The Collared Pratincole *Glareola pratincola* in the National Park of Doñana, South west Spain

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INTRODUCTION

Long before the creation of the National Park of Doñana (NPD) in 1969, the Marshes of the Guadalquivir River were known for their rich fauna. There are data referring to the Collared Pratincole *Glareola pratincola* in the notes of some expeditions to the marshes (Lilford 1856; Saunders 1869; Irby 1875; Witherby 1899; Chapman & Buck 1893, 1910; Verner 1909; Yeates 1946; Robertson 1954; Mountfort 1958; Mountfort & Ferguson-Lees 1961). Chapman & Buck (1893) give some information on phenology and feeding. But it is J. A. Valverde who has contributed most to the knowledge of this species in the area (Valverde 1958, 1960, field notes 1953–1975) with data on abundance, phenology, habitat, and food habits. However, there were few estimates of breeding numbers in the area of Doñana until 1989 when a national count was organized. Valverde (1960) considered the species very common in the area, remarking that the highest breeding population of Collared Pratincole in Europe and North Africa is probably located in these marshes. Vielliard (1962–1965) came to a similar conclusion and estimated a minimum of 10,000 breeding pairs in the marshes of the Guadalquivir (including areas that do not belong to the NPD at present). García *et al.* (1985) estimated 1,000 breeding pairs in the NPD. They suggest that the number may be decreasing due to the use of insecticides and herbicides in nearby rice and cotton fields. Finally, the partial count of 1989 suggested that 419–463 pairs bred in Doñana (Martínez-Villalta 1991), 12.1% of the total Spanish population. The species is now considered as vulnerable (ICONA 1986).

In this paper we contribute to the knowledge of the Collared Pratincole in the NPD with data on the number of breeding pairs, an analysis of the habitats used and the factors that lead the birds to settle in them.

STUDY AREA

The marshes of the National Park of Doñana extend over 25,000 ha, which is 70% of the present non-'reclaimed' marshland. The marsh soil is clay or clay-slime, with a very low degree of permeability, which allows an annual winter flooding. The micro-topography is very important in determining the length of flooding and the salt content of the earth (Aguilar *et al.* 1979). These factors have a direct influence on the type of vegetation cover.

The vegetation in the highest areas of marsh liable to flooding 'Paciles' is typically formed by Chenopodiaceae, whereas the lower areas are dominated by 'castañuela' *Scirpus maritimus*. In the channels and at the edges of the depressions, *Scirpus maritimus* is replaced by 'ballunco', *Scirpus litoralis*. 'Vetas' and 'Vetones' are small naturally elevated areas in the marshes.

The climate is Mediterranean with Atlantic influence. There is a period of rainfall from October to March and a long dry season (Aguilar *et al.* 1979). The mean annual rainfall usually varies between 500 and 600 mm (Tenajas 1984) although it varies. The winter periods of 1988–1989 and 1989–1990 registered rainfall of 387.5 and 880.3 mm respectively.

METHODS

We recorded data on the number of individual Collared

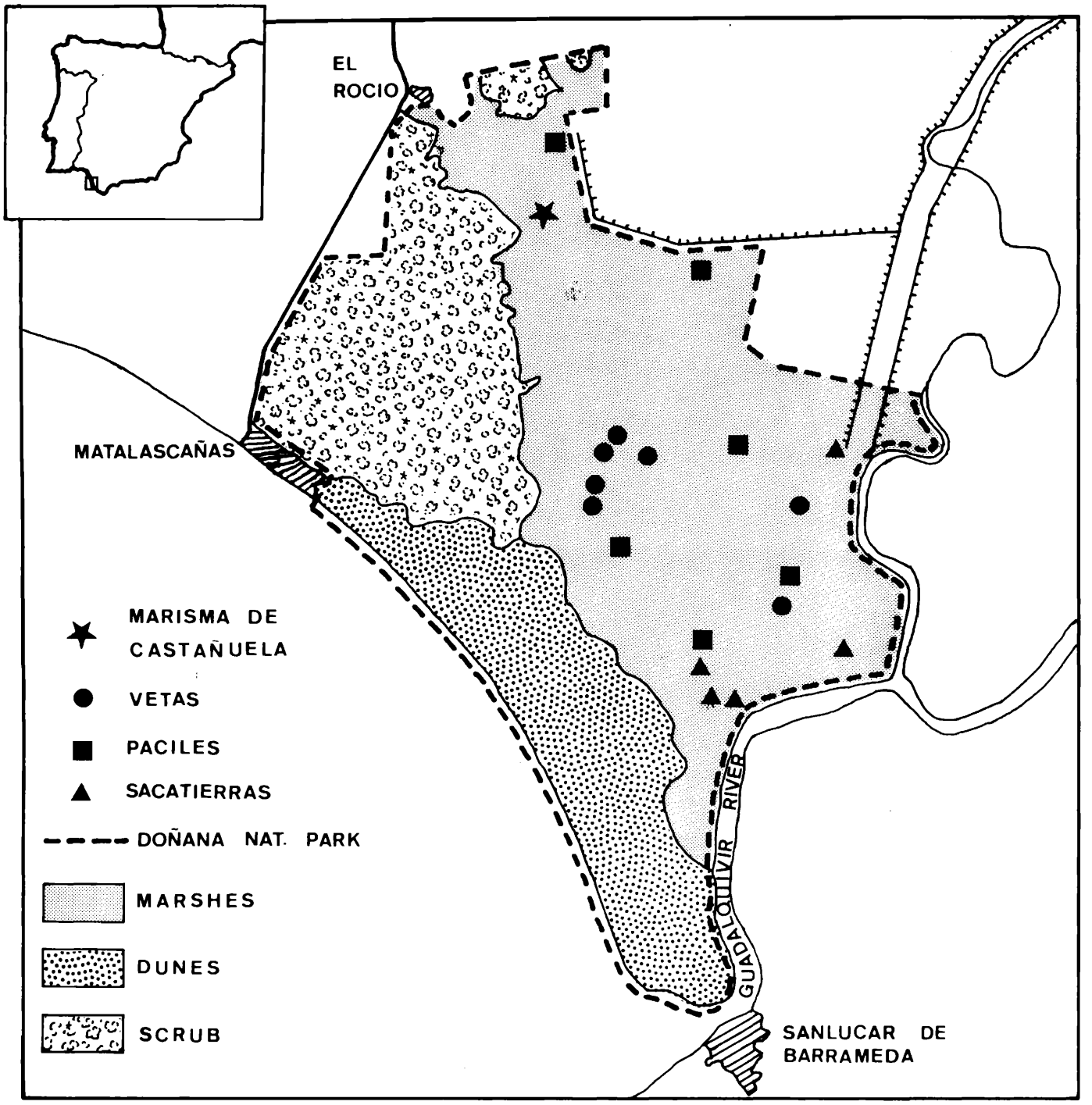

Figure 1. Approximate location of Collared Pratincole colonies in 'Vetas', 'Paciles' and 'Sacatierras' in 1990. The area of grazed 'Marisma de Castañuela' (1,900 ha) has been considered as a whole and includes several colonies which were not delimited. Symbols do not relate to colonies or area size or to number of individuals in them.

Pratincoles per colony or area, state of the breeding cycle, type of habitat and vegetation features, between April and June 1990. We carried out counts in all the areas of the park where pratincoles were settled. Nevertheless, due to the large size of the marshes in the NPD and the impossibility of reaching a small area, we might have missed a few small colonies. We used the method described in Calvo & Alberto (1990) for the survey. In an extension of 300 ha within the grazed area of the 'Marismas de castañuelas' (Figure 1, Table 1) it was not possible to delimit some apparently homogeneously distributed groups. Here, we counted the number of birds in an area of 100 ha and extrapolated the result for the

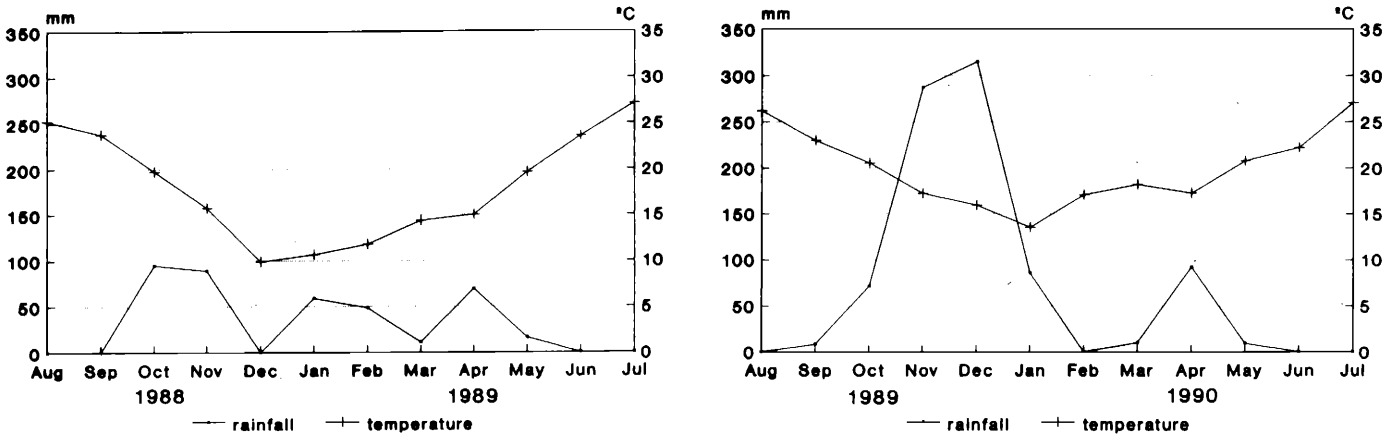

Figure 2. Temperature (°C) and rainfall (mm) data for 1988, 1989 and 1990 in the National Park of Doñana.

total.

We calculated the number of hectares of the different habitat types by using a planimeter on 1:50,000 and 1:5,000 maps.

We considered the following habitat types:

Vetas Small areas (generally less than 10 ha) with a natural elevation in the marshes of approximately one metre. This elevation prevents the 'vetas' from being covered with water in the winter, in years with standard rainfall. This fact and the different substrates (sand/ clay) determine the earth salinity and vegetation type. This vegetation is mostly formed by Chenopodiaceae such as *Suaeda splendens, Suaeda maritima* and *Salicornia sp.* In the highest level of the 'vetas' Compositae (mainly thistles) and grasses (Gramineae) predominate. In the transition between the highest part of the 'vetas' and the marsh level surrounding it, there is a strip of mud practically without vegetation.

Paciles Areas with a vegetation composed mainly by *Salicornia* sp. and delimited by channels, river branches or rivers. They are less elevated than the 'vetas' and get covered by water during two to three months each year.

Marisma de castañuela The lowest area of the marshes where Pratincoles breed, being covered by water during the winter and drying in spring, allowing vegetation (mainly *Scirpus maritimus*) to grow. They are covered with water for five to six months per year.

Sacatierras Slightly elevated artificial habitats formed by earth extracted from the channels. This earth, in the NPD, is spread out and flattened alongside the channels, as it is a good nesting habitat for Avocets *Recurvirostra avosetta,* Kentish Plovers *Charadrius alexandrinus* or Pratincoles. The 'sacatierras' are gradually colonized by species such as *Salicornia* and *Sarcocornia.*

We obtained weather data from a weather station located in the park.

RESULTS

The results are shown in Table 1 and Figure 1.

Vetas We did not find Collared Pratincoles nesting in any of the 'vetas' with sandy substrate, although we know (Valverde pers. comm.) that they nested in these years ago, with a high percentage of nests on cow pats. The dark colour of the latter could provide camouflage for eggs.

The mean vegetation cover and mean maximum height was measured in two 'vetas' which were thought to be representative of those 'vetas' where Pratincoles were nesting.

Paciles The cover varies from place to place. As in 'vetas', we selected as a vegetation sample site a 'pacil' which was considered to be representative of the other 'paciles' in which the Pratincoles were nesting. The mean cover and maximum height found for 'paciles' with colonies was 17.2%, 14.2 cm, and without colonies was 36.3%, 52.6 cm.

Most of the 'paciles' have no colonies, with only a few areas of low cover and short vegetatation, usually where there is considerable grazing pressure from cattle.

Marisma de castañuela This marshy area is homogeneously composed of Cyperaceae, with 80% cover (Allier & Bresset 1977) and a mean maximum height of 120 cm. The

Table 1. Counts of Collared Pratincoles in the National Park of Doñana in 1989 and 1990.

*	number of individuals		
Hh	*Himantopus himantopus*	Ra	*Recurvirostra avosetta*
Bo	*Burhinus oedicnemus*	Vv	*Vanellus vanellus*
Ca	*Charadrius alexandrinus*	Tt	*Tringa totanus*
Sa	*Sterna albifrons*		

AREAS	NUMBER OF PAIRS 1989	NUMBER OF PAIRS 1990	OTHER SPECIES (1990)
VETAS			
Paciles Cortados		500	Hh, Ra, Bo, Vv
Vetón de los Flamencos		25	Vv
Veta de Los Ansares		80-100	Hh
Veta de la Rata	0	18	Ca
Veta Quemada	3	0	--
Veta de Las Llaves		100	Hh, Tt, Ca
Veta del Tío Pedro		70	--
Veta de las Baquiruelas	25	0	Ra
Huerto de Los Tarajales	0	600*	Hh, Ra
SACATIERRAS			
Cangrejo Chico	65-72	90	Hh, Ra, Ca, Vv, Tt, Sa
Caño de La Nuevas	45	70-100	Hh, Ra, Ca, Tt, Sa
Caño de Brenes	20	70	Ra, Tt
Caño de Brenes Norte	5	10	Ca, Tt
Caño de la Figuerola	0	5-6	Hh, Ra
PACILES			
Cerrabarba	40-45	10	--
Veta de las Piedras	10-12	20	--
El Velaero		150-200	Hh, Ra
Pacil de los Almajos Dulces	30-50	200*	Hh, Tt
Pacil de la Zahurda	25-30	40-50	Hh, Tt, Vv
Pacil de Cardales	2	0	
MARISMA DE HINOJOS			
Grazed areas	149-154	1,050-1,110*	Hh, Vv
TOTAL	419-463	1,258-1,369 1,850-1,910*	

Collared Pratincoles only breed in the areas with cattle, which keep the vegetation very short with a low level of cover.

Sacatierras The colonies located in 'sacatierras' formed recently (after the channels were created) in places where they were not nesting previously or not, at least, in the numbers they do at present. The vegetation cover increases reaching mean cover of 9% and maximum height of 16 cm. The channels are dredged every few years, adding more earth to the sides and modifying the appearance of the colony. The effect of this process on the nesting birds is not known.

We can estimate the apparent available area of each habitat for nesting, and the number of individuals counted in each. This gives only a rough idea of the density of birds in each

Table 2. Area of available habitat for breeding Collared Pratincoles; number of individuals and rough density in different habitats of the National Park of Doñana

Habitats	Area (ha)	Number of individuals	Density (individuals/ha)
VETAS	78.2	2,186 - 2,226	27.95 - 28.46
SACATIERRAS	25	490 - 552	19.60 - 22.08
PACILES	320	640 - 760	2.00 - 2.37
MARISMA	1,900	1,050 - 1,110	0.55 - 0.58

habitat. The results do not mean that the most densely occupied habitats are necessarily those of better quality (Fretwell 1969; O'Connor 1981; Horne 1983) but give an idea of the preferred areas at the time of settlement.

The state of the breeding cycle was not the same in all areas. The colonies located in 'sacatierras', most of the 'vetas' and 'paciles', fledged young in mid-June, whereas in the 'marisma de castaˈuela' it was still easy to find young chicks at this time.

In certain places (Table 1), it seems that there were some individuals that did not breed, so we will consider the number of individuals, and not pairs, for those areas.

Stilts *Himantopus himantopus*, Kentish Plovers and Lapwings *Vanellus vanellus* (which nest in very low numbers in the park) often nest in the same habitats occupied by Pratincoles. In zones close to water (mainly in 'sacatierras'), Pratincoles also breed together with Avocets and Little Terns *Sterna albifrons*. Stone Curlews *Burhinus oedicnemus* and Redshanks *Tringa totanus* nest occasionally in these mixed colonies.

DISCUSSION

Habitat selection

The Collared Pratincole shows a preference for open areas (Sterbetz 1974) with thin vegetation cover of a low height. All the colonies we found were in areas with these features (but not all the areas with these features were occupied).

An appropriate combination of sparce cover and low vegetation height allows the settlement of Pratincoles. We have obtained a range from 9% to 36% cover, with mean maximum heights ranging from 7.6 to 24.2 cm. The areas with the highest cover percentage have the lowest vegetation height. In most of the 'paciles' (36.3% cover) settlement by Pratincoles is not possible due to the vegetation height (52.2 cm). Note that the cover in these 'paciles' is very similar to that of the 'vetas' with colonies (36.5%), but these have much lower vegetation (mean height 7.6 cm).

In the 'Marisma de castañuela' (80% cover) settlement is only possible in areas with strong cattle pressure, where the cover is minimum. The density of cattle and horses was 0.114 units per ha in 1988 (the last year for which data are available), the strongest cattle pressure in the park. Cattle tend to concentrate in the north of the park where there is water from a well available all year round. This is the area where the Pratincoles settle. Here, cattle density can reach 0.5, five times that accepted in extensive cattle raising in Mediterranean pastures (Pérez Turrau 1986).

It seems then that both vegetation cover and height play an important role in the settlement of Pratincoles. Another important factor is known to be the soil moisture when they settle. Armitage, in his notes of an expedition to the marshes of the Guadalquivir in 1930, visited Doñana on 11 May (date when the Pratincoles are already settled under normal circumstances) and writes that many Pratincoles had not settled due to recent rainfall. Also Pérez-Chiscano (1965) observed a delay in the phenology of the birds in the river Guadiana due to strong rainfall. According to Dolz *et al.* (1990), the settlement did not take place until the water table level was 28 cm under the surface. This would lead us to expect, in years with typical rainfall, the existence of a preference for 'vetas' and 'sacatierras' (the most elevated areas), followed by 'paciles' and finally 'Marisma de Castañuela', the lowest areas that retain the water for a longer time. Timing of breeding in the different areas support this idea.

Vegetation cover and height and soil moisture explain the settlement in most of the colonies but there are a number of apparently adequate areas without colonies. Other factors such as visibility, available surface of adequate terrain, cattle, predation or food may influence occupation in ways that we do not yet understand. Furthermore, the location of the colonies in the park may change over years.

1989 & 1990 counts

We can relate the difference between the total count for 1989 and 1990 to the weather conditions, although we should take into account that the number obtained for 1989 was only a

partial census and not a total estimate for the Park (Table 1).

The number of Pratincoles in the Park varies between years. According to García *et al.* (1985) there can be fluctuations in the population in certain years, although they do not specify why. Chapman & Buck (1910) and Valverde (1960) visited the Park in extremely dry years and they report that hardly any birds bred. We think that the number counted in 1990 is quite high and that it might be related to the peculiar weather conditions of the year. There had been heavy rainfall during the winter (Figure 2) and there was still much water in the area in spring. This fact may have favoured the production of certain insect species used by the Pratincoles and, therefore, allowed a higher number of them in the area. We do not have any data to support or refute this idea.

The presence of individuals that did not breed in three of the areas (Table 1) could be due to the water level as well. There might not have been enough suitable places for all of them to breed by the time of settlement, or some of these places may have become suitable too late in the breeding season. Another possible explanation in some places, could be disturbance by cattle in the area where they originally settled causing them to leave it. This has been observed in 'vetas' when cattle and sheep have occupied them.

CONSERVATION OF COLLARED PRATINCOLE IN THE NATIONAL PARK OF DOÑANA

The Guadalquivir Marshes (NPD and its surroundings) are the most important area for breeding Collared Pratincole in Europe. These marshes maintain some 80–85% of the total Spanish breeding population (based on data obtained in 1989 by Martínez–Villalta (1991) and in 1990 by us).

The most serious hazard for the species is probably the loss of habitat through damage of marshland outside the NPD. Although the NPD is a protected area, some 2,750–3,000 pairs nested outside the Park in 1990 (Calvo unpublished). The conversion of marsh into agricultural land was first tried at the end of last century (1870) but was mainly carried out from the 1950s (Grande 1967). At present, more than 70% of the original marshes of the Guadalquivir have been drained (Sánchez *et al.* 1977). Even now, the area maintains the most important breeding population in Europe, although with a far smaller number than that found 20 years ago (Vielliard op.cit.), representing a 60% reduction to the present day.

The NPD is the least altered area of the marshes where the Pratincoles breed, although the transformations carried out in the park are of great importance for them (creation of channels and 'sacatierras', cattle...). Breeding is clearly sensitive to changes in water levels. Direct human disturbance can affect the Pratincole, particularly that related to cattle management, transit of crab–fishers, cars, and management of the water resources.

We have already considered the positive effects of cattle in the 'Marisma de Castañuela' (keeping vegetation short), but their effect on eggs and chicks are not known. This negative impact may be much more serious on 'vetas' when there is too much water on the lower parts of the marsh and a high number of animals concentrate on these small elevated areas disturbing or trampling Pratincoles and other wader nests, as happened in 1990.

Crab–fishers have a negative impact on those Pratincoles settled on the 'Marisma de Castañuela'. These birds usually breed later than on other substrates, just at the same time as the earth is dry enough for the crab–fishers' vehicles to circulate. This activity lasts until the end of the Pratincoles' breeding period and it will presumably be an important factor causing egg and chick loss. Water management can also affect Pratincoles. Water is removed from the park around July as a conservation measure. This fact probably forces Pratincoles to leave the area earlier than they would normally do. Post–breeding aggregations could be seen in the area some years ago, mainly around water resources, up to September (Haffner 1966).

The most common bird predators in the park are Black Kite *Milvus migrans*, Red Kite *Milvus milvus*, Marsh Harrier Circus aeruginosus, Montagu's Harrier *Circus pygargus* and Kestrel *Falco tinnunculus* (Bernis 1974; Valverde field notes 1954, Valverde 1960). There are a few references to other species such as Barn Owl *Tyto alba* and Peregrine *Falco peregrinus* (Melgarejo 1966; Valverde 1960), or Raven *Corvus corax*. (a colony of 20 pairs was destroyed by these; Kowalsky, field notes 1975). Among the mammals, we have only found some references to predation by wild boars and foxes. We have not found any reports on other mammals (rats for instance) or reptiles eating Pratincoles or their eggs.

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