Breeding ecology of the endemic subspecies of cream-coloured courser, *Cursorius cursor exsul*, in Maio, Cape Verde

Fieldwork report, September 10th – November 25th 2015

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Summary

The island of Maio is home to arguably the largest breeding population of the Cream-coloured courser subspecies, *exsul*. This is an endangered subspecies of cream-coloured courser; the global population size of this subspecies was estimated to be only 150-350 (Wetland International, 2016) This year, FMB and the University of Bath initiated a project to monitor the courser population in Maio, study breeding ecology and make behavioural observations. We focused on Salina Porto Ingles where FMB and Bath University also investigate Kentish plovers. We found a total of 21 nests, of which 10 hatched. The breeding population, however, is substantially larger since we also found 8 families in which the chicks hatched from nests we did not find. We attempted to monitor 18 broods in total. Both predation and abandonment were important causes of the low proportion of nests that hatched compared to the total number found. Based on our ringing and observation, the cream coloured courser is a widespread breeder in the salina especially in the area called North Funchago. Since North Funchago is currently not protected, we propose expanding the protection to this area that is a key area of both breeding and feeding coursers.

Resumen

La isla de Maio tiene una de las mayores poblaciones de la subespecie exsul del corredor sahariano. Esta es una subespecie en peligro ya que la población global se estima en 150-350 individuos (Wetlands International, 2016). Este año, FMB y la Universidad de Bath iniciaron un proyecto para monitorear la población de corredores en Maio, estudiar su reproducción, ecología y hacer observaciones de comportamiento. Nos enfocamos a trabajar en la Salina de Porto Inglés donde FMB y Bath también trabajan con los chorlitos Kentish. Encontramos un total de 21 nidos, de los cuales 10 eclosionaron. La población reproductiva es substancialmente más grande ya que encontramos al menos 8 familias en donde crías eclosionaron de nidos que no fueron encontrados. Intentamos monitorear la sobrevivencia de 18 nidadas en total. La depredación y el abandono fueron la causa principal del bajo éxito de eclosión registrado. Con base en las anillaciones y observaciones que realizamos, los corredores se reproducen en la Salina y especialmente en el área denominada Funchago Norte. Ya que Funchago Norte actualmente no está protegida, proponemos expandir el área de protección hasta esta zona que es clave para la reproducción y alimentación de los corredores.

Introduction

The 535 hectare area of the Salina do Porto Inglês is recognised as a protected area by the government of Cape Verde, and is a RAMSAR site (Cesarini & Forte 2014). It forms an important breeding area for cream-coloured coursers (*Cursorius cursor*), Kentish plovers (*Charadrius alexandrinus*) and hoopoe larks (*Alaemon alaudipes*). Studying the cream-coloured courser population will allow identification of interesting topics for research into the breeding ecology of this species. Work in Maio is of particular importance because the courser subspecies, *exsul*, is endemic to the island. Although the cream-coloured courser is a wide-spread breeding shorebird in deserts and semi-deserts in North Africa and the Middle East, very little information is available on their breeding ecology and behaviour. In addition, there may be aspects of breeding or behaviour that are unique to the exsul subspecies. Monitoring of the courser population, along with the Kentish plover project that is already established in Maio, will allow possible threats to the biodiversity of the Salina do Porto Inglês area to be identified and dealt with.

The main aim of this project was to establish the courser project by collecting data on breeding ecology and morphology of coursers in the Salina do Porto Inglês from September to December 2015. We aimed to improve the basic knowledge of the Cape Verdean subspecies of the cream-coloured courser so that efforts can be made to conserve it and further studies can be done with more specific research aims.

The main objectives of the project are as follows:

1. Study population dynamics of the cream-coloured courser
2. Study growth rates and reproductive success
3. Identify the threats affecting the species during reproduction
4. Assess the likely impact of tourism and development on this species

The key achievements of the project are as follows:

- Ringed 51 coursers (juveniles and adults), either with a metal and colour ring combination or just a colour ring combination
- Recorded morphometric data: weight, wing length, tarsus length and bill length
- Placed nest cameras on 2 nests
- Photographed nests for investigation into whether egg pigmentation varies with habitat
- Measured eggs to identify whether there is variation in egg size
- Floated eggs to estimate the incubation period of coursers
- Recorded mates, nest sites, hatching success and brood fates
- Did weekly surveys of the courser population
- Visited Morro and Calheta once a week to search for nests and families
- Noted the threats faced by coursers during reproduction
- Recaptured several chicks and collected morphometric data from them in order to produce a growth curve

2. Methods

2.1 General methods

From 14th September until 20th November 2015 we looked for cream-coloured coursers nesting in the rocky part of the Salina, following the protocol described in Székely et al. (2008) for breeding

waders especially small plovers. Fieldwork was carried out predominantly in the Salina rocky part, but we also visited Morro and Calheta once a week when possible. Data were collected by Keeley Seymour and Philippa Harding using a car and a mobile hide.

When nests were found, the egg lengths and widths were measured and the eggs were floated in water to determine the incubation stage, as described in Székely et al. (2008). At nests that were incubated for more than 10 days, we then attempted to trap the adults from the nest in order to ring them and take measurements. The nest was shaded using rubbish placed on the trap if we attempted to trap on a sunny day. Once eggs had been incubated for 18 days we started to check nests for pipping (chicks emitting sounds from inside the egg) once a day. We found that slight cracking of the egg was a better indicator that the eggs were near to hatching than listening for pipping. The chicks hatched between several hours to 3 days after cracking appeared, with pipping becoming noticeable only when very close to hatching. When chicks were found they were ringed, measured and blood samples were taken, using the methods described in Székely, 2008. Any unringed chicks that were found were captured and placed under a sieve with a trap over the top to attempt to trap the parents.

Successfully trapped parents were ringed and measured. Photos of adults were taken according to the protocol described in Argüelles-Ticó, A. (2008, Figure1), however no tripod was used. In order to take these photos without a tripod, adults had to be securely held in a bird bag. We found that the use of a large elastic band around the main body of the bird, over the bird bag, helped to keep the adults from escaping the bag by keeping their wings and legs in place.

The parents and chicks were weighed using a scale with an upper limit of 200 grams. The above technique of keeping adults in a bird bag secured with an elastic band was also used for weighing the parents, after subtracting the tare weight. Chicks could be placed directly onto the scale without a bag. We ensured the entire bird was on the scale before recording the weight.

Nest contents were photographed holding the camera approximately one metre above the nest, as well as one taken closer to see the eggs in more detail. A ruler and a grey card labelled with the nest ID, date, time, and ‘Maio 2015’ were included in the photos.

At two nests we photographed the incubating adults every minute for 72 hours using Bushnell trophy cameras.

2.2 Order of tasks with captured adults

1) Check if ringed – if yes, record metal ring number and ring combination; if no, assign ring combination from sheet to the bird and ring it, recording the metal ring number and ring combination
2) Measure bill length using a sliding calliper
3) Measure tarsus length using calliper
4) Take blood sample from wing vein
5) Weigh bird bag on scale
6) Place bird in bird bag, secure with drawstring and place elastic band over bag around main body of bird

7) Weigh bird on scale and subtract the weight of the bird bag before recording the measurement

8) Take photographs of bird

9) Check the book to ensure all tasks have been completed

10) Release bird directly onto the ground

Figure 1. Photo of an adult cream-coloured courser

2.3 Photographing chicks

Chicks were photographed using the methodology of Pinjia Que. They were placed on the ground near to where they were found and photographed with a grey card labelled with nest ID, 'Chick 1' or 'Chick 2', the date and time and 'Maio 2015' (Figure 2). The photo was taken from about 0.5 metres above the chick, but this varied depending on how much the chick tried to run away. It was necessary to take the pictures closer to the ground if the chick tended to run so that it was easier to catch the escaping chick. To prevent chicks running away during the photo-taking process, we held our hand over them until the last second before taking the photo and then immediately covered the chicks up again with our hand. This helped to keep them calm enough for us to take photos successfully.

Figure 2. Example of a chick photo

2.4 Surveys

From the 10th October to the 22nd November we completed weekly surveys of the rocky part of the Salina, following the same route each time (Figure 3). During these surveys we recorded the number of coursers seen, whether the coursers were light or dark coloured (for potential sexing in future), colour rings, and comments on behaviour. The route followed began at the fork leading to Bella Vista, and ran parallel to the road in North Funchago in the direction of Vila do Maio, before turning back on itself towards the abandoned buildings. The route then turned back to the direction of Vila do Maio again and ran in a straight line from the abandoned buildings, along the wall of Funchago and then parallel to the road until it reached the entrance of the Salina. This route was followed in alternating direction every other survey to ensure that we looked for coursers from both perspectives. We stopped the car if a courser was detected without binoculars, or every 100 metres. We also recorded any disturbance agents, such as dogs, ravens, cars, people and cows.

Figure 3. Route followed (red line) during the weekly survey of the rocky part of the Salina.

2.5 Finding nests

Coursers do not have obvious nervous behaviours that indicate they have a nest like Kentish plovers do. Coursers emit a 'praak-praak' call or sharp 'whip' piping sound (Cramp *et al.*, 1972), especially when in flight, which should be listened out for when trying to spot them. However, a large proportion of the nests in this season were found by spotting coursers already sat down on the nests (Figure 4). The coursers are very well camouflaged amongst rocks, making this technique difficult. However, it is necessary because many coursers are not easily disturbed by the car or hide and often do not leave the nest at all.

Some nests can be found by spotting coursers that appear to be running with purpose and speed, in a particular direction and without much feeding or preening along the way. This often indicates that the courser is running towards a nest. The courser will usually then settle on the nest with a shuffling

motion, but note that some coursers pretend to sit on a nest before moving and settling on their actual nest. Presumably, this is to distract the attention of predators. It is therefore recommended that the researcher waits for a few minutes to see if the courser will move on before checking for a nest.

Once the researcher has decided to check the spot for a nest, he/she must work out several reference points in order to find the nest. It is recommended that several references are mentally noted at different distances from the potential nest, as well as a reference next to the nest. This will be of great aid in locating the nest.

Figure 4. Adult coursers sometimes sit tightly on nest so can be approached to about 5 m

2.6 Trapping

Firstly, it should be noted that we only attempted trapping if the desired courser was already sat on the nest or appeared to be nearby. This can be determined by stopping the car/hide far away from the nest and checking with binoculars or a telescope to see if the parent is present.

Funnel trap

We used a slightly larger version of the plover trap as described in Szekely et al. (2008): the courser trap was approx. 50 centimetres in diameter and 30 centimetres in height. Place the trap over the nest, ensuring the eggs are close to the entrance of the trap and visible to the parent. The eggs must be far enough away from the entrance that the courser does not sit in the entrance when it sits on the nest, as this may allow it to escape. The entrance should be facing the direction at which you will run towards the trap later. If the sun is very intense, the eggs should be shaded by placing a cowpat or piece of rubbish on the top of the trap in a position that causes it to drop a shadow over the eggs. The most effective times of day to trap coursers were 9.00-12.00 and 15.00-18.30. There are two methods of waiting for the courser to enter the trap, and each works with varying success with each individual courser, so if one fails another should be tried:

a) Leave the trap completely and move to a different area for half an hour to an hour. This is only possible in a car, but allows the researcher to make observations while waiting for the courser to enter the trap. The researcher should return to the trap by driving close enough to it to check if the courser is on the nest (Picture 5) without disturbing it. If it is on the nest,

the researcher should drive quickly up to it, then exit the car and run to the trap as quickly as possible to ensure the courser does not escape before it can be caught. When the researcher reaches the trap, he/she should reach into the entrance (Picture 6) and catch the bird, holding it in a suitable way to ensure the bird cannot flap and injure itself or escape.

b) Move to a suitable distance away from the trap: far enough away so the parents are not too nervous about entering the trap but close enough that the researcher can see (using binoculars) if the courser has entered the trap. Watch the trap using binoculars and if the courser enters the trap, drive towards it quickly and follow the protocol as described in (a). If in the hide, the researcher should be able to sit close enough to the nest that he/she can run to the trap straight from the hide without having to move the hide beforehand.

Figure 5. Trapping a courser using funnel trap

Circular trap

This style of trap consists of a large metal ring (approximately one metre in diameter) covered in fishing net, balanced on a wooden stick which has fishing wire attached to it (see Szekely et al. 2008). This style of trap was much faster and more effective than the funnel trap in capturing coursers.

1) Position the car or hide at a suitable distance away from the nest: far enough away that the courser parent is not disturbed by its presence but close enough that the string will reach from the trap to the car/hide and can be pulled to collapse the trap

2) Place ring over the nest, with the eggs in the centre. Lift up the edge of the trap closest to the position you will watch the trap from and balance it on top of the stick

3) Tie the fishing line around the bottom of the stick

4) Take care to ensure the ring falls directly over the nest when the stick is pulled, so that the courser and eggs will not be harmed by the trap falling. We did several test runs of pulling the string before leaving the trap

5) Ensure that the stick is secure and will not fall over before the string is pulled

6) Leave the trap, unwinding the wire on the way back to the car/hide, ensuring the wire is quite taught at all times so it does not get caught in rocks and bushes

7) Hold the string tight while sitting in the car/hide and watch the nest

8) When the parent enters the trap and settles on the eggs (identifiable by the shuffling movements they make before sitting), quickly and firmly pull the string to collapse the trap on the courser

9) Go RUN? to the trap and carefully catch the courser inside, ensuring not to injure it when removing it from the trap

2.7 Ringing

Making colour rings following the protocol described in Szekely et al. (2008).

1) Cut some coloured plastic using scissors into a long rectangle, with a length of 33mm and width of 6mm

2) Cut the corners slightly to round off the edges

3) Sand down the edges, focusing on the corners, until they are smooth

4) Hold the plastic at one of the 6mm edges using some thin-tipped tweezers and use a heat-gun to melt the plastic until it is malleable

5) Wait for the plastic to cool slightly then wrap the plastic tightly around the tweezers to form a tight ring

6) Use the fourth hole on the ringing pliers to tighten the ring on the tweezers for around 10 seconds

7) Remove the ring from the tweezers and use the fifth, fourth and third holes on the ringing pliers to tighten the ring further

Ringing adults by colour

1) Unravel ring using fingers – with practise this can be done easily while holding the courser with the other hand, but for ease the courser can be placed securely in a bird bag which is hung up while the ring is prepared

2) Position ring on the courser's leg and wrap it around, ensuring the edge that was on the inside of the ring ends up on the outside of the ring – this allows the ring to be more tight and secure on the courser leg

3) Squeeze the ring into a rough circular shape

4) Use the fourth hole on the ringing pliers to tighten the ring, ensuring that the ring is secure and will not fall off, but also that it can be twisted around 360 degrees and moved up and down

Ringing adults by metal rings

1) Open the ring enough that it can be slipped onto the leg

2) Position the ring on the leg

3) Squeeze the ring shut using your fingers

4) Use the fourth hole on the ringing pliers to ensure the ring is securely closed

Ringing chicks

1) Unravel ring using fingers – with practise this can be done easily while holding the courser with the other hand, but for ease the courser can be placed securely in a bird bag which is hung up while the ring is prepared

2) Position ring on the courser's leg and wrap it around, ensuring the edge that was on the inside of the ring ends up on the outside of the ring – this allows the ring to be more tight and secure on the courser leg

3) Squeeze the ring into a rough circular shape

4) Use the fourth hole on the ringing pliers to tighten the ring. With chicks you must be much more careful when ringing as their legs are much thinner than adult legs. Ensure that the ring is just tight enough that it will not slip over the knee, but loose enough that it will fit the adult courser.

5) It is recommended that chicks are given a unique combination of 2 colour rings, 1 ring on each of the upper parts of the legs (Figure 7). This combination should be recorded so that the chick can be identified in future and given a metal and colour ring combination upon recapture, when its legs are large enough.

Figure 6. Colour-ringed courser chick

Metal-ringing juveniles

The metal rings we currently have for coursers are too large for the chicks, whose legs are much thinner than adult legs. Potential solutions to this problem would be to get some rings with a smaller diameter, because the rings have plenty of room to spare even on the adults, or to use a plasticine method (Sutherland *et al*., 2004). During this season we have been giving a unique colour ring combination to chicks as described above, then giving the chicks a metal and colour ring combination when they are recaptured and their legs are large enough to carry a metal ring.

2.8 Estimating incubation stages

The incubation stages of courser nests were estimated using the figures for Kentish plovers in *Table 1,* which worked accurately enough. In future studies it may be helpful to produce an incubation

stage table specifically for the coursers of Maio. The 18th day of incubation was used as a standard for checking the eggs for pipping. The eggs hatched between three days before this day and nine days after this day, so it is not entirely reliable as a way of estimating when eggs will begin to hatch. Checking the eggs for cracking and pipping on the estimated 15th day of incubation would allow the researcher to be more successful at determining when the nests will hatch and ensure hatch dates are not missed.

The researcher should start attempting to trap parents when the eggs have had at least four days of incubation (details in Székely et al., 2008). Trapping tends to be more successful at later stages of incubation, especially when the eggs have already begun hatching. This is because the parents become increasingly protective of the nest, returning to it faster and becoming bolder about sitting on the nest in the trap. Adults can also be trapped once the chicks have hatched by placing the chicks under a sieve and placing the trap over them, but this is a less reliable method and should not be depended upon.

Table 1. Incubation stages estimated in 2014 with Kentish plovers and used for courser fieldwork in 2015. '+1', '+2' and '+3' refer to different levels of floating, with '+1' referring to the egg being slightly afloat with just a small tip of the top of the egg emerging from the water (approximately 5 millimetres diameter), and '+3' referring to the highest level of floating with a relatively large amount of the top of the egg emerging from the water (approximately 15 millimetres diameter), as designed by Olivier Pineau (Szekely et al., 2008).

Incubation stage	0°	30°	45°	90°	90°˥	+1	+2	+3
Number of days incubated	0	2	6	12	17	18	20	>20

3. Results

3.1 Nests

We found a total of 21 nests, all of which were in the rocky part of the Salina. Although courser nests have been found elsewhere in the Salina in previous years, we believe that the majority of coursers nest in the rocky part. The majority of nests were found in mid-November (Figure 7. The nests seemed to appear in clusters spatially, suggesting a social aspect to nesting. 17% of nests were lost to predation (Figure 10), most likely due to Brown-necked ravens (*Corvus ruficollis*), crabs and cats. All nests had two eggs, but many lost one egg over the incubation period. Several nests that lost an egg were eventually abandoned. The crabs and cats often take just one egg at a time. Therefore, predation may be a factor that contributes to the 24% of nests that were abandoned (*Fig. 2)*. Some eggs were damaged, either by predation attempts (Figure 8) or trampling, presumably by cows (Figure 9).

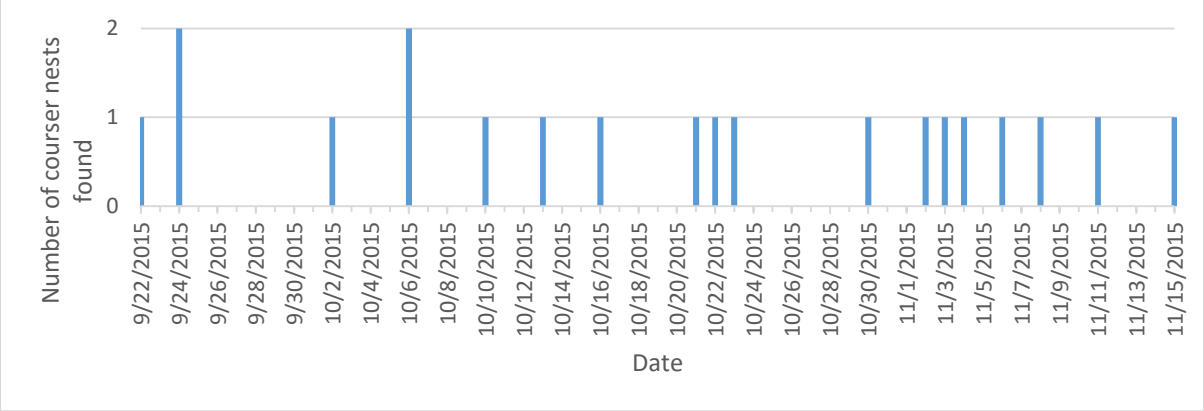

Figure 7. Number of cream-coloured courser nests found during fieldwork in Maio 2015.

Figures 8 and 9. Damaged eggs, presumably due to attempted predation (8) and trampling by a cow (9).

Of the 10 nests that hatched (48% of total nests), at five nests two chicks were found and ringed and at the other five nests, one chick was found and ringed. It is possible that there were two chicks on some of the nests at which we found one chick, because on some occasions one chick had hatched and when we returned to the nest to find the other chick, the family had moved on. It is not known in these cases whether the remaining hatching chick hatched or was predated.

The classification of the fate of nests is as follows:

1) Hatched: chicks were found in the nest
2) Unknown: nests that were found empty and close to the estimated hatching date without finding parents or chicks
3) Abandoned: nests that had not been incubated for at least 24 hours
4) Disappeared: nests that were found empty before the estimated hatching date; these were most likely predated but have not been confirmed using nest cameras

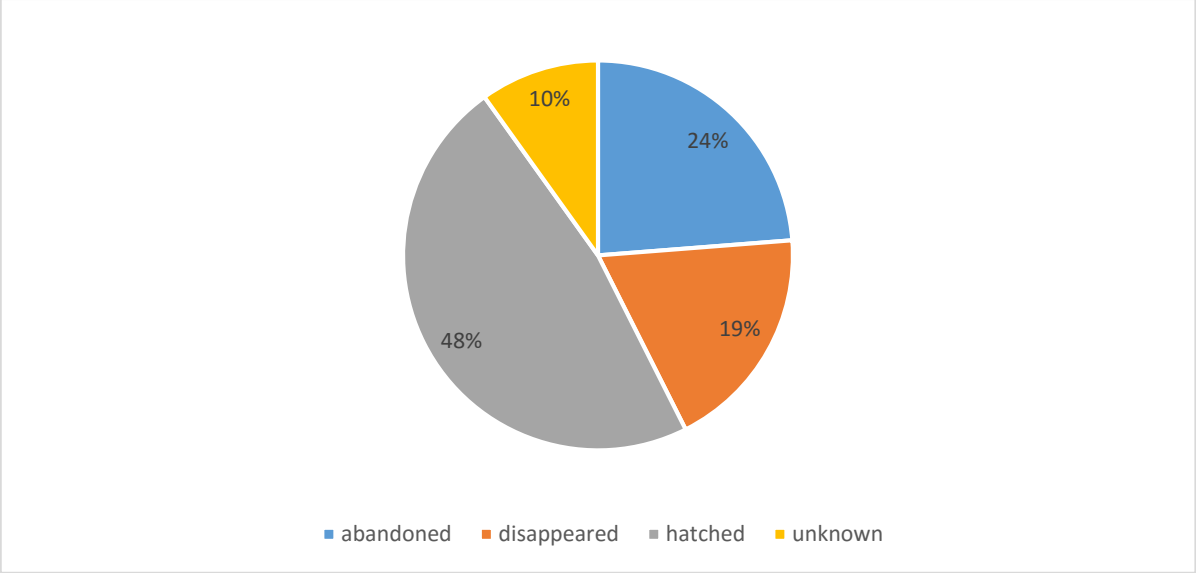

Figure 10. Fate of cream-coloured courser nests (n = 21 nests).

3.2 Mate identities

In total we identified 29 families during fieldwork. We identified 8 families in which…. hatched from nests were unknown, and found nests for the remaining 21. Of the 29 families found, we were able to capture both parents in 8 cases, 1 of the parents in 10 cases, and no parents in 11 cases. Trapping became more successful once we started to use the circle trap (see Methods). The vast majority of cases in which neither of the parents could be trapped were negative families (broods where the nest was not found prior to hatching), and the stick-pull trap was not employed with most of these because we had not made the trap when these families were found. When we attempted to trap parents of one negative family with the stick-pull trap we did not succeed because the parent was not able to settle on the chicks inside the trap due to the sieve. Night trapping was attempted several times but was not successful.

3.3 Nest contents photos

Photos of nest contents were taken (Figure 10) to investigate whether egg pigmentation varies with the nest material found on the nest. There is a lot of variation in egg pigmentation and size between nests, along with a lot of variation in the choice of habitat to place the nest on.

Figure 11. Examples of nest contents photos, showing the difference in egg pigmentation in different habitats

3.4 Captures

We captured a total of 51 coursers (25 adults, 26 juveniles). The adults were given a unique metal ring and colour ring combination. The colours used were red, blue, orange, yellow and green. The newly born chicks were given a unique combination of 2 colour rings because the metal rings were too large for their legs so would fall off. If chicks were recaptured at a later date and were large enough to put a metal ring on, the chick was given a unique metal and colour ring combination just like the adults. In future work a plasticine method should be attempted for putting metal rings onto chicks, as the chicks cannot always be recaptured. We took ornament photos for 27 adults and some recaptured chicks. Morphometric measurements were taken for every courser captured (*Table 2*)

	Weight (g)	Right wing length (mm)	Right tarsus length (mm)	Bill length (mm)	n
Chick at hatch	9.51 ± 1.43	0 ± 0	16.55 ± 0.82	6.96 ± 0.43	14
Adult	116.15 ± 6.77	158.40 ± 3.93	54.66 ± 2.21	21.70 ± 0.79	25

Table 2. Morphometric summary of juvenile and adult cream-coloured coursers, subspecies *exsul*, captured in Maio in 2015. Mean ± standard deviation are shown. Juvenile data includes only the 14 freshly hatched chicks captured. Adult data includes both male and female coursers because the sex is unknown.

3.5 Brood re-sightings

Chick survival

At least one chick (Figure 12) was ringed in 16 broods. 8 broods were found without knowing the nest beforehand (7 in the Salina rocky part, 1 in Calheta). Of the 16 broods found, we were able to re-sight 10 at least once after ringing. The fate of the remaining 6 broods is unknown because we did not find the family again after ringing the chick(s). This is potentially at least in part due to families leaving the rocky part after the eggs have hatched and moving to other areas on the island. The broods may move to the other side of the main road running parallel to the rocky part, where the habitat is very similar but has not been explored as part of the bird projects. In future, it would be useful to set up a survey route in this area. Additionally, some families may move to the sand-dunes, Sessuvium or plateau area on the other side of the Salina, so setting up a courser survey route there would be helpful. Morro and Calheta have been monitored as part of this year's fieldwork and only

one family was found in Calheta, with zero in Morro. Therefore it is unlikely that families move to either of these areas after the eggs hatch. The fact that most of the broods have been re-sighted in the rocky part suggests that most broods stay near to their original nest site.

Parental care

Of the 63 brood sightings, both parents were seen in 58 cases and one parent was seen in only five cases. This suggests that both parents play an approximately equal role in parental care. Both parents remained with their chicks even once they had started to fly. Of the ringed coursers, the same pairs were consistently seen. This implies monogamous behaviour in the coursers of Maio, with high fidelity. However, inconsistent with this, a ringed pair abandoned their nest and several weeks later one of the pair was seen courting with an un-ringed courser. This suggest some flexibility within the breeding season in nesting and mate choice. It is possible that the other ringed courser from the original nest died, so it would be of interest to try to find these coursers next year and look at mate fidelity among years and in relation to the previous reproductive success with a given partner.

Figure 12. Courser chick

3.6 Weekly surveys

A total of seven surveys were done, starting on 10th October and ending on 11th December 2015. All surveys summed 74 recordings in total. In most of these cases the coursers were un-ringed because this was the first year of the project so none of the birds had been trapped. Towards the end we had 8 re-sightings of ringed coursers aside from family re-sightings. It is not yet known if male and female coursers vary in morphology, so there was no way to identify sex. We noticed that the coursers are either light or dark in colour, and it appeared that you often found one larger light-coloured courser and one smaller dark-coloured courser in most pairs. These differences may correspond to sex. Therefore when molecular sexing has been done with the blood samples collected, these can be matched to the ornament photos of the coursers that they came from in order to identify any potential patterns in sex and morphology. If there are differences, they can be used to identify male and female coursers in the field.

3.7 Nest camera photos

We photographed two nests every minute for 72 hours each using Bushnell trophy cameras placed 1 metre away from the nest.

One of the cameras showed a nest that was not incubated for an entire night, and both of the cameras recorded long periods during which neither parent was on the nest. This suggests that eggs

can survive long periods without incubation, and may suggest that there is a low predation risk for courser nests as parents are not nervous about leaving their nest unguarded. However, as we only have this type of data for two nests, strong conclusions cannot be drawn and it could simply be two cases of poor parental care. On other nights, the nests were well incubated (Figure 13). Future projects should aim to set up nest cameras on more nests to see if there are more examples of this behaviour.

Additionally, nest cameras have proved useful for recording disturbance agents such as cows (Figure 14) and humans (Figure 15). This evidence of human/livestock disturbance is important for the conservation of the species and the habitat in which they live.

Figure 13. Courser sat on its nest at night.

Figure 14. Courser crouching as cow walks past.

Figure 15. Courser has been disturbed from the nest by a passing man.

3.8 Behavioural observations

Courting behaviour

The following courting behaviours were noticed:

- Scraping the ground with beak in a side-to-side motion, either standing or sitting down
- Holding a flower in beak and running while other follows

- Jerky rear up-and-down movements
- Bowing heads to one another in turn while moving towards each other
- Pecking ground
- Flapping wings
- Ruffling feathers
- Calling
- One courser following another
- Stretching out wing to show black underside

Cooperative breeding

Two pairs of adults were seen with the chicks of R6 on two occasions. This may be an example of the cooperative breeding behaviour that has been observed in coursers, in which the adults cooperate in rearing the chicks. This is an isolated example, suggesting it is uncommon in the Salina. The R6 brood consists of two chicks, whereas many of the families we managed to resight only had 1 chick. Perhaps cooperative breeding is more important when raising two chicks rather than just one, but from this single case we cannot tell whether it is a normal occurrence.

Notably, coursers are very often found in large groups. These groups feed, preen and move around together whilst calling intermittently. Until more of the coursers are ringed, it is not possible to determine whether these groups are made up of related coursers. It would be of interest to investigate whether these groups are made up of already-determined pairs, as they seem to split off into pairs every so often during feeding or preening. This leads on to the question of whether pair fidelity is high or if coursers choose different mates each season. A lot of courting was seen during the breeding season.

Night-time observations

It would be of interest to invest in some night-vision equipment for this project. We have not made any observations of brooding behaviour by the parents, including feeding the chicks. It is possible that chick feeding happens more at night, perhaps because the coursers feel protected by the low visibility. Designating some evenings to observe courser behaviour in the dark would be a good addition to the current set of data we have been collecting.

Patrolling behaviour

We observed a patrolling behaviour by one of each pair at a time (Figure 15). One of the parents would sit on the nest while the other covered an approximately 50 metre radius around the nest. During this patrol behaviour the courser would remain mostly stationary, looking around, then move slightly to a different position at which it would stop and check its surroundings again. During this time the patrolling courser would occasionally feed or preen, but most of the time it appeared to be checking for threats, regarding us warily while we were in the car or the hide. It was not observed whether in clustered pairs the sentinel duty is shared or if one of each pair looks out for its own nest only.

Figure 16. Courser exhibiting patrol behaviour

Stormy weather and abandonment

24% of nests were abandoned by the parents before hatching. This was a particularly prominent issue with nests that had lost one egg, although the parents often did not abandon the nest until days after the predation event. We suggest that this may be because the courser breeding season is long, stretching from August to May, or double with one clutch between August and November and a second clutch between the months of January and April (Koch & Hazevoet 2000, Naurois 1983). Therefore perhaps abandoning a nest is not too much of a loss as there will be a chance to lay a new nest. This would predict a decreasing probability of nest abandoning during the season. The original nest may not have been in an ideal place for feeding, and if just one egg is left it may be a better investment to lay a new nest with a clutch size of two. It would be interesting to see whether the coursers that abandon their nests do lay another, and indeed if coursers that have raised a brood go on to lay another in the January to April period. Also worth investigating would be whether they stay with the same mate for this new nest or find a new mate.

Several nests seem to have been abandoned just after stormy weather. Perhaps the eggs were made inviable by the storm, either directly or because the parents did not sit on the nest enough, and this is why the parents abandoned the nest.

To check if a nest had been abandoned, we placed a small stick (light enough to be moved by the courser but heavy enough that it is unlikely that wind would move it) on the nest and returned in 24 hours. If the stick had moved it was presumed the nest was not abandoned. If the stick remained there, the nest was presumed to be abandoned.

3.9 The importance of North Funchago

Notably, a very large proportion of the cream-coloured courser nests and families were found in the North Funchago area. Of the 21 nests found overall, 10 were found in the North Funchago area. Of the 10 nests that hatched overall, seven were in this area. Little is known about their antipredatory behaviour; it would be interesting to investigate whether neighbouring courser parents join together in defence against predators such as ravens. Of the eight negative families found, 6 resided in North Funchago. This illustrates the vital importance of this site to courser breeding ecology, both in

nesting and in rearing chicks. The planned building works in North Funchago would be extremely detrimental to the population, as it forms the main breeding ground. The rocks and bushes offer excellent camouflage for both the chicks and the eggs from predators such as the brown-necked raven, ensuring that the population can be maintained. Additionally, many coursers are seen feeding and courting there, as it is abundant in insects and well sheltered by bushes.

Discussion

We achieved all of the objectives proposed for this fieldwork season, including monitoring and doing weekly surveys of the cream-coloured courser population in Maio, and establishing the methods for future years of fieldwork on coursers.

Problems encountered

- We were not fully trained and prepared for working on coursers in time to collect data competently for many of the first nests found, as the traps were not ready and a car was not available
- Courser breeding unexpectedly increased just before we left Maio, so potential data are missed
- There were not enough courser traps to be very efficient at trapping – this was less of a problem once the stick-pull trap was incorporated into the routine as the traditional trap could be set and left while the stick-pull method was employed at a different nest.

Technical improvements

- Night-time observations of courser behaviour
- Researchers working on coursers in Maio from the start of September until at least mid-December to ensure as much data is collected as possible
- 3 traps should be available for coursers: 1 stick-pull and 2 traditional style. This will allow 2 traditional traps to be placed and left while the stick-pull method is employed on another nest. We currently have 1 stick-pull trap and 1 traditional trap, so only 1 more traditional trap will need to be made
- Survey route on opposite side of the main road that runs parallel with the salina
- More use of the stick-pull style trap as opposed to the traditional trap that is used with the Kentish plovers
- Scale with a box to ensure the entire courser weight is measured properly
- Place nest cameras on more nests; to do this more nest cameras will need to be taken to Maio as not enough were available this year
- Collect data from January to April as well as September to November, to include the full potential breeding season of the courser

Future projects

There were several interesting observations that have spawned potential questions for future research projects, including the following:

- Does egg pigmentation and size vary with the habitat the eggs were laid on?
- Do individuals stick to the same habitat/ ground colouration over time?
- Do the courser social groups consist of families from previous years?
- Do males and females differ in the amount of time spent on the nest?
- How far do courser broods stray from the original nest site?

- Do coursers lay a new nest once it has abandoned one? If so, do they stay with the same mate?
- Do coursers lay new nests in January to April after the breeding season of September to November? If so, do they stay with the same mate?
- Are the courser social groups (for feeding, preening etc.) made up of mating pairs or unaffiliated individuals?
- Do courser pairs remain together year after year or are new mates found?
- Do courser pairs lay nests in the same area each year, and do they lay them at the same time each year?
- Do different predators cause different alarm calls? A recording device could be placed close to a nest. In the case of aggregations, several broods can be monitored at once and nest cameras can be used in conjunction with the recording device in order to identify predators relating to each alarm call.

Conclusions

- Predation and abandonment of nests seem to be the main reasons for nests not hatching, with predation potentially being a factor in the parent's decision to abandon the nest. The main predator of cream-coloured courser nests in the rocky part of the Salina is most likely the brown-necked raven. Abandonment of nests appears to correspond to when there were storms in the Salina.
- Most of the courser broods remain in the same approximate area that the original nest was in. However, it appears that not all broods remain in the area that the nest was in, perhaps moving away from the Salina entirely.
- Cream-coloured coursers of Maio appear to be monogamous. The pair stay with their young until very late stages in development, even once the juveniles are able to fly, so parental care is very good in this population.
- The coursers are very social, feeding and preening in groups and even showing examples of potential cooperative breeding.
- North Funchago is a vital area for cream-coloured courser breeding and should be conserved to allow the courser population to be maintained.

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