arabian Kentish Plover population in Al Wathba, UEA (Kosztolányi et al., 2009). This difference may be due to the fact that Al Wathba is surrounded by a fence to deny many terrestrial predators access, and the fence thus reduced their effects on the nest success.

Despite the abundance of halophytic bushes, breeding Kentish Plover seem to prefer nesting at exposed sites rather than nesting under bushes. This result is in line with the study of Amat and Masero (2004) conducted at Fuente de Piedra Lake, southern Spain, and also with the study of Gómez-Serrano and López-López (2014) conducted in the east of Spain, but it is in contrast with the study of AlRashidi et al. (2011a) conducted on the Farasan Islands where Kentish Plovers preferred nesting in shade under bushes. This difference may be because the terrestrial predator density in Sabkhat Al-Fasl Lagoons is higher than on the Farasan Islands, but this requires further investigation.

Brood desertion is rare in this Kentish Plover population which is consistent with the argument that a harsh environment can favour biparental care (Fraga & Amat, 1996; Kosztolányi et al., 2009; AlRashidi et al., 2011a). In temperate zone populations, a single parent may be sufficient to guide and brood chicks (Lessells, 1984; Székely & Lessells, 1993). In contrast, in harsh environments with an extremely hot environment and/or high predation pressure, such as Sabkhat Al-Fasl Lagoons, both parents are

needed to brood and shade the chicks to avoid predation and overheating (Fraga & Amat, 1996; Kosztolányi et al., 2009; AlRashidi et al., 2011a).

It was found that the parents attended their nests more than 84% over the full day and more than 90% of the time during day-time (6:00–18:00 h), and the number of change-overs increased during the hottest parts of the day which may be because a single parent cannot protect the eggs and itself from overheating. This result is partly consistent with the previous studies (AlRashidi et al., 2010; AlRashidi et al., 2011b) which were all carried out in other extremely hot environments, namely Al Wathba and the Farasan Islands. Small differences were observed in the incubation behaviour (total incubation, male incubation, female incubation and number of change-overs) between this population and other populations in Al Wathba and the Farasan Islands, which may be attributed to the sample size and the time of data collection. The data of seven nests only were used in this study, compared to 28 nests in Al Wathba and 17 nests in the Farasan Islands (AlRashidi et al., 2010; AlRashidi et al., 2011b). Moreover, in this study the data were collected in just one year between late May and the beginning of June, while in the previous studies the data were collected in two years between March and July.

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**Disclosure Statement**

No potential conflict of interest was reported by the author.



## References

AlRashidi, M., Kosztolányi, A., Küpper, C., Cuthill, I. C., Javed, S. & Székely, T. (2010): The influence of a hot environment on parental cooperation of a ground-nesting shorebird, the Kentish Plover *Charadrius alexandrinus*. *Frontiers in Zoology*, *7,* 1.

AlRashidi, M., Kosztolányi, A., Shobrak, M., & Székely, T. (2011a): Breeding ecology of the Kentish Plover *Charadrius alexandrinus* in the Farasan Islands, Saudi Arabia. *Zoology in the Middle East, 53*, 15–24.

AlRashidi, M., Kosztolányi, A., Shobrak, M., Küpper, C., & Székely, T. (2011b): Parental cooperation in an extreme hot environment: natural behaviour and experimental evidence. *Animal Behaviour*, *82*, 235–243.

AlRashidi, M., Long, P. R., O'Connell, M., Shobrak, M., & Székely, T. (2011c): Use of remote sensing to identify suitable breeding habitat for the Kentish Plover and estimate population size along the western coast of Saudi Arabia. *Wader Study Group Bulletin*, *118*, 32–39.

Amat, J. A., Fraga, R. M., & Arroyo, G. M. (2008): Brood desertion and polygamous breeding in the Kentish Plover *Charadrius alexandrinus*. *Ibis*, *141*, 596–607.

Amat, J. A., Masero, J. A. (2004): Predation risk on incubating adults constrains the choice of thermally favourable nest sites in a plover. *Animal Behaviour*, *67*, 293–300.

BirdLife International (2015): Important Bird Areas factsheet: Sabkhat al-Fasl lagoons. /www.birdlife.org [downloaded on 03.10.2015].

del Hoyo, J., Elliott, A., & Sargatal, J. (1996): *Handbook of the birds of the world*. Vol. 3. Barcelona: Lynx Edicions.

Fraga, R. M., & Amat, J. A. (1996): Breeding biology of a Kentish Plover *Charadrius alexandrinus* population in an inland saline lake. *Ardeola*, *43*, 69–85.

Gómez-Serrano, M. Á., & López-López, P. (2014): Nest site selection by Kentish Plover suggests a trade-off between nest-crypsis and predator detection strategies. *PLoS ONE,* 9(9), e107121.

Kosztolányi, A., Javed, S., Küpper, C., Cuthill, I. C., Al Shamsi, A., & Székely, T. (2009): Breeding ecology of Kentish Plover *Charadrius alexandrinus* in an extremely hot environment. *Bird Study*, *56*, 244–253.

Lessells, C. M. (1984): The mating system of Kentish Plovers *Charadrius alexandrinus*. *Ibis, 126,* 474–483.

R Development Core Team (2015): R: a language and environment for statistical computing. Version 3.2.1, Vienna: R Foundation for Statistical Computing. https://www.r-project.org.

Székely, T., & Cuthill, I. C. (1999): Brood desertion in Kentish Plover: the value of parental care. *Behavioural Ecology*, *10*, 191–197.

Székely, T., Kosztolányi, A., & Küpper, C. (2008): Practical guide for investigating breeding ecology of Kentish Plover *Charadrius alexandrinus*. Version 3. Unpublished Report, University of Bath; [available at www.bath.ac.uk/bio-sci/biodiversity-lab/pdfs/KP_Field_Guide_v3].

Székely, T., & Lessells, C. M. (1993): Mate change by Kentish Plovers *Charadrius alexandrinus*. *Ornis Scandinavica*, *24*, 317–322.