

A review of records and research actions for the Critically Endangered Beck's Petrel *Pseudobulweria becki*

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Summary

The “Critically Endangered” Beck's Petrel *Pseudobulweria becki* has been recorded regularly in the Bismarck Sea during the past five years, but its nesting grounds are yet to be located. Previously, over 70 years elapsed between the collection of the original specimens in 1928 and 1929, and the next confirmed observations in 2007. We evaluate over 40 documented records of the species as well as recorded survey effort within the Bismarck Archipelago and Solomon Islands and we assess potential breeding areas as well as land and sea priority search areas. On current evidence, southern New Ireland, within the Bismarck Archipelago, remains the highest priority area to search for nesting colonies but other parts of the region also warrant further investigation. The species's distribution, population size and trends, ecology and threats are all poorly known, so prescribing conservation actions is difficult. As a starting point we identify the most important research actions to advance current knowledge, recognising that locating the nesting grounds of the Beck's Petrel remains the prime conservation priority for this species.

Introduction

Beck's Petrel *Pseudobulweria becki* is a small, contrastingly dark brown and white gadfly petrel, virtually identical in appearance to Tahiti Petrel *P. rostrata* but c.10–20% smaller (Murphy and Pennoyer 1952, Shirihai 2008a). It was described as ‘maybe extinct’ (Bretagnolle *et al.* 1998) and ‘extremely rare’ (Brooke 2004) during a period of 77 years without a record following its discovery and a description based upon two birds shot at sea in the Bismarck Archipelago, Papua New Guinea in 1928 and east of Rendova, Solomon Islands in 1929 (Murphy 1928, Murphy and Pennoyer 1952). Beck's Petrel was rediscovered in 2007 (Shirihai 2008a), attracted to ‘chum’ at several locations in the Bismarck Sea north of New Britain, and around New Ireland, Papua New Guinea. A spate of records has followed, all at sea. To date, no breeding colonies have been discovered and their whereabouts remains uncertain.

In the past, the systematic treatment of the *P. rostrata* and *P. becki* complex (hereafter *rostrata* and *becki*) has been controversial (Bretagnolle *et al.* 1998). This paper follows Imber (1985), Sibley and Monroe (1990), Dickinson (2003), Brooke (2004), Onley and Schofield (2007) and BirdLife International (2012) in treating *becki* as a full species, but Jouanin and Mougín (1979), Harrison (1985), Marchant and Higgins (1990), Warham (1990), Carboneras (1992), and Christidis and Boles (1994, 2008) all treat *becki* as a subspecies of *rostrata*.

Beck's Petrel is classified as “Critically Endangered” on the IUCN Red List because a very small number of mature individuals are currently known, all within a single subpopulation which is suspected to have declined (BirdLife International 2012). Declines are postulated on the basis that predation by introduced cats and rats on its currently unknown breeding grounds has probably

driven population declines (Birdlife International 2012). Unlike a number of other Critically Endangered gadfly petrels for which the level of search effort to date suggests they are genuinely very rare (e.g. Fiji Petrel *P. macgillivrayi* and Magenta Petrel *Pterodroma magentae*), the paucity of records of Beck's Petrel may be because there were relatively few searches prior to 2007 (BirdLife International 2012). Indeed, this pattern has already changed considerably with two recent surveys estimating over 100 individuals encountered (Shirihai 2008b, Bird 2012). Nevertheless, determining population size and trends, threats to the species and its conservation status are all reliant on locating the breeding grounds. This is regarded as the pre-eminent research action for this species (Birdlife International 2012, Bird 2012). Just one targeted search for its breeding grounds on land has been attempted (Bird 2012), but a number of more general terrestrial bird surveys have been conducted in the Bismarck Archipelago that have failed to record any sign of burrow-nesting seabirds (see Mayr and Diamond 2001).

In this paper we: (i) assess the scant information concerning the taxonomic validity of Beck's Petrel; (ii) collate, update and review all records of Beck's Petrel; (iii) examine the extent and findings of avifaunal surveys in the Bismarck Archipelago and northern Solomon Islands; (iv) review potential breeding sites; and (v) prescribe research actions needed to inform the conservation of the species.

Taxonomic status of Beck's Petrel

According to molecular evidence, Bretagnolle *et al.* (1998) concluded that the two Tahiti Petrel subspecies *Pseudobulweria rostrata trouessarti* from New Caledonia and *P. r. rostrata* from Polynesia, do not deserve species status because of their two distributional extremes, and should be regarded as valid subspecies. Their conclusion was supported both by morphometrics and vocalisations (De Naurois and Erard 1979, Bretagnolle unpubl. data in Bretagnolle *et al.* 1998). Their analysis did not include *becki* as no birds have been sound-recorded or handled at breeding grounds so no vocal or genetic samples were available for comparison. Morphometric comparison of three specimens of *becki* with a sample of the two *P. r. rostrata* and *P. r. trouessarti* (Villard *et al.* 2006) showed no overlap in wing, tail, bill or tarsus measurements (Shirihai 2008a). However, given that vocal and genetic differences are recognised as important cues for determining taxonomic relationships in petrels (Randi *et al.* 1989, Wink *et al.* 1993a, b, Bolton 2008) identification of Beck's Petrel's breeding grounds to collect these data and allow comparison with *P. r. rostrata* and *P. r. trouessarti* is highly desirable to further clarify the taxonomic status of *becki*.

Records of Beck's Petrel

Records at sea

In total, we collated 45 reports of Beck's Petrel, all of which refer to at-sea observations (Table S1 in the online supplementary material). Identification of Beck's Petrel at sea is challenging. It cannot be reliably separated from Tahiti Petrel in photographs (Shirihai 2008b) and descriptions in trip reports published online and verbal descriptions received are often conflicting and confusing (e.g. Collins 2008, 2010, 2011, P. Harrison *in litt.* 2012, D. Fisher pers. comm.). During personal observations (JB) of *Pseudobulweria* petrels in Fiji and the Bismarck Sea there were no definitive plumage differences. However, these observations supported the notion in Shirihai (2008b) and Collins (2011) that small *becki*-type petrels in the Bismarck Sea have a distinctly more rapid and shorter flight action during arcing wind-assisted flight than larger *rostrata*-type birds.

Given the current uncertainty over the identification of Beck's Petrel in the field we investigated the veracity of each report. Reports were classified as either: (i) *confirmed* if the bird was taken as a specimen; (ii) of *high* reliability if the record has been published in a peer-reviewed paper, was based on a multi-observer sighting, or a description was available for review that corroborates the record; and (iii) of *low* reliability if there was insufficient documentation to support the record, or doubt from the observers. Of 43 confirmed or high reliability records, 40 are from the last five years.

There may be additional unpublished reports from this period as birdwatchers visiting the archipelago now target this species, with boat charters available to search at sea e.g. MV FeBrina at Walindi Plantation Resort, New Britain (Walindi Plantation Resort 2012).

Records on land

No records exist of any Beck's Petrels seen or captured on or over land. Steadman *et al.* (1999) analysed bird bones from five late Pleistocene and Holocene archaeological sites on New Ireland. Represented by a coracoid and carpometacarpus, they identified a *Pseudobulweria* petrel, either *rostrata* or *becki* from Matenbak, southern New Ireland (Figure 1). The petrel bones were estimated to be 6,000 years old (Steadman *et al.* 1999). Based on their relatively large size, Steadman *et al.* (1999) concluded that the two bones may represent the Tahiti Petrel. However, their analysis was prior to the collection of the third specimen of *becki* and the morphometric analyses of Villard *et al.* (2006) and Shirihai (2008a). Neither species is known to breed currently on New Ireland.

Surveys for petrels in the Bismarck Archipelago and Solomon Islands

At-sea surveys

Pterodroma and *Pseudobulweria* petrels are highly dispersive covering large distances (hundreds of kilometres) during foraging trips in search of low-density or patchily distributed prey (Warham 1996). They are normally encountered singly but aggregations can occur at sea when a prey source is identified or when breeding birds gather close to shore in the early morning and evening having visited colonies during the hours of darkness (Warham 1996). This latter behaviour is

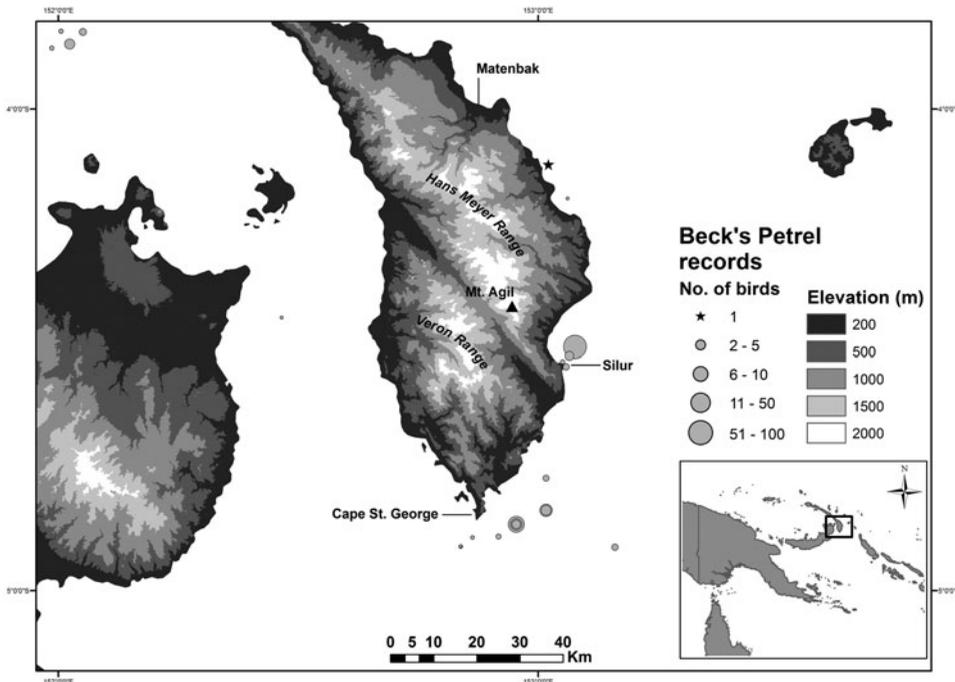


Figure 1. Key locations in Southern New Ireland reported in the text, with observations of Beck's Petrel.

considered to be a strong indication that birds breed nearby (D. Forsell pers. comm. to Simons *et al.* 2006). Therefore evaluating at sea observations can help to pinpoint potential breeding grounds. It is also important to review the coverage of at sea surveys to evaluate whether apparent hotspots of Beck's Petrel sightings are likely to represent genuine high-use areas or if they simply correlate with survey effort, in which case there may be other high-use areas awaiting discovery in poorly surveyed parts of the region.

Of the confirmed and high veracity records in Table S1, 11 refer to records of 10 or more individuals. All but two of these were observations of birds attracted to chum; akin to Warham's (1996) description of petrel aggregations formed when a prey source has been identified. The remaining two records are of early morning encounters of birds massed close to land performing circulatory flights, more indicative of nearby breeding.

When mapped, the clustering of Beck's Petrel records around southern New Ireland is evident (Figure 2). The poor quality of effort data does not permit statistical analysis of the relationship between observations and at-sea survey effort, but a simple overlay indicates the areas where most Beck's Petrels have been recorded overlap strongly with the areas that have been surveyed most frequently.

Terrestrial surveys

The only speculation to date as to where Beck's Petrel breeds suggests the mountains of southern New Ireland (Shirihai 2008a), especially Mt. Agil (Bird 2012), Bougainville (Hadden 1981), or the Solomon Islands (Murphy and Pennoyer 1952). Within the wide region of the Bismarck

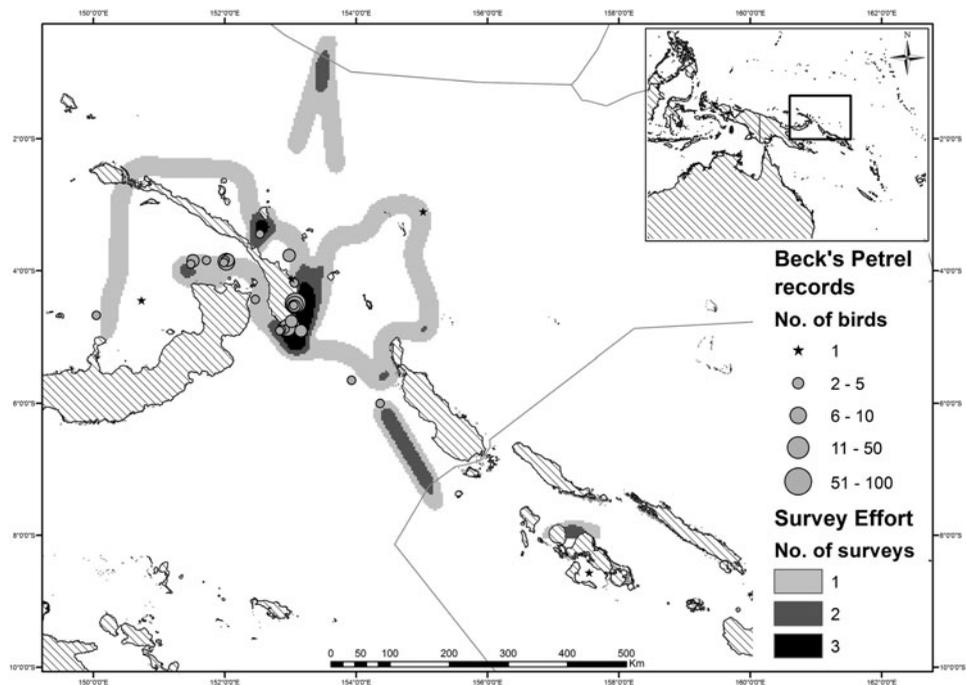


Figure 2. Records of Beck's Petrel overlain on at-sea survey distribution. Survey distribution is derived from tracks logged by JB in February/March 2012; sunrise and sunset waypoints collected on Western Pacific Odyssey trips in 2009 and 2010 (C. Collins *in litt.*) and digitised from Shirihai (2008a).

Archipelago and Solomon Islands there has been extremely limited terrestrial survey effort focused specifically on locating petrel colonies. In particular there has been very little spot-lighting at night; a method which has routinely been used to locate elusive petrel species at their nesting grounds (Warham 1996). Bird (2012) performed ad-hoc interviews in coastal villages in southern New Ireland to gather any local knowledge of nesting petrels, completed pre-dawn to early morning and late-afternoon to post-dusk coastal sea-watches for birds returning to land, and spot-lighted for seabirds at sub-optimal foothill sites while playing Tahiti Petrel calls. This survey received no compelling reports of petrel-like birds on land, with no harvesting of seabirds taking place, and no evidence of birds grounded at lights in villages (Bird 2012).

The only documented reports of burrow-nesting seabirds on land in the Bismarck Archipelago and Solomon Islands are those in Hadden (2004) of Heinroth's Shearwater *Puffinus heinrothi* breeding in the Crown Prince Range, Bougainville, although this species is also believed to breed on Kolombangara (Buckingham *et al.* 1995); and the original specimens of Heinroth's Shearwater collected on Watom (BirdLife International 2012). Hadden (2004) lists Beck's Petrel for Buka and Bougainville but this appears to be based only on the type specimen collected north of Buka. There has apparently been no petrel-focused survey effort within the region that has used proven survey techniques such as spot-lighting from mountain peaks at night, or playback of *Pterodroma* or *Pseudobulweria* calls. Any such techniques will be hampered by a lack of information on the timing of breeding for targeted species, which for Beck's Petrel is poorly known.

Mayr and Diamond (2001) catalogued all bird surveys that took place in the islands of the Bismarck Archipelago and the Solomons up to 2000. Mapping the level of effort by total number of surveys (Figure 3) it is evident that larger islands have received greater survey effort than

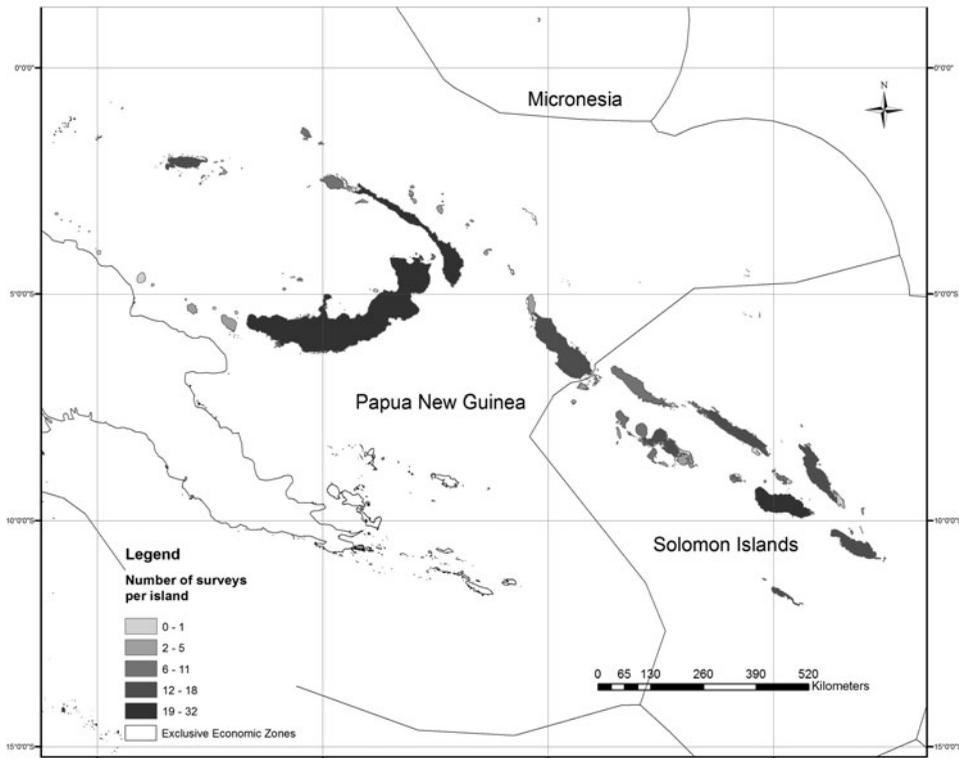


Figure 3. Total number of surveys per island documented in Mayr and Diamond (2001).

small islands, and large islands in the Bismarck Archipelago have been visited more often and more recently than large islands in the Solomons. Many small satellite islands have never been surveyed for birds and no surveys have been temporally spaced within a calendar year. Although it is not apparent in Mayr and Diamond (2001), few surveys have visited the upland interiors of the larger islands (G. Dutton pers. comm.), so along with the more remote off-islands and satellite islands these are the least explored parts of the region. One notable exception is the biodiversity assessment of Southern New Ireland, which spent one week above 1,800 m near the summit of the Hans Meyer Range during January and February 1994 (Beehler and Alonso 2001). However, as with other surveys, spot-lighting and audio surveys at night were not conducted.

Discussion

Very little is known of the status of Beck's Petrel. Recent observations at sea suggest it may be relatively common compared, for example, to Fiji Petrel which has been recorded far less despite a similar or higher level of survey effort (D. Watling pers. comm. 2010). The reason Beck's Petrel went unrecorded for so long may reflect the limited survey effort within its range during that period rather than rarity. Nevertheless, to date, no single survey has confirmed that the population is larger than the threshold of 250 mature individuals which, together with a presumed declining trend, qualify the species as "Critically Endangered" on the IUCN Red List.

Location of the nesting grounds

Shirihai (2008a) observed Beck's Petrels close to land (1–2 km) at Cape St. George, New Ireland in the late afternoon in August, 2007, leading him to speculate that birds are breeding in the Veron Range or Hans Meyer Range of southern New Ireland (Figure 1). A more precise area could not be pin-pointed because no behaviours exhibited by birds approaching breeding colonies such as rafting, vocalising or circulatory flights (Warham 1996) were observed. Birds seen by Bird (2012) in March, 2012 in the same area and at the same time of day as Shirihai's observations were all in active flight heading out to sea towards Buka, not approaching land.

Of all records to date, the strongest indication of nearby breeding comes from the aggregation of 100 or more individuals performing non-directional circulations, rather than actively foraging or dispersing, within 2 km of shore (Bird 2012). These birds were present in the early morning at Silur, southern New Ireland on 13 and 14 March 2012 (Table S1). This site is adjacent to the highest peak in the Hans Meyer Range, and all of New Ireland, Mt Agil at over 2,000 m. The upper elevations of Mt Agil and the Hans Meyer Range are dominated by perpetually wet mossy forest with a low canopy and tangled understory vegetation (Beehler and Alonso 2001). It is approximately 11 km from the summit to the sea. The characteristics of this area are very similar to Mt Lata, Ta'u, American Samoa, where a large colony of Tahiti Petrels is known to breed (O'Connor and Rauzon 2004) and conforms with one type of locality likely to suit Beck's Petrel (see references below to Tahiti Petrel breeding on low-lying islands).

Tahiti Petrels forage within the vicinity of their colonies during the breeding season (Onley and Scofield 2007). Assuming Beck's Petrel is similar, the clustering of observations (Figure 2) and in particular those of birds exhibiting behaviours associated with approaching and departing the colony, strongly suggest southern New Ireland hosts a breeding population. The most likely site is Mt Agil owing to the location of at sea observations and the characteristics of the site itself. This is potentially supported by the discovery of *Pseudobulweria* bones in archaeological deposits from Matenbak, c.50 km to the north (Steadman *et al.* 1999).

A major corollary of the modern day distribution of petrels worldwide is the occurrence of mammals (Warham 1996, Onley and Scofield 2007). Historic distributions were often shaped by native mammal distributions with procellariiformes occurring on mammal-free islands (Onley and Scofield 2007). Distributions have been modified subsequently by the spread of invasive mammals transferred by humans, which have led to a spate of island extirpations and the

extinction of several species. Importantly what little information is available on the presence of petrels on New Ireland contradicts this trend. Steadman *et al.* (1999) makes two important points: 1) according to the archaeological record New Ireland has a lower proportion (24%) of extinct/extirpated species than islands to the east in Oceania which he postulates may be related to the presence of indigenous rodents *Melomys rufescens* and *Rattus mordax sanila*. In Remote Oceania, birds evolved without native mammalian predators, leading to naïveté and vulnerability to predation when humans and associated non-native mammals arrived. Evolving alongside native rodents exposed New Ireland's birds to potential predation from terrestrial animals in pre-human times (Steadman *et al.* 1999). 2) Humans had colonised the Bismarck Archipelago and Solomon Islands by 35,000–30,000 years ago. Thus, unlike in Remote Oceania, where human arrival in the late Holocene was clearly devastating to indigenous birds, the Lapita peoples who moved across the Bismarck Archipelago and Solomons about 3,500 years ago found a flora and fauna that already had withstood tens of millennia of human activity. At Matenbek where Steadman *et al.* (1999) identified *Pseudobulweria* remains deposits reveal two phases of human occupation from 20,000 to 18,000 B.P., after which the site was abandoned and then reoccupied from 9,000 to 6,000 B.P. Species of mammals brought to New Ireland by humans appear at the sites after 19,000 B.P. These are phalangers *Phalanger orientalis*, *Spilocuscus maculatus*, wallabies *Thylogale brunii*, rats *Rattus praetor*, *R. exulans*, pigs *Sus scrofa*, and dogs *Canis familiaris*. The *Pseudobulweria* bones were dated to 6,000 B.P. suggesting that, if petrels were native to New Ireland (as seems likely), they had already persisted for 13,000 years in the presence of non-native mammals. Since then, cats *Felis catus* have been introduced but these appear still to be rare at higher elevations, and mammal surveys in 1994 did not record black rat *Rattus rattus* or brown rat *R. norvegicus* (Beehler and Alonso 2001). Therefore, there is little direct evidence to suggest invasive mammals will have had an adverse impact on birds breeding at high altitude on New Ireland.

We have presented above compelling evidence that Beck's Petrel may well breed on New Ireland, Papua New Guinea. However, there may be other breeding sites within the Bismarck Archipelago and Solomon Islands. Plausible locations are the relatively under-surveyed islands of Western Province, Solomon Islands (Figure 3), where a 1929 specimen was collected east of Rendova, and where Heinroth's Shearwater is thought to nest, although no confirmation has been obtained (Buckingham *et al.* 1995). If Heinroth's Shearwater, a presumed burrowing species, remains extant on an island it is possible that conditions could support other burrow-nesting petrels, as is the case with Tahiti Petrels nesting within Shearwater colonies in the Southern Lagoon of New Caledonia (Benoit and Bretagnolle 2002). Therefore Bougainville and adjacent Buka are also plausible nesting sites for Beck's Petrel. Finally, Tahiti Petrel is known to nest on low-lying islands (Benoit and Bretagnolle 2002). Such small and low-lying islands in Papua New Guinea and the Solomons have received less survey effort than the main islands. Any mammal-free *motu* in atolls east of the main islands of the Bismarck Archipelago and Solomons could potentially support undiscovered petrel populations.

Threats

Although Beck's Petrel may prove to be commoner than feared, it is almost certainly rarer today than it was historically. Drawing comparisons with other procellariiformes breeding in the Pacific the assumption that the population is probably declining (Birdlife International 2012) is a sensible one. As little is known about the ecology of Beck's Petrel we can only guess as to the nature and extent of any threats.

Invasive species are recognised as the greatest threat to seabirds, invariably active at breeding sites (Croxall *et al.* 2012). While we have outlined why the impact of invasive species on New Ireland may have been less acute than elsewhere in the Pacific, the current distribution of Beck's Petrel is probably limited geographically and altitudinally by invasive species. Species introduced since European exploration, like feral cats, are a potentially serious threat to extant populations. Any surveys for this species would need to be aware of 'opening-up' of forest paths to the arrival

of feral animals such as pigs and cats. These 'new' invasions of abundant 'lowland distributed' feral animals have been documented for remote breeding Newell's Shearwater *Puffinus newelli* in Kauai'i, Hawaiian Islands (Duffy 2010).

We presume that Beck's Petrel nests in dense forest cover like other petrels in the tropical Pacific. Such areas are relatively free from human disturbance and hunting pressure is likely to be low. Invasive species generally occur at lower densities here than in modified habitats. Therefore broad-scale habitat conversion represents a potential threat, although as likely nesting sites are at high elevation, possibly on steep slopes, or on remote islands the likelihood of a direct impact may be low. Forest conversion is occurring rapidly within the region owing to logging, mining and the expansion of oil palm plantations (Buchanan *et al.* 2008, Pauku 2009). It is projected that all lowland forest in the Solomon Islands will have been cleared by 2015 (Pauku 2009). Identifying nesting colonies will allow assessment of likely impacts from current and proposed mining, logging and oil palm concessions.

Future conservation actions

At this stage conservation actions relate to research rather than recovery actions. Locating the nesting grounds is imperative (BirdLife International 2012, Bird 2012). To this end there are a number of active field-based activities that should be pursued, but also more passive (and much cheaper) desk-based exercises that could inform future searches. These suggested actions have been loosely ordered to help readers visualize a systematic programme that would address highest priority needs first and identify subsequent priorities for the future.

- 1) Although the complete absence of any Beck's Petrel records from land precludes it, species distribution modelling could be attempted for Tahiti Petrel for which there is sufficient data on colony distribution. This might allow areas apparently appropriate for *Pseudobulweria* nesting to be identified in the Bismarck Archipelago and Solomon Islands. Similarly additional datasets exist, but were unavailable for our analyses, that could improve modelling the at-sea distribution of Beck's Petrel and inform future boat-based searches for the species outside the regularly visited areas identified in Figure 2. Even without this exercise the little visited seas around Rendova are an obvious target.
- 2) Spot-lighting at night has been used routinely to identify petrels on land at or near their nesting grounds (Warham 1996). Employing this technique within the putative range of Beck's Petrel is an obvious next step, particularly at Mt Agil in New Ireland. However, many years of similar effort yielded very few captures of Fiji Petrel on Gau, Fiji (Priddel *et al.* 2008, O'Connor 2012). Additionally, the training for local capacity to carry out such activities is difficult without experience in either the technique or its application to nocturnal seabirds, requiring significant time by experienced practitioners. Without a definite focused area for its application, the 'nil-report' for nights of effort dramatically reduces the effectiveness of this survey method in unsupervised programmes.
- 3) More successful has been the use of trained dogs to search for burrows. This focused effort requires a better understanding of potential smaller breeding islands and regions within larger landmasses that has yet to be determined. However, the application of detector dogs requires lead-in time for the procuring of suitable dogs. Substantial commitment is also needed by selected local residents. The local commitment is not only in the training to receive a suitably trained dog but in the on-going care and maintenance of the dog(s) and follow-up efforts to ensure they retain their searching skill-sets.
- 4) As is apparent from 2) and 3) above, in any recovery programme one of the highest priorities is to build capacity within key local communities surrounding a breeding site. With the breeding locations currently unknown and uncertainty surrounding their possible locations this aspect of the programme remains inactive. A strong current NGO presence within communities would be invaluable for addressing this issue.

- 5) A recent reassessment of the 2007 specimen (Table S1) confirmed it is a juvenile (G. Taylor *in litt.*). The specimen was collected in August, implying a breeding season beginning in March/April. Refining this breeding season is complicated by *rostrata* being known to produce fledglings at other locations almost year-round (Villard *et al* 2006). Nevertheless, trapping of Beck's Petrel at sea to determine breeding status (through presence of brood patches) may be warranted to corroborate this to identify optimal timing for any labour intensive land-based surveys. The employment of small craft in chumming for species less likely to approach large vessels has facilitated capture of individuals of other species at sea and its application to Beck's Petrel should be investigated. Success in the at-sea capture of the species would also allow for the attachment of two-stage transmitters for radio-tracking. However the terrain and elevation of potential breeding areas creates further complexities. Substantial effort by aircraft-based trackers with extensive experience with signal attenuation, impacts of vegetation and terrain on any search effort would be required for success using this technique. Obtaining morphometrics, vocal and tissue samples from any live specimens would be invaluable in determining the case for the specific status of Beck's Petrel from its close relatives.
- 6) Automated audio recording devices are being employed for surveys for New Zealand Storm-petrel *Oceanites maorensis* and Ashy Storm-petrel *Oceanodroma homochroa* (C. Gaskin, pers. comm., M. McKown pers. comm.). These have the potential to reduce the need for surveyors to be on-site to check for the presence of nocturnal seabirds. However, it is highly likely that Beck's Petrel will only vocalise at the breeding colony: if these are disbursed over large areas, similar to Magenta Petrel, then audio surveys will have limited value. Given the potential remoteness of the breeding areas of Beck's Petrel audio devices could be deployed following initial on-ground surveys.
- 7) When a colony site is identified specific research needs to address general ecology and breeding biology of Beck's Petrel. It will be essential to identify and ameliorate land-based threats causing egg, chick or adult mortality. Parameterising environmental factors particular to the site location of the colony will allow identification of comparable sites within the potential breeding range that could support additional colonies. Determination of the species' vocalisations will greatly assist discovery of additional breeding sites and help to resolve taxonomic relationships. An assessment of population size and trends will be essential in future management of this species.
- 8) Given that the threats to Beck's Petrel are unknown and may be either on land or at sea, revealing at-sea movements by deploying geolocation devices may provide vital clues to threats away from breeding colonies. However, as with other proposed actions, the application of geolocation devices, applied and removed at nest burrows, can only be attempted once the breeding sites have been identified.

Supplementary Material

The online supplementary materials for this article can be found at journals.cambridge.org/bci

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