Reproductive biology of black-necked Swans *Cygnus melancoryphus* at three Chilean wetland areas and feeding ecology at Rio Cruces

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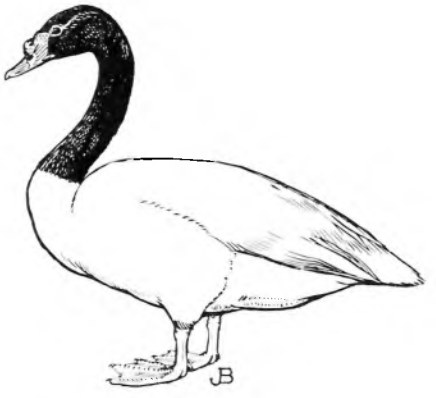

Reproductive biology of Black-necked Swans has been monitored at three sites in Chile, Laguna El Peral, Laguna Torca and Rio Cruces. The eight pairs at El Peral have produced 4.2 cygnets/pair in three seasons, but chick mortality has been 83% due to territoriality and aggressive interactions. At Torca on average 15 pairs have produced 3.4 cygnets/pair with mortality of 12% for only one surveyed season. At Rio Cruces nests have more than doubled each season increasing from 55 (1986-87 season), 120 (1987-88) to 243 (1988-89). Pairs have also increased: 118 (1985-86), 90 (1986-87), 167 (1987-88) up to 250 (1988-89 season) with different degree of reoccupation for nests. Average number of eggs/pair was 5.4 eggs (1986-87), 2.9 (1987-88 season) and 2.4 for the 1988-89 season. Average cygnet mortality has been low, about 8% (1986-87) and 5% (1987-88) for a strongly increasing population. Predation of eggs by Polyborus plancus *is considered important.*

The Rio Cruces Black-necked Swan population feeds mainly on introduced Egeria densa *weed (99% of faecal samples). Food is abundant and does not seem to be important in regulating stable breeding populations. Adult aggression towards cygnets and juveniles is an important mortality factor in small areas. Some of the cygnets found dead showed skeletal deformation perhaps due to malnutrition.*

The different size, history and ecological conditions of the three localities which are being censused by reserve wardens have revealed that Black-necked Swan *Cygnus melancoryphus* populations have different reproductive and mortality rates, and strategies for their survival. The three places, when compared, form a valuable natural experiment to study factors which may regulate populations on swan species in relation to habitat and social conditions. The three localities have been characterized elsewhere (Schlatter *et al.* 1991) and will not be described further here.

This preliminary study focuses on causes of distinct reproductive and population regulation strategies in order to set up management plans which will have to be applied in the near future to stimulate the Black-necked Swan populations.

Methods

Breeding populations (number of pairs) and productivity (number of cygnets per pair) have been counted in Laguna El Peral and at Laguna Torca since 1984-85 to 1987-88. Similar figures have been obtained at Rio Cruces from 1986-89. Data on clutch sizes have only been collected at Rio Cruces. Since 1988 there has been an intention to set a standard procedure in order to make the data obtained in the three wetlands more comparable. At Rio Cruces nests have been marked and checked since 1988-89. At least 250 nests are recognizable by poles with acrylic numbered signs, visible from a distance.

Cygnet mortality figures need to be more precise in the future but are adequate to provide some initial conclusions.

Food studies were based mainly on collection of fresh faeces at nests or from the intestines of dead birds. Stomach samples are not useful for food studies due to the presence of grit and hard parts of aquatic plants (stem and roots) which bias figures.

Results

The breeding season at Torca and Rio Cruces starts in July and may end by March-April of the next year. The population of Laguna El Peral breeds from August to December.

Laguna El Peral with a regular population of eight pairs during three seasons has produced on average 4.2 cygnets/pair. Cygnet mortality

has been very high: 83%. Observations in November 1988 showed persistent aggression of one adult pair toward cygnets and juveniles which, presumably, belonged to other pairs. During the 1988-89 season, of 30 cygnets which hatched from seven pairs, 29 died.

At Nature Reserve Laguna Torca the average of 15 pairs recorded for several seasons have produced 3.4 cygnets/pair and 12% cygnet mortality was calculated from surveys during one season.

Within the Rio Cruces Nature Sanctuary most pairs hatched 1-3 cygnets (67% for the 1985-86 season and 78% for the 1986-87). Average clutch-size/pair has been 5.4 eggs (1986-87 season), 2.9 (1987-88) and 2.4 (1988-89 sea-

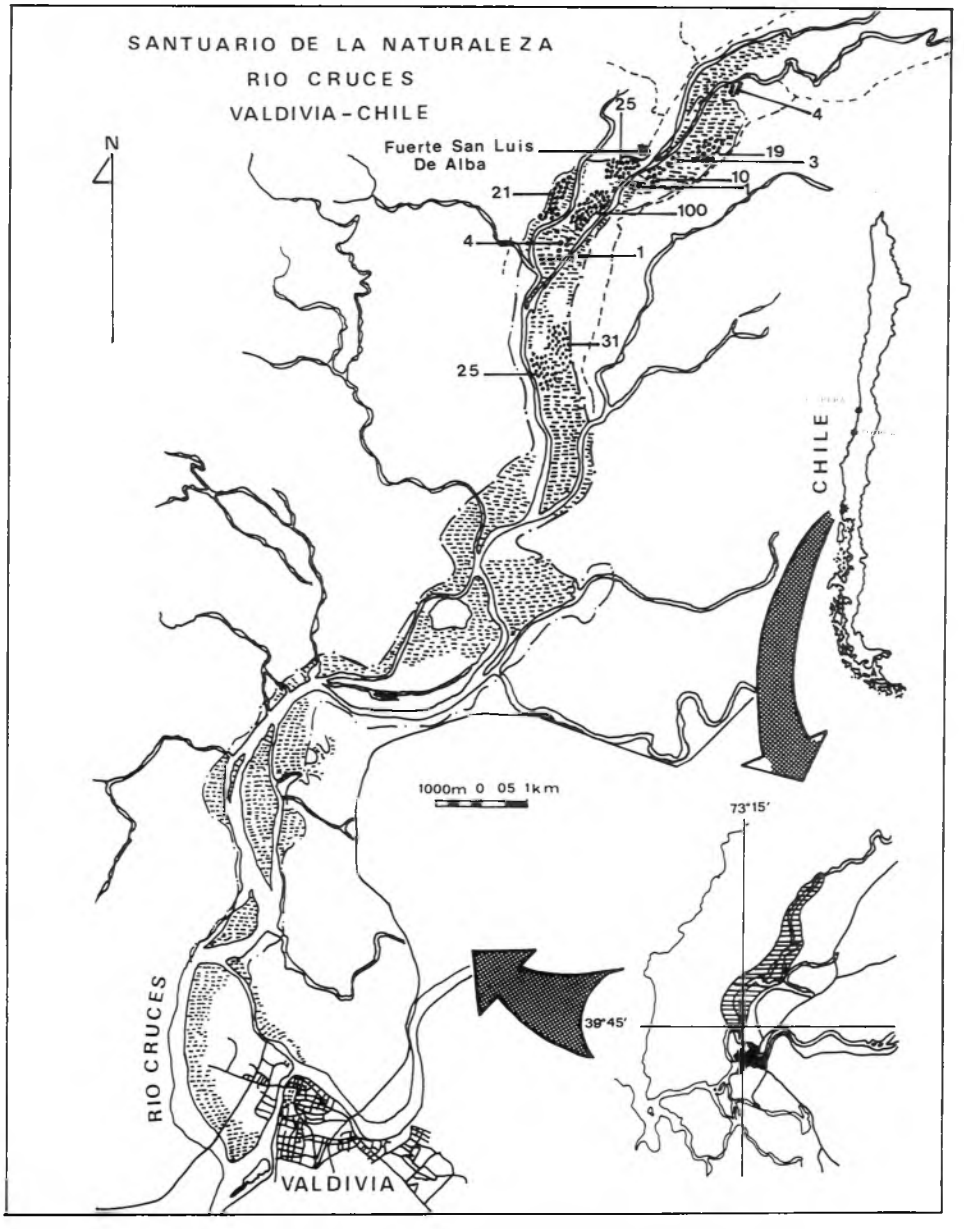

Figure 1. Rio Cruces Nature Sanctuary, location in Chile in relation to other wetlands mentioned in text, and general pattern of habitat. Nests tend to clump on northern part of protected area. Nest distribution correspond to 1988-89 breeding season.

son). Mortality of cygnets during some seasons has been rather low, about 8% for the 1986-87 season and 5% for the next. The survey has been difficult in this large area and figures may not be very precise. The predation factor due to *Polyborus plancus* (4-19 individuals counted) has been observed on eggs and cygnets.

The nests tend to be localized on the northern part of the Rio Cruces wetland (Fig. 1). Black-necked Swans tend to aggregate their nests which seems to indicate a rather colonial system, but this has to be checked further to see if it is only due to a lack of suitable nesting habitat elsewhere in the wetland. Average distance between nests (39 samples) was 13.56 m with a maximum of 32 m and a minimum of 1.70 m.

The number of nests has increased significantly from one year to the next at Rio Cruces. During the 1986-87 season there were 55 nests, 1987-88: 120 and 1988-89: 243. In the last two seasons only a few nests were re-occupied: five in 1987-88 and eight in 1988-89 season; presumably by different pairs.

Preliminary feeding studies have commenced at Rio Cruces. At present the local population of Black-necked Swan feeds mostly on *Egeria densa*, the dominant submerged cosmopolitan waterplant. Plants are bitten off or pulled out completely. In 99% of the faecal samples collected (n = 25) this plant species was the main food type, mostly consisting of the leaves (96%) and rarely the stems (4%). Adjacent to nesting areas depletion of food has been observed. Future studies will include identification of the main foraging areas and rate of food depletion as well as the birds feeding needs.

Discussion

The breeding season of Black-necked Swans corresponds to those of other southern hemisphere swan populations like the Black Swan *Cygnus atratus* in New Zealand (Miers & Williams 1969) although our Black-necked Swan population tends to have a more prolonged breeding season. Lack of overall nesting sites for breeders in the three wetlands, intraspecific interactions and or inadequate food may be the cause for this unusual large reproductive season and should be investigated.

Laguna El Peral has a stable breeding population of apparently experienced pairs. There is quite good cygnet productivity but very high cygnet mortality caused by social interactions of yet uncertain nature. Probably territorial aggression could be the main cause, as explained for similar conditions by Braithwaite (1981).

At Laguna Torca the breeding population has remained stable at 15 pairs, with lower cygnet production but apparently lower cygnet mortality than at El Peral. This may indicate that this wetland also has a stable population of adult breeders. Factors which control and regulate the population have to be investigated. New neck-collar marking will hopefully give us a clue of what is happening.

At Rio Cruces conditions are quite different. Since 1987-88 there has been a rapid increase in the number of nests, doubling every year for the last three seasons. When nest numbers double, as in this case, then there is obviously an important influx of new breeders, most probably inexperienced ones as can be concluded from the low average clutch size in recent seasons. Mortality figures at this place may not be precise but they tend to be low. At least 20 dead juveniles which have been examined have shown wing deformities ("angel wing"), articular problems in their feet and lack of calcification in their skeletons. The same birds contained large numbers of stomach parasites *Amidostomum anseris* (Nematoda), which suggests poor nutrition.

Egeria densa covers 90 to 100% of the submerged vegetation at Rio Cruces and builds the association *Egerietum densum* in the wetland area at a mean depth of 2 m. This explains why it is the main food item for swans. This plant species showed the lowest calorific value for a hydrophyte (2.264 cal/g) and a very high ash content (52.3%) (Steubing *et al.* 1980). This may account for the probable nutritional problems which are occurring in juveniles and few adults which have been examined. Low local plant diversity and low calorific value of a waterplant would not help breeding performance (Birkhead & Perrins 1986) and probably not help cygnet growth. This area may also be calcium deficient.

Further studies should approach this problem and investigate if this introduced hydrophyte is an adequate food item for the local Black-necked Swan population which has greatly increased due to recent immigration, or if this important swan influx is causing interactions which may affect foraging and breeding performance.

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