

EVIDENCE FOR ROCK SHAGS *PHALACROCORAX MAGELLANICUS* AND IMPERIAL CORMORANTS *P. ATRICEPS* LEAVING THEIR NESTS AT NIGHT

A. SAPOZNIKOW¹ & F. QUINTANA^{1,2}

¹*Centro Nacional Patagónico -Conicet- (9120), Puerto Madryn, Chubut, Argentina
(alex@cenpat.edu.ar)*

²*Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, New York, New York 10460, USA*

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Imperial Cormorants *Phalacrocorax atriceps* and Rock Shags *P. magellanicus* are foot-propelled pursuit divers usually described as visual feeders (Johnsgard 1993). Previous studies describing Imperial Cormorant and Rock Shag feeding behaviour show that birds forage from dawn to dusk (Croxall *et al.* 1991, Quintana 1999, 2001). Studies showing evidence for nocturnal foraging are not common. As part of a broader study of the foraging ecology of cormorants at Caleta Malaspina (45°11'S, 66°30'W), Bahía Bustamante, Chubut, Argentina we recorded the nest attendance of 24 adult Rock Shags and nine Imperial Cormorants equipped with VHF radio transmitters (Standard model, Advanced Telemetry Systems, Betel, MN) during 1998 and 1999 (see details in Quintana 1999). Both species of cormorants nest together on two rocky islands (0.3 and 6 ha) on flat areas, with no surrounding vegetation and close to the water (0–15 m). Nest/colony attendance was automatically registered every ten minutes by a data logger (DCCII model, ATS, Inc.) connected to a scanning receiver (R2000 model, ATS, Inc). The equipment was located 2–5 m from the nests of the studied birds. We were able to record any instrumented bird within a radius of 20 m, which represented the maximum distance between the equipment and the water's edge. Trip duration was calculated as the time difference between departure from and arrival at the nest.

We recorded only three (12.5%) Rock Shags (one in 1998 and two in 1999) and three (33%) Imperial Cormorants (one in 1998 and two in 1999) leaving the colony at night. These absences represented 6 to 25% of the number of trips recorded for each bird.

Rock Shags left their nests at night for periods ranging from 0.4 to 1.33 h (mean 0.7 ± 0.3 h, $n = 7$) whereas Imperial Cormorants' nocturnal absences lasted 0.85 to 8.6 h (mean = 4.7 ± 3.9 , $n = 3$) (Table 1). Ninety percent of the nocturnal absences were within the range of diurnal foraging trips recorded for Rock Shags (mean = 1.8 ± 1.2 h, range = 0.33–8.16 h, $n = 198$) and Imperial Cormorants (mean = 4.3 ± 2.4 h, range = 2.25–9.92 h, $n = 58$) in the area (A. Sapoznikow & F. Quintana unpubl. data).

Unfortunately, the islands were not easy to gain access to and we were unable to record independent evidence of birds actually foraging at night. However, seven of ten registered absences occurred during a half moon or a nearly full moon, suggesting the existence of suitable light conditions for night-time foraging. Recent measurements of foraging illumination conditions for European Shags *P. aristotelis* and Imperial Cormorants showed that minimum light requirements are equivalent to the light levels at ground level produced by a half moon and a full moon under clear skies, respectively (Wanless *et al.* 1999). Other species such as King Penguins *Aptenodytes patagonicus* are able to feed under much lower light conditions (Martin 1999). Our studies in the area suggest that these birds are feeding at depths ranging from 4 to 20 m (F. Quintana unpubl. data). Because light levels diminish with depth, the question is to what extent do visual cues play a role in detecting prey at greater depths. According to depth distribution of prey it seems reasonable to suggest that cormorants may locate prey by touch (Voslamber *et al.* 1995). This technique could be successful when prey are relatively immobile. In fact, Rock Shags and Imperial

TABLE 1

Summary statistics of nocturnal absences from the colony by Rock Shags and Imperial Cormorants

Species	Bird	Absence duration (h)	Number of recorded nocturnal absences	Total recorded trips	% of the moon illuminated
Imperial Cormorant	1	8.67	1	7	35
Imperial Cormorant	2	4.50	1	16	98
Imperial Cormorant	3	0.83	1	4	100
Rock Shag	4	0.5 ¹	2	20	5/5
Rock Shag	5	0.75	1	14	63
Rock Shag	6	0.83 ²	4	16	63/73/73/82

¹ & ² Means calculated from the total nocturnal absences performed by the bird (sd: 0.0 and 0.4 for birds 4 and 6, respectively).

Cormorants at Caleta Malaspina have been previously shown to be bottom foragers feeding mainly upon small benthic fish and invertebrates (F. Quintana unpubl. data).

In our study there were only a few individuals showing nocturnal absences from the colony. The duration of these absences was similar to that of diurnal foraging trips and occurred mainly during illuminated nights. Our observations are the first indirect evidences for nocturnal foraging in these species of cormorants. However, future studies using light-level sensors and time-depth recorders should be undertaken to address further this question.

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