Laysan Albatross on Guadalupe Island, México: Current Status and Conservation Actions

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LAYSAN ALBATROSS ON GUADALUPE ISLAND, MÉXICO: CURRENT STATUS AND CONSERVATION ACTIONS

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Abstract.—Guadalupe Island, off the Baja California peninsula, México, hosts the most important growing Laysan Albatross (*Phoebastria immutabilis*) breeding colony in the eastern Pacific. Since this seabird's first arrival in 1983, it has been affected by predation from feral cats (*Felis catus*), present on Guadalupe since the late 19th century. Heavy predation events have been recorded on the island, so we initiated a feral cat control campaign in 2003 and began collecting baseline information for developing an eradication plan. At the same time, we conducted seasonal monitoring of Laysan Albatross reproductive success in order to assess the benefits from control activities. Cat relative abundance on Guadalupe was estimated through spotlight surveys, and control was done at the southernmost end of the island around the 2 locations where Laysan Albatross nest: Colinas Negras and Punta Sur. Laysan Albatross population growth rate was calculated based on the number of reproductive individuals, while breeding success was estimated as the proportion of laid eggs that resulted in fledged chicks. A total of 203 cats were removed from the south end of Guadalupe between 2003 and 2013. During this same period, high reproductive success (0.8) was recorded for Laysan Albatross, suggesting a positive effect of cat control activities. We found significant differences in reproductive success between years with predation and no predation by feral cats. The Laysan Albatross colony on Guadalupe has grown steadily during the past 30 years, increasing from 4 to 143 breeding pairs between 1984 and 2013, respectively, and with a population growth rate of 1.10 between 2004 and 2013.

Resumen.—La Isla Guadalupe, frente a la península de Baja California, México, alberga la colonia reproductora más importante y en crecimiento de albatros de Laysan (*Phoebastria immutabilis*) en el Pacífico Oriental. Desde su llegada en 1983, esta ave marina ha sido afectada por la depredación por parte de gatos ferales (*Felis catus*), presentes en Guadalupe desde el siglo XIX. Se han registrado fuertes eventos de depredación en la isla, por lo que en 2003 iniciamos una campaña de control, acompañada del registro de información de línea base para el desarrollo de un plan de erradicación. Al mismo tiempo, se inició el monitoreo estacional del éxito reproductivo del albatros de Laysan a fin de evaluar los beneficios derivados del control. La abundancia relativa de gato se estimó mediante conteos nocturnos usando faros incandescentes o "spotlights," mientras que el control se hizo con trampas de cepo en el sur de la isla, en las dos zonas donde anida el albatros de Laysan: Colinas Negras y Punta Sur. La tasa de crecimiento poblacional del albatros de Laysan se calculó con base en el número de individuos reproductivos, en tanto que el éxito reproductivo se estimó de acuerdo a la proporción de huevos puestos que resultaron en volantones. Entre 2003 y 2013 se eliminaron un total de 203 gatos en la porción sur de Guadalupe. Durante este mismo periodo se registró, en general, un éxito reproductivo alto (0.8) en el albatros de Laysan, lo que sugiere que el control de gato tiene un efecto positivo. Encontramos diferencias significativas en el éxito reproductivo entre los años con y sin depredación por gatos ferales. La colonia de albatros de Laysan en Guadalupe ha crecido de manera estable durante los últimos 30 años, pasando de 4 a 143 pares reproductores entre 1984 y 2013, respectivamente, teniendo una tasa de crecimiento poblacional de 1.10 entre 2004 y 2013.

The feral cat (*Felis catus*) is among the world's worst invasive alien species (Lowe et al. 2004). Its presence on islands has been recognized as one of the main causes of extinction of insular species (e.g., Jehl and Parkes 1983, Mellink 1992, Veitch 2001). Cats on islands have contributed to the extinction of 33 mammals, birds, and reptiles worldwide (Aguirre-Muñoz et al. 2011, Medina et al. 2011). Seabirds have several characteristics that make them particularly vulnerable to cat predation: they are long-lived species with low reproductive rates (usually a single chick per breeding cycle) and have late recruitment, as they start to reproduce around 7–12 years of age (Cairns 1992, Baker et al. 2002). Furthermore, seabirds—like many insular species—lack antipredator behavior since they have evolved in environments free of mammalian predators (Milberg and Tyrberg 1993, Cooper and Pérez-Mellado 2012).

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Guadalupe Island remains one of the most important breeding sites for seabirds in Mexico (e.g., Pitman et al. 2004, Keitt 2005, Wolf et al. 2005, Birt et al. 2012). It hosts 7 threatened seabirds: Guadalupe Storm-Petrel (*Oceanodroma macrodactyla*), Laysan Albatross (*Phoebastria immutabilis*), Leach's Storm-Petrel (*Oceanodroma leucorhoa socorroensis* and *O. l. cheimomnestes*), Guadalupe Murrelet (*Synthliboramphus hypoleucus*), Cassin's Auklet (*Ptychoramphus aleuticus*), and Black-vented Shearwater (*Puffinus opisthomelas*). Cats were introduced to Guadalupe around 1885, rapidly establishing a feral population (Moran 1996). Over the years, feral cats became a major concern for the conservation of birds at Guadalupe Island (Jehl and Everett 1985). They have been involved in the extinction of 6 bird taxa, including the Guadalupe Storm-Petrel (not recorded since 1912), the Guadalupe Ruby-crowned Kinglet (*Regulus calendula obscurus*), and the Guadalupe Northern Flicker (*Colaptes auratus rufipileus;* Jehl and Everett 1985, Barton et al. 2004, Keitt et al. 2005, Aguirre-Muñoz et al. 2011).

Almost the entire Laysan Albatross population breeds in the central Pacific (northwestern Hawaiian Islands); but in 1983, the species colonized Guadalupe—the first colony in the eastern Pacific—probably due to saturation of breeding sites in its former location (Pitman et al. 2004). Since then, new colonies have been recorded in the eastern Pacific, all within Mexico (Islas Alijos, Roca Partida, San Benedicto, and Clarion Islands in the Revillagigedo Archipelago; Pitman 1985, Howell and Webb 1990, Pitman and Ballance 2002). However, the most important colony to date is the one at Guadalupe Island (Pitman et al. 2004, Henry 2011).

Feral cats affect native vertebrates on at least 120 different islands worldwide, and birds are the most impacted group (Medina et al. 2011). According to a global review on the impacts of feral cats on islands, predation by cats has been documented for 5 other albatross species besides the Laysan Albatross on Guadalupe: *Diomedea amsterdamensis, Thalassarche carteri,* and *T. chlororhynchus,* all on Amsterdam Island; *Diomedea epomophora* on Auckland Island; and *Phoebastria irrorata* on Isla de la Plata (Medina et al. 2011).

On Guadalupe, predation events at the main island colony are frequent, causing losses of both adults and chicks (Gallo-Reynoso and Figueroa-Carranza 1996, Keitt et al. 2005, this paper). Laysan Albatrosses are reluctant to leave their nests when they are incubating (Kepler 1967), and this characteristic makes them highly vulnerable to predation. For example, in the 2002–2003 breeding season, 35 breeding adults were killed by cats on Guadalupe, causing the failure of their nests (Keitt et al. 2005).

To actively protect all seabird populations on Guadalupe Island, including the Laysan Albatross, the eradication of feral cats has been identified as a key restoration strategy (Aguirre-Muñoz et al. 2011, Croxall et al. 2012, Aleixandre et al. 2013, Nogales et al. 2013). Nevertheless, even when eradication is the preferred option, sometimes control has to be the immediate response to a species conservation contingency (Courchamp et al. 2003), especially while fundraising for usually expensive eradication campaigns. There are several examples of how ongoing feral cat control strategies have protected seabird populations, particularly when eradication of feral cats is not feasible due to technological or financial constraints (e.g., Bonnaud et al. 2010, Zino et al. 2001). At Port-Cros Island (France), for example, feral cat control around Yelkouan Shearwater (*Puffinus yelkouan*) colonies led to an increase in and immediate protection of the population (Bonnaud et al. 2010).

To ensure the permanence of the Laysan Albatross on Guadalupe, a campaign to control feral cats was started in 2003. In order to evaluate the effectiveness of control actions, we also conducted seasonal monitoring of albatross reproductive success. Here, we report the outcomes of these activities for 2003–2013.

METHODS

Site Description

Guadalupe Island is a biosphere reserve, located in the Pacific Ocean, 260 km off the Baja California peninsula, Mexico (29° 04′ N, 118° 17′ W; Fig. 1). The reserve's terrestrial area comprises the main (Guadalupe) island (24,171 ha, elevation 1298 m), 3 islets (Zapato, Toro, and Negro), and several offshore rocks (Fig. 1). The island has a Mediterranean climate characterized by hot and dry summers and cold and wet winters (Camps and Ramos 2012, Granda et al. 2014). Climate is defined as

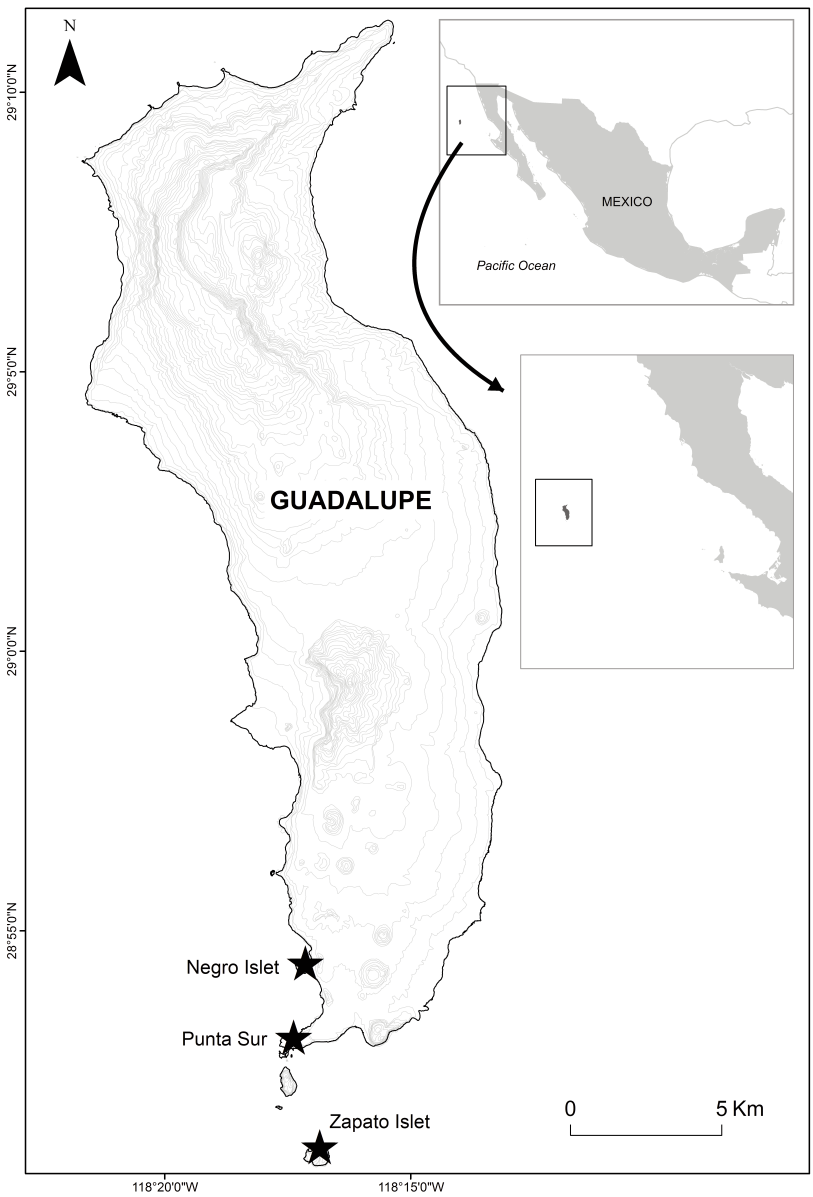

Fig. 1. Geographic location of Guadalupe Island. Black stars indicate locations of 3 nesting colonies of Laysan Albatross.

BWhs: dry (arid), low-latitude climate (average annual temperature between 18 and 23 °C), and winter rainfall (García 1998).

Floristically, Guadalupe Island is similar to the Channel Islands, USA (Raven 1965). Ten well-defined vegetation communities have been described based on historical records (Oberbauer 2005). These include 3 forests (cypress, pine, and palm; all endemic species), 2 woodlands (juniper, oak), chaparral (shrubs), native grassland, and 3 communities dominated by low shrubs. The vegetation community on the southern end of the island and islets was dominated historically by succulent perennial herbs such as the endemics *Cistanthe guadalupensis, Bariopsis guadalupensis, Coreopsis gigantea,* and *Deinandra* spp. This community has been described as succulent herbland (León de la Luz et al. 2003) or mesa/islet scrub (Oberbauer 2005). Given the

island's considerable distance from the mainland, only invertebrates, birds, and marine mammals were able to colonize (Moran 1996); terrestrial mammals and reptiles are absent. From 1850, goats (*Capra hircus*), dogs (*Canis familiaris*), cats, and house mice (*Mus musculus*) established feral populations on Guadalupe together with invasive birds and weeds (Junak et al. 2005, Quintana-Barrios et al. 2006). Feral goats (approximately 10,500) and a small population of dogs (<100) were eradicated between 2004 and 2007 (Aguirre-Muñoz et al. 2011).

Laysan Albatross

On Guadalupe, Laysan Albatross are distributed in 3 different colonies: 2 on the islets (Zapato and Negro), and one on the main island (2 locations: Punta Sur and Colinas Negras; Figs. 1, 2). At Punta Sur, albatrosses were recorded for the first time in 1984 (Gallo-Reynoso and Figueroa-Carranza 1996); whereas in Zapato, Negro, and Colinas Negras, they were first found in 2000 (Pitman et al. 2004). Laysan Albatross are monogamous, forming strong pair bonds usually only disrupted by disappearance of one of the birds, in which case another mate will be found (Fisher 1971, 1975, 1976, Rice and Kenyon 1962). The species is long lived (>20 years; Fisher 1976), with high survival (between 0.93 and 0.99; VanderWerf and Young 2011). Yet, breeding adults do not nest every year and only one chick per pair is produced every season (Rice and Kenyon 1962, Henry 2011, this paper). On Guadalupe, Laysan Albatross start their breeding season in early November, with chicks hatching from late December to February and fledging in June (Gallo-Reynoso and Figueroa-Carranza 1996, Henry 2011, this paper).

The albatross colony on Guadalupe was monitored from 2003 to 2013. From 2003 to 2008, we monitored in collaboration with Robert W. Henry as part of a PhD project that investigated the range expansion of this species over the Pacific Ocean (see Henry 2011). The annual finite population growth rate was estimated as $\lambda = N_{t+1}/N_t$, where N is number of reproductive individuals and t is breeding season (year); the instantaneous population growth rate is $r = \ln \lambda$ (Caughley 1977, Hone and Sibly 2002). Total number of nests, number of eggs laid, and number of chicks fledged were recorded for every breeding season. Breeding success was estimated as the proportion of eggs laid that resulted in fledged chicks (Young et al. 2009).

Feral Cat Abundance

The relative abundance of cats was estimated using spotlight surveys. Counts of individuals were made at night using a spotlight of 2M candle power (Brinkmann, TX, USA) held by a person in a vehicle driven at a constant speed (15–20 km · hr^{-1}) along a 37.2-km transect (main road on the island). All animals observed in a wide strip of approximately 200 m (100 m per side) were counted. Monitoring was conducted in winter 2007 and then seasonally from 2009 to 2013. For this paper, we used an average value from winter (January–February) and spring (April–May), as these are the seasons that coincide with the albatross breeding period. The total number of individuals counted was used to provide an index of cat population density on Guadalupe, represented as cats · km^{-1} and averaged over the 3 nights of observation (Sharp et al. 2001, Schauster et al. 2002).

Feral Cat Control

In 2003, after the heavy predation event during the 2002–2003 breeding season, a campaign to control cats around the albatross colony was initiated. Given that resources (both human and financial) were limited from 2004 to 2008 and that no heavy predation events were detected in the Guadalupe colony, the trapping effort around the colony was low (ca. 500 trap-nights annually). The trapping effort intensified beginning in 2009 as more resources were available. In addition, since Laysan Albatross established again on Colinas Negras in 2007, traps were also set in this location from 2009, which increased the total number of traps set. On average, 40 traps were set around the Laysan Albatross colony on Guadalupe every year (Fig. 2). Traps were set before the arrival of the first individuals to the colony (before November), and control continued throughout the albatross breeding period. Cats were captured using leg-hold traps (Victor Oneida Soft Catch leg-hold traps No. 1.5) and euthanized with a lethal injection (see also Luna-Mendoza et al. 2011).

An analysis of variance was done to evaluate the effect of feral cat control on albatross breeding success. Data from 2003 to 2013

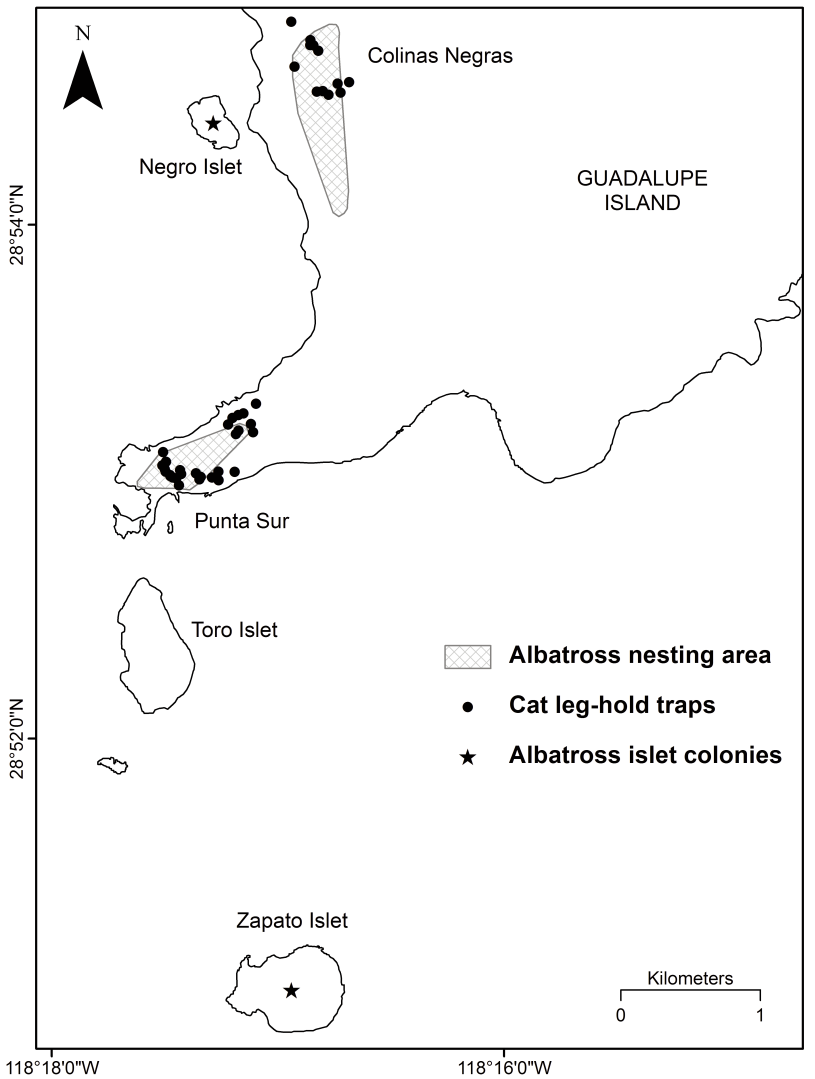

Fig. 2. Laysan Albatross nesting area at 2 locations on the main island: Punta Sur (18 ha) and Colinas Negras (35 ha). Black dots indicate the location of feral cat traps.

were used (Henry 2011, this paper) as well as historical information from 1991, 1992, and 2000 (Gallo-Reynoso and Figueroa-Carranza 1996, Pitman et al. 2004). We included these last 3 years since they were the only ones with available information about the number of nests and chicks produced.

All analyses were conducted in R version 3.0.1 (R Core Team 2012) in R Studio, version 0.97.551 (RStudio 2013). For statistical analyses and graphs, packages plotrix version 1.33 (Lemon et al. 2014) and psych version 3.5–3 (Revelle 2014) were used.

RESULTS

Laysan Albatross

Population growth rate.—The annual finite population growth rate (λ) was estimated as 1.10, based on the number of reproductive (nesting) individuals from 2004 to 2013. The Laysan Albatross colony on Guadalupe has grown steadily during the past 30 years, increasing from 4 to 143 breeding pairs on the main island colony (Fig. 3; Gallo-Reynoso and Figueroa-Carranza 1996, Henry 2011, this paper). The islets have been experiencing a

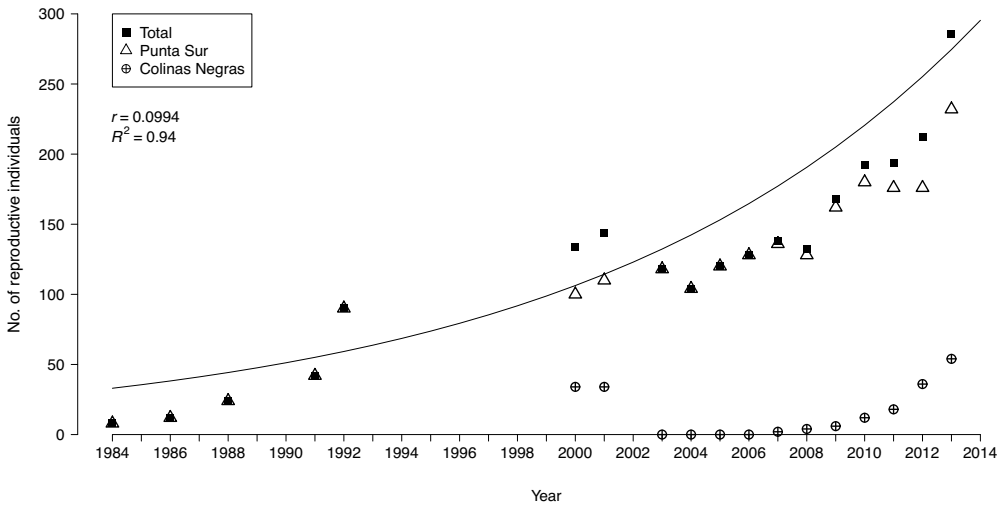

Fig. 3. Number of reproductive Laysan Albatross on Guadalupe's main island colony from 1984 to 2013. Years with no data are blank. The fitted line represents the instantaneous population growth rate (r). (See Dunlap 1988, Oberbauer et al. 1989, Howell and Webb 1992, Gallo-Reynoso and Figueroa-Carranza 1996, Pitman et al. 2004, Henry 2011, and this paper.)

similar occurrence, and colonies there have increased from 373 nests in 2009 (Henry 2011, GECI unpublished data) to 503 nests in 2013: 332 on Zapato and 171 on Negro, (GECI unpublished data).

The Colinas Negras colony was just discovered in 2000, when 17 nests were found (Pitman et al. 2004). However, by 2003 no individuals were found nesting there, possibly due to extirpation by feral cats and dogs. Breeding in this colony was observed again in February 2007, when one nest was found (María Félix and Robert W. Henry personal observation). Since then, the number of nests has increased annually (Figs. 3, 4).

Reproductive success.—Low reproductive success was recorded from 1988 to 2003 and in 2012 ($\bar{x}$ = 0.39, SD 0.25; n = 5), when cat predation events were recorded (Fig. 5). In contrast, high reproductive success was recorded in 2004, from 2006 to 2011, and in 2013 ($\bar{x}$ = 0.8, SD 0.05; n = 8), when no predation events were recorded (Fig. 5). There were significant differences in reproductive success between years with predation and no predation by feral cats ($F_{1, 12}$ = 12.83, P = 0.004).

The low reproductive success recorded previous to 2003 was also due to predation by feral dogs and egg losses due to human exploitation (Howell and Webb 1992, Gallo-Reynoso and Figueroa-Carranza 1996, Pitman et al. 2004). In 2002–2003 predation occurred on adults, while in 2012 cats preyed upon chicks (n = 30). Also, in 2012 eight nests failed due to human disturbance (egg exploitation; Julio Hernández personal observation). In 2005, low reproductive success was observed despite no recorded predation events by cats. This low may be associated with the high predation event during the 2002–2003 breeding season, because looking for a new mate when the partner has been lost might affect reproductive success in subsequent years (Henry 2011).

Feral cat control and abundance.—From 2003 to 2013, we captured a total of 203 cats around the main (Guadalupe) island albatross colony (Fig. 6). Feral cat captures increased twofold after 2008 since we expanded our trapping effort from about 500 trap-nights a year to an average of 2408 (SD 2027) trap-nights between 2009 and 2013, ranging from 1080 to 6000 trap-nights in 2009 and 2013, respectively. Trapping effort was increased for 2 main reasons: (1) to reinforce the protection of Laysan Albatross both at Punta Sur and Colinas Negras in order to maintain this colony's growth rate and (2) to gather baseline information (e.g., morphometric and diet data) about the population of feral cats on Guadalupe as part of the development of an eradication plan (see Luna-Mendoza et al. 2011).

Regarding cat abundance on Guadalupe, the lowest index value (0.04) was recorded in

Fig. 4. Laysan Albatross nesting on Zapato Islet.

2007, when we only did the spotlight counts over winter. The highest index value (1.03) occurred in 2009, which coincides with our highest captures of cats. Between 2009 and 2013, the average cat index value was 0.68 (SD 0.30; Fig. 6).

DISCUSSION

The Laysan Albatross colony on Guadalupe Island has shown steady growth since its establishment in 1983, despite the fact that frequent disturbance to the colony has been observed, either through predation or human disturbance. The finite population growth rate of 1.35 reported by Gallo-Reynoso and Figueroa-Carranza (1996) is higher than our rate of 1.10. This decrease in the colony's growth rate may be related to the fact that cat predation has decreased adult survival and thus breeding success (Fig. 5). For instance, on Guadalupe the number of nests increased from 67 in 2000 (Pitman et al. 2004) to 143 in 2013 (this paper). In contrast, during this same period the number of nests increased from 52 (Pitman et al. 2004) to 503 (this paper) on the islets, where there are no cats present. This difference can be attributed to the lack of predation pressure on the islets which results in higher breeding success and adult survival. Seabirds potentially select sites to establish new colonies based on several factors, one of them being predation risk (Burger and Gochfeld 1994, Danchin et al. 1998, Kharitonov and Siegel-Causey 1988); thus it is possible that some breeding birds may have selected the islets over the main island to nest.

Nevertheless, the overall population growth rate of the Guadalupe colony is still higher than those observed for other species of albatrosses, ranging from 0.910 to 1.073 (e.g., Arnold et al. 2006, Finkelstein et al. 2010, Robertson et al. 2014). This means that the colony is still growing. According to Gallo-Reynoso and Figueroa-Carranza (1996), this growth can only be explained by constant immigration from other sites rather than intrinsic recruitment, despite the colony's high breeding success (0.80 without cat predation; Henry 2011, this paper). On the island of Oahu (Hawaii), for example, albatross finite population growth rate was 2.7, even though predation was occurring. As in Guadalupe, this colony's growth seems to be related more to immigration than local recruitment (Young et al. 2009), especially because prospecting birds might replace those individuals killed by cats (Pontier et al. 2008, Bonnaud et al. 2009).

Although Laysan Albatross seem tolerant of moderate predation, heavy predation, particularly on adults, could provoke a collapse in the breeding population in just a few years

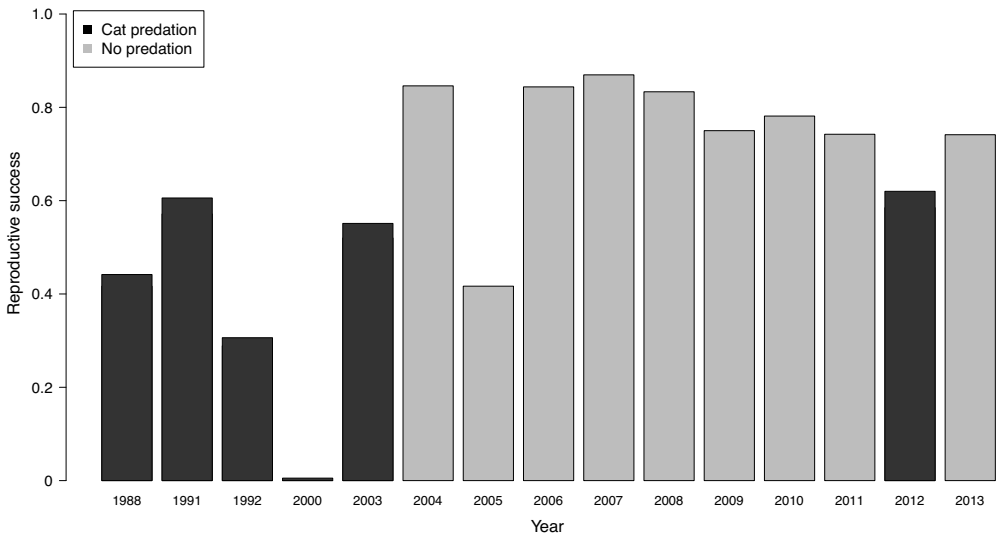

Fig. 5. Reproductive success of Laysan Albatross on Punta Sur and Colinas Negras during years with cat predation and years without cat predation. (See Oberbauer et al. 1989, Gallo-Reynoso and Figueroa-Carranza 1996, Pitman et al. 2004, Henry 2011, and this paper.)

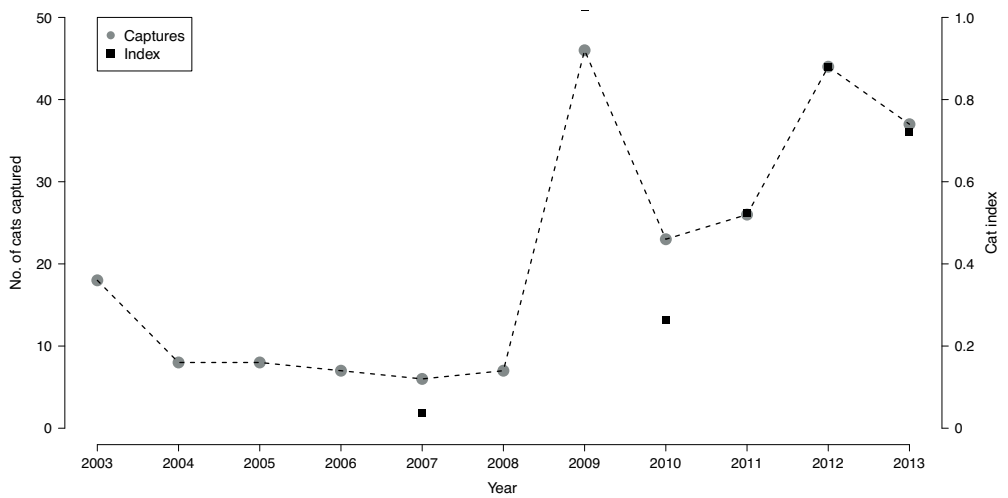

Fig. 6. Number of cats captured at Punta Sur and Colinas Negras during the past decade. Values of cat relative abundance (cats · km^{-1}) for 2007 and 2009–2013 are also shown (black squares).

(Simons 1984, Smith et al. 2002, Peck et al. 2008, Faulquier et al. 2009). Adult loss can be one of the most important factors affecting population growth rate (Lewison et al. 2012) on Guadalupe. In fact, population growth rate is very sensitive to changes in adult survival in other species of albatross like the Black-browed Albatross (*Thalassarche melanophris;* Arnold et al. 2006, Rolland et al. 2009) and the Waved Albatross (*Phoebastria irrorata;* Anderson et al. 2008). If predation continues, the island could act as a sink habitat, where a high number of reproductive individuals are being lost and therefore the population becomes unsustainable in the long term without a high rate of immigration (Peery et al. 2006, Bonnaud et al. 2009).

Laysan Albatross reproductive success in those years when no predation events were recorded on the colony was 0.80 (SD 0.05),

which is consistent with other seabird species. Nur and Sydeman (1999) found that few studies have reported average reproductive success as high as 0.8 (reproductive success defined as proportion of fledglings to chicks reared). Therefore, it is likely that this is the highest reproductive success that can be achieved by albatross on Guadalupe. It is interesting though that the reproductive success of Laysan Albatross on Guadalupe was higher or about the same as the one recorded on the island of Oahu (0.48) when predation represents isolated events (Young et al. 2009).

Laysan Albatross reproductive success in years when cat predation was recorded was 0.4 (SD 0.22). On Guadalupe, no selective predation has been observed, as feral cats can prey equally upon adults and chicks. From 1988 to 2000, predation by invasive mammals was recorded, but no actions were taken to remove the predation pressure from the colony, except the removal of one dog in 1988 (Gallo-Reynoso and Figueroa-Carranza et al. 1996). In 2000, this lack of action led to the loss of all chicks (Pitman et al. 2004). In contrast, during the breeding season of 2002–2003 and 2011–2012, feral cats were removed from the colony as soon as predation was detected.

Feral cat predation in the albatross colony could be related to individuals acquiring some sort of learned behavior and the ability to kill albatross (Keitt et al. 2005). This behavior has been observed in other invasive predators such as rats and mice preying upon albatross in other islands (Kepler 1967, Cuthbert et al. 2013). Some cats can learn to kill specific novel prey. This ability was observed on Stewart Island, New Zealand, where few cats were specifically targeting Kakapo (*Strigops habroptilus*) and New Zealand Dotterel (*Charadrius obscurus*). Feral cats were previously present at the site but never exhibited such high rate of predation (Dowding and Murphy 1993, Powlesland et al. 1995).

In addition, when food resources are scarce in other parts of the island, cats may increase predation pressure on seabird colonies, especially during years when cat abundance is high as a result of high availability of their preferred food item: house mice (Luna-Mendoza et al. 2011, Luna-Mendoza 2014). Cats on Macquarie Island (Australia) moved, possibly only for foraging, to sites where additional food resources were available during winter when prey is generally absent on the island (Jones 1977). Cats can associate certain areas with availability of additional prey, as observed on Corvo Island (Portugal), where one domestic cat made a single trip to visit all Cory's Shearwater colonies on the island (Hervías et al. 2014). Our estimation of cat abundance suggests that in those years when cat relative abundance was high (2009–2013), the visitation rate (calculated by the number of cats captured) to the albatross colony was higher than in those years when cat relative abundance was low (2007–2008). This behavior could also explain why from 2006 to 2008, despite low trapping effort around the albatross colony (Fig. 6), no predation events were recorded. Few data points were available to test the effect of predation on albatross reproductive success (Fig. 5). However, the analysis of variance suggests a positive effect of cat control in this population parameter overall.

Our aim is to continue with cat control until sufficient funding is obtained to conduct an eradication campaign on Guadalupe. We have been gathering data on the best approach to eradication over the past few years and determined that the most cost-efficient method to remove cats is through trapping and ground-hunting rather than use of toxic baits. This view has been supported by international experts in the field (Parkes et al. 2012) and has proven to be effective on islands with similar characteristics to Guadalupe (e.g., Campbell et al. 2011, Robinson and Copson 2014). We estimate that a 3-year feral cat eradication program would cost $4 million USD just for implementation. Compared to other cat eradications, this estimate puts Guadalupe at the midrange cost of $164 USD per hectare for this type of operation (Campbell et al. 2011). Macquarie Island (12,800 ha), the second largest island from which cats have been eradicated, cost $258 AUD per hectare (ca. $230 USD per hectare; Robinson and Copson 2014, Parkes et al. 2014).

During the past 5 years (2009–2013), cat control on Guadalupe has cost $1.25 million USD, at a rate of $250,000 USD per year. This includes costs such as transport to and from the island, staff monthly salaries, materials and equipment, food, and maintenance of a biological station. Although this figure is lower than the cost of the eradication program, control eventually becomes less cost efficient in the long term since the problem (feral cats) is not

completely removed. Furthermore, sustaining cat control on Guadalupe over a decade has proven challenging.

Despite the challenges, cat control has been very effective in protecting the Laysan Albatross colony, and we will continue this important action until funding for implementing the eradication program is secured. Protecting the colony on Guadalupe is of high importance since it is the most successful breeding colony in the eastern Pacific (Pitman et al. 2004, Henry 2011).

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