

Nesting habitat of Chubut Steamer Ducks in Patagonia, Argentina

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Abstract. We studied nest-site selection of the flightless Chubut Steamer Duck (*Tachyeres leucocephalus*) along 292 km of continental coastline and 59 km of island coastline in Patagonia, Argentina, between 2004 and 2006. This area encompasses the main breeding range of the species. Almost all nests were on islands and islets, which ranged in area from 0.5 to 54.4 ha and were 0.5–16 km from the mainland. Nesting sites were within bays and inlets with shallow waters and protected from waves, winds and strong currents. Using logistic regression analyses in an information-theoretic framework to compare habitat characteristics between nesting sites and randomly chosen sites, we found that Chubut Steamer Duck nesting sites were strongly and positively associated with higher proportions of shrub vegetation cover. To a lesser degree, the percentage of silt sediment was also positively associated with nesting sites. Nest-site selection is thought to be associated with concealment from aerial predators and protection from weather. This study of breeding habitat and nest-site selection of Chubut Steamer Ducks, and will contribute to management and habitat conservation for this rare flightless duck through identification of both general and specific habitat features that should be preserved or enhanced.

Additional keywords: breeding habitat, endemic flightless marine duck, nest-site selection, *Tachyeres leucocephalus*

Introduction

The nesting site of birds constitutes the most spatial scale of habitat selection (Wiens 1986; Block and Brennan 1993) and must provide a location where adults and eggs are sheltered from environmental stresses (Ricklefs and Hainsworth 1969; Walsberg 1985) and afford some protection from predators (Martin and Roper 1988). From a conservation perspective, determining nesting habitat is a critical step towards preserving, restoring or creating areas that support reproductive activity.

The Chubut Steamer Duck (*Tachyeres leucocephalus*) is a flightless anatid duck endemic to the marine coast of Central Patagonia, Argentina (Madge and Burdett 1988). Breeding range extends along approximately 500 km of coastline, from the Chubut River mouth (42°38'S, 65°31'9"W) south to the Santa Cruz and Chubut Province boundary (39°35'S, 67°35'44"W) (M. L. Agüero and J. P. García Borboroglu, unpubl. data). It is classified as Near Threatened globally (IUCN 2010). A recent systematic census indicated that, along the marine coast of Chubut Province, numbers are estimated to be 3700 breeding individuals (M. L. Agüero and J. P. García Borboroglu, unpubl. data) (Fig.1).

The species is exposed to several potential anthropogenic threats, including oil exploration activities, and harvesting of

guano and macroalgae (García Borboroglu and Yoccoz 2005). Egg-collecting has also been reported but appears to occur at very low intensity at a few sites (J. P. García Borboroglu, unpubl. data). Another potential threat is the presence of three introduced species: the Green Crab (*Carcinus maenas*), Asian Kelp (*Undaria pinnatifida*), and the Acorn Barnacle (*Balanus glandula*), all of which may cause dramatic changes to ecosystems (Eklöv 2004; Hidalgo et al. 2005; Schwindt 2007) upon which Steamer Ducks rely.

The combination of its restricted breeding distribution, small population, flightlessness and the potential threats to which it is exposed mean the species would be of significant conservation concern (BirdLife International 2010). However, there is little knowledge of its basic ecology. In this study we aimed to

Our candidate model set consisted of all additive combinations of non-redundant variables (Table 1). We consider that all of these combinations represent plausible hypotheses regarding the habitat features that differentiate nesting sites from randomly selected sites.

To test for overdispersion, we calculated \hat{c} for the global model, including all four explanatory variables. \hat{c} is a variance inflation factor calculated as the deviance Chi-square statistic for goodness-of-fit divided by the degrees of freedom. In this case, \hat{c} was < 1 (0.57), indicating that no overdispersion was present, so a variance inflation factor was not required.

For each model in the candidate set, we calculated the second-order Akaike information criterion (AIC_c), which accounts for any small sample bias (Burnham and Anderson 2002). Models with lower AIC_c values have more support from the data. We also calculated ΔAIC_c values for each model, which are simply the difference in AIC_c values between a model and the best supported model in the set. Finally, we calculated Akaike weights (w_i) for each model, which provide easily comparable numbers to gauge the degree of evidence that a given model is the best model, the

Discussion

Nests of Chubut Steamer Ducks were found almost solely on islands and islets. Such sites are thought to offer better protection from terrestrial predators, human disturbance and pollution (Lack 1968). Several potential mammalian predators have been recorded on the mainland coast area in our study area but do not occur on islands, such as the Hairy Armadillo (*Dasypus villosus*), Argentine Grey Fox (*Pseudalopex griseus*), Patagonian Ferret (*Galictis cuja*), Geoffroy's Cat (*Felis geoffroyi*), Culpeo (*Lycalopex culpaeus*) and Pumas (*Puma concolor*). There is also less human disturbance on the islands, which may enhance the suitability of the islands for breeding by thoughtless marine duck. There are a range of human activities that take place along the continental coast, including tourism, recreation and nautical sports (Tagliorette and Losanoff 1996), small-scale coast fishing (Caille 1996) and harvesting of macroalgae (Piriz and Casas 1996) that do not occur on the islands. The inaccessibility of the islands is increased by the difficult navigation conditions in the area. Steamer Ducks may have nested more commonly on mainland shorelines historically, when levels of human disturbance were lower, but no data are available to evaluate that hypothesis.

Nesting sites were mostly along shorelines sheltered from wind, waves and strong currents (Agüero 2006). All members of the genus *Tachyeres* breed in sheltered bays, inlets or creeks with shallow and calm waters (Wells 1975, 1976; Johnsgard 1978). In general, sites protected from wave action would presumably be easier for Chubut Steamer Ducks to forage, and they would be more adequate for the chicks to swim and forage, in comparison to sites exposed to wave action.

Consistent with a preliminary study of Humphrey and Livezey (1985), of 10 nests on one island, our analysis showed that vegetation cover was a key variable in nest-site selection by Chubut Steamer Ducks. Vegetation cover in part determines the thermal properties of a nest and the incubating female (Carboneras 1992), providing increased protection from wind, and reduced nocturnal radiative heat-loss and diurnal heat-gain (Walsberg 1981, 1985; Gloutney and Clark 1997). Another advantage of greater nesting cover is increased concealment from predators (Laurila 1989; Clark and Nudds 1991; Lester 2004;

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