

FIRST BREEDING POPULATION OF BULWER'S PETREL *BULWERIA BULWERII* RECORDED ON GRAN CANARIA (CANARY ISLANDS)—POPULATION SIZE AND MORPHOMETRIC DATA

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SUMMARY

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This contribution reports the discovery of the first breeding population of Bulwer's Petrel *Bulweria bulwerii* on Gran Canaria (Canary Islands) after a five-year study (2002–2006). The breeding site (27.83°N, 15.78°W) was situated on cliffs along the southwest coast of the island, between Mogán and Veneguera. The population was roughly estimated to be 2051 ± 2010 birds (based on 2005 data) or 689 ± 267 birds (based on 2006 data) using CAPTURE software. Mean adult measurements were consistent with the biometrics from other Atlantic colonies. Predation by introduced mammals and light pollution on the island could pose a serious threat for this little-known breeding population.

Key words: Bulwer's Petrel, *Bulweria bulwerii*, distribution, Gran Canaria

INTRODUCTION

Bulwer's Petrel *Bulweria bulwerii* is a pan-tropical species, with breeding populations in both the Atlantic and Pacific oceans. The Atlantic population is confined to the Macaronesian archipelagos of Azores, Madeira, Canary and Cape Verde (Le Grand *et al.* 1984, Del Hoyo *et al.* 1992), where, excluding Cape Verde, it is estimated to be 7000–9000 breeding pairs (BirdLife International 2004a). Globally, the species is categorized as being of "least concern," but in Europe, it is considered to be SPEC3 and Rare (BirdLife International 2007), and in Spain it is listed as Endangered (Ramos & Trujillo 2004).

This small procellariiform nests colonially under rocks and in holes and crevices (Nunes & Vicente 1998, Martín & Lorenzo 2001). Like most cavity-nesting petrels, it is nocturnal on land (Nunes & Vicente 1998, Mougeot & Bretagnolle 2000). Adults return to their breeding grounds in late April (Le Grand *et al.* 1984, Martín & Lorenzo 2001) to begin courtship and preparation of burrows. Eggs (one per pair per year) are laid in late May or early June, eggs hatch out near the end of July after incubation by both parents, and chicks fledge in September (Monteiro *et al.* 1996b, Martín & Lorenzo 2001).

The Canary Islands are an important breeding area for procellariiforms in the central-northern Atlantic Ocean, with seven species breeding in the archipelago. A small amount of information is available on the occurrence, location of breeding sites and biometrics of Bulwer's Petrel in the Canaries, but the overall distribution of the species in the islands remains uncertain. According to Hernández

et al. (1990), the Canary Islands host an estimated population of around 1000 breeding pairs. Although not abundant, the species has been found on almost all the islands in the archipelago (Martín & Lorenzo 2001). Breeding on the island of Fuerteventura has been suggested, but not proven (Hernández *et al.* 1990, Emmerson *et al.* 1994, Martín & Lorenzo 2001), and on Gran Canaria the only evidence was a fortuitous observation of a fledgling in 2005 (Rodríguez & Navarro 2006).

Before the present study, evidence suggested that Gran Canaria hosted breeding Bulwer's Petrels, especially on the southwest coast (near Mogán). The existence of a breeding colony near Mogán's Beach in the mid-20th century was suspected, but that colony was probably exterminated by feral cats *Felis catus* (Hernández *et al.* 1990, Martín & Lorenzo 2001). In addition, dozens of Bulwer's Petrels are recovered each year between May and September in the urban areas of Gran Canaria, having been grounded by light pollution (Calabuig unpubl. data). The season when such accidents occur coincides precisely with the April-to-September breeding period of the species (Martín & Lorenzo 2001). Between 1987 and 2002, a total of 205 Bulwer's Petrels were recovered, most of them at the Mogán area. Of these, 58% were fledglings (Calabuig unpubl. data).

The present work documents the nesting of Bulwer's Petrel on the island of Gran Canaria and provides an estimate of the size of the only Bulwer's Petrel population known so far on the island, plus some morphological measurements of adult birds. Determining the localization of breeding colonies and the population size is essential

for the design of conservation plans. In addition, biometry provides basic and useful data for characterizing a bird population (e.g. Bost *et al.* 1992, Le Corre & Jouventin 1999, Martínez-Abraín *et al.* 2002).

STUDY AREA AND METHODS

Study area

The Canary Islands comprise seven large (and some small) volcanic islands off Morocco (27–29°N, 13–18°W; Fig. 1). Gran Canaria, in the middle of the archipelago (Fig. 1), is approximately 1560 km² and rises to around 1949 m above sea level. It is almost circular in shape and is intersected by numerous wide ravines. The mean annual rainfall and temperature for the entire island are 299 mm and 22°C respectively, but the island encompasses many diverse microclimates, from Arid to Mediterranean (Martín & Díaz 1988), among which the annual rainfall and temperature vary substantially.

We focused on the southwest coast of the island where, according to previous data, there was a reasonable probability of finding nests. The study area was composed of 4000 m of coastal cliffs about 200 m high, between the ravines of Mogán and Veneguera (Fig. 1). This coastal strip is divided by small ravines, and multiple terraces occur at various altitudes along the cliffs, where numerous holes, stone screens and cracks provide suitable cavities or burrows for breeding petrels. The vegetation is mainly sparse xerophytic shrubs such as *Euphorbia balsamifera*, *Plocama pendula* or *Lycium intricatum*. Nests of Cory's Shearwater *Calonectris diomedea* are abundant throughout the area.

Looking for nest sites of Bulwer's Petrel

During each breeding season during 2002–2006, we systematically searched all the accessible zones within the study area where there could be nests. Each accessible terrace was exhaustively surveyed by walking or climbing both day and night by a group of two to six observers looking for signs of breeding by Bulwer's Petrel inside every suitable cavity or hole using lanterns and listening for nocturnal vocalizations. Approximately 1300 hours were spent searching during the five-year period.

Estimating population size

We used mist-nets to trap and ring Bulwer's petrels, and through mark–recapture techniques (Seber 1982), estimated the population

size. From May to September 2005, 61 sessions were spent trapping petrels, and from July to August 2006, a further 22 sessions were spent, at a mean of six hours per session from sunset. Petrels were also trapped in 2003 and 2004, but these data were disregarded for the mark–recapture analysis. We used three black mist-nets (9×2.5 m, 9×2.5 m, and 12×2.5 m, with 16-mm mesh), which were always set up at the same place near the top of the cliff. This site was in the middle of the study area, above the terraces where most birds had been heard or seen. The terraces below had risky access and the high abundance of Cory's Shearwaters made them unsuitable for placing nets after nightfall. Thus, to attract petrels into the nets, we used a playback of the calls of Bulwer's Petrel on a portable compact disc player with two small speakers (5 W). The low volume matched that of natural calls and was kept constant for all work. Because the calls were inaudible beyond c. 50 m, we assumed that all attracted birds came from the studied population. All captured birds were ringed for later identification.

We applied mark–recapture techniques, assuming a closed population, no difference in mortality rates between marked and unmarked animals (Seber 1982, White *et al.* 1982), and a constant capture probability. For the estimation of the population size (N), the analysis was carried out using the CAPTURE software program (White *et al.* 1982, updated version by Rexstad & Burnham 1991). With this program, we statistically tested the assumption of a closed population and the fit of the data. We ran only the null (M_0) model, which assumes that the time of capture, the heterogeneity between individuals or the trap-response do not affect the capture probability of birds in the population being sampled (Otis *et al.* 1978, White *et al.* 1982, Rexstad & Burnham 1991).

Morphological measurements

Six standard measurements of each captured bird were made:

- Mass to the nearest 2 g on a Pesola (Baar, Switzerland) spring balance
- Maximum chord or wing length (± 0.5 mm), from the outer bend of the carpal joint (including skin and feathers) to the tip of the longest primary
- Tarsus length, the distance from the posterior junction of the tibia (tibiotarsus) and the tarsus (tarsometatarsus) folded to a right angle and including the skin to the distal junction of the tarsus at the base of the middle toe
- Culmen or bill length, as measured from the posterior end of the culmen to the tip of the bill
- Maximum head or head-and-bill length, the distance from the external occipital ridge at the back of the head to the tip of the bill
- Bill depth at nostrils or nostrils height

The latter four measurements were made using a calliper (± 0.1 mm).

RESULTS

Nesting confirmation

At the beginning of 2002, we found remains (feathers, excrement, etc.) of the species in the study area. The first contact with flying birds occurred in May 2002 in Veneguera, a location inside the study area, and the first birds were caught in summer 2003 in Lomo de las Pardelas. All these captured birds had very clear incubation patches. A dead adult was collected in August 2004 at Las Escarranchaderas.

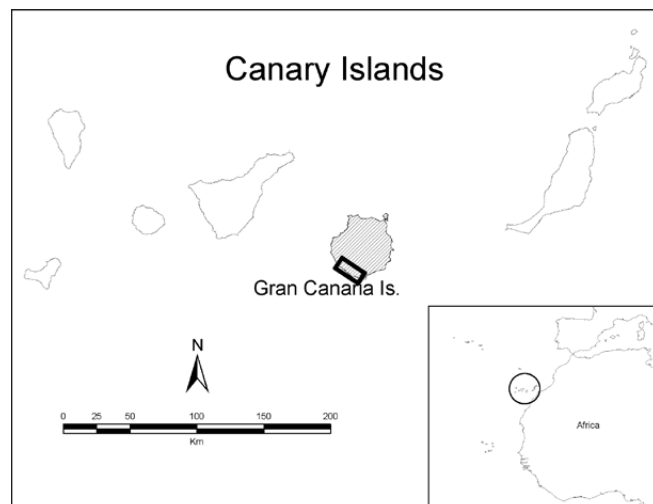


Fig. 1. Situation of the Canary Islands, showing the study area on the southwest coast of Gran Canaria.

In May 2005, the remains of six more adults were found, all of which had probably been killed by feral cats. Although we saw an adult inside a crack in July 2005, the depth and inaccessibility of the site made it impossible to confirm whether a nest was present, a situation that was repeated several times. In August 2005, we found the first broken egg in Cañada del Perchel. Remnants of other six eggs were later found nearby. In September 2005, a pre-fledging petrel was found dead and partially eaten in Las Escarranchaderas. Other signs of Bulwer's Petrel, including numerous footprints (frequently observed along the terraces), excrement, bones and feathers, were also found. Uncountable sightings of flying adults and multiple calls inside cavities were also noted. On the whole, the data confirmed the existence of a considerable breeding area of Bulwer's Petrel on the southwest coast of Gran Canaria.

Population size estimation

A total of 194 adult Bulwer's Petrels were ringed during the study period. Only four petrels were marked in 2003 and another two during 2004, all of them having an incubation patch. In 2005, 123 adult birds were captured, 84% having an incubation patch. Seven controls were caught in 2005: six birds that had been ringed earlier the same year and one had been caught and ringed in 2003 in the same place. In 2006, 65 new adult birds were ringed, almost 98% having an incubation patch. Six controls were caught: one bird ringed in the same year and five that had been ringed in 2005. Using each year's data separately, the 2005 population estimate for the null model M_0 was $N = 2051 \pm 2010$ birds, with a 95% confidence interval of 448 to 10366 ($P < 0.005$). For 2006, $N = 689 \pm 267$ birds, with a 95% confidence interval of 351 to 1469 ($P < 0.005$).

Morphological measurements

Table 1 shows the results for the six biometric descriptors, as well as the measurements published for other Macaronesian islands.

DISCUSSION

This study provides new information about a little-known species in the Canary Islands. Effort was focused on southwest Gran Canaria, following previous indications of attendance of the species there. Although most of the island remains unexplored and other Bulwer's Petrel colonies are suspected, a more encompassing project on the seabirds of Gran Canaria (also using call playbacks) failed to reveal other Bulwer's Petrel sites on Gran Canaria. Nevertheless, we highly recommend a more detailed survey of the island to improve our knowledge about the distribution and the conservation status of this petrel.

Difficulties of estimating procellariid population sizes are well known because of the location of breeding colonies usually in inaccessible places and the burrow-nesting and nocturnal habits of the birds (James & Robertson 1985a, Monteiro *et al.* 1999). Furthermore, the smallness of the Bulwer's Petrel [being the smallest of all procellariids (Warham 1990)], their dark colour and their lack of in-flight calling (James & Robertson 1985b, Nunes & Vicente 1998) add additional difficulty to the task of estimating population sizes.

Responses to recorded sounds have been used for detecting and censusing nocturnal burrowing seabirds (James & Robertson 1985a), and it is well known that Bulwer's Petrels are not seen on land unless they are near their breeding sites (Monteiro *et al.* 1996a, Paterson 2002). However, our low recapture rate precluded good estimates of the population size. We believe that our playbacks did not attract petrels from the remotest parts of the study area and that we caught petrels only from the subcolonies near the nets. As a result, the population size may have been underestimated. However, the playbacks may have attracted passing non-breeders, resulting in a tendency toward an overestimate of the breeding population size. As a result, our assumption that all attracted birds were from the studied population is not unreasonable.

Hernández *et al.* (1990) estimated the Canarian population of Bulwer's Petrel to be around 1000 breeding pairs, but that estimate excluded any data from Gran Canaria. Our estimates from Gran Canaria indicate the need for a thorough revision of the archipelago total for the Bulwer's Petrel. Sound knowledge of the breeding status and distribution of the species is urgent in the Canary Islands so that this endangered petrel can be managed accordingly.

The effects of introduced mammals, especially the effect of feral cats, on populations of many Procellariiformes is well known (e.g. Cuthbert & Davis 2002, Keitt & Tershy 2003). Predation on Bulwer's Petrels (especially adults and pre-fledging birds) on Gran Canaria by feral cats was confirmed during this study. Furthermore, the potential effects of rats (*Rattus* spp.) and Mice (*Mus domesticus*) on eggs and chicks should be noted, because these non-native mammals were also present in the breeding site. Their activities may explain the egg remnants found in the study area. Predation is a major concern, because petrel populations are particularly sensitive to changes in adult mortality—even low predation rates may lead to rapid population declines (Monteiro *et al.* 1999, Bried & Bourgeois 2005). Finally, the growing light pollution of the island, which is a known cause of disorientation among petrels, could also pose a serious threat to the local population.

TABLE 1

Measurements of adult Bulwer's Petrels *Bulweria bulwerii* caught on Gran Canaria, Canary Islands, 2003–2006, and comparable measurements from other studies

Variable	Gran Canaria			Vila ^a			Deserta Grande ^b	
	Mean±SD	Range	Sample	Mean±SD	Range	Sample	Mean±SD	Sample
Body mass (g)	93.4±7.1	78–120	n=185	97.7±11.5	76–139	n=252	90.6±7.5	n=205
Wing length (mm)	204.6±4.8	196–217	n=23	203.8±4.3	187–214	n=168	199	n=205
Tarsus length (mm)	28.70±1.41	25.4–33.4	n=185	28.20±0.98	25.1–30.2	n=138	27.4	n=205
Head-and-bill length (mm)	53.87±1.42	49.2–57.3	n=186	53.80±1.15	50.9–56.9	n=121	—	—
Culmen length (mm)	21.40±0.79	19.7–25.0	n=186	21.71±0.76	19.2–23.4	n=143	21.6	n=205
Bill depth at nostrils (mm)	9.35±0.61	7.7–10.7	n=186	9.30±0.42	8.3–10.4	n=133	9.2	n=205

^a Data from Vila Islet in the Azores (Monteiro *et al.* 1996b).

^b Data from Deserta Grande in the Madeira archipelago (Nunes & Vicente 1998).

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