Habitat Use and Status of the Bokikokiko or Christmas Island Warbler (*Acrocephalus aequinoctialis*)[1]

Eric A. VanderWerf,[2,5] *Ray Pierce,*[3] *Ratita Bebe,*[4] *and Katareti Taabu*[4]

Abstract: The Bokikokiko or Christmas Island Warbler (*Acrocephalus aequinoctialis*) is found only on Kiritimati (Christmas) and Teraina (Washington) Islands in the Republic of Kiribati. The population on Kiritimati Island is threatened by habitat degradation, sea level rise, and predation from feral cats (*Felis catus*), Pacific rats (*Rattus exulans*), and recently arrived black rats (*Rattus rattus*). There is scant information about distribution and abundance of the Bokikokiko. From 2007 to 2012, we conducted surveys with song playbacks at 83 points on 12 transects in the northern half of Kiritimati Island to measure abundance of the Bokikokiko and begin monitoring for possible declines associated with the spread of rats, and we collected habitat data to investigate factors that influenced Bokikokiko abundance. Song playbacks resulted in a 263% increase in detection rate over passive listening. We detected an average (±1 SE) of 0.63 ± 0.11 birds per point using playbacks. Average population density was 0.36 ± 0.06 birds per hectare, but abundance varied among regions, and no birds were detected in some areas with apparently suitable habitat. Range of the Bokikokiko encompassed an area of 14,180 ha but was fragmented by many lagoons and bare ground, and only about half that area was actually occupied. Estimated population size was 2,550 ± 425 birds. Bokikokiko were more abundant in areas with taller *Heliotropium* trees and taller *Scaevola* shrubs, and less abundant in areas with more *Suriana* shrubs, bare ground, and grass. Conservation actions needed for the Bokikokiko include ongoing removal of rats from islets within the lagoons of Kiritimati Island, protection of preferred habitat from development and fires, and translocations to create additional populations on rat-free atolls.

The Bokikokiko (*Acrocephalus aequinoctialis*) is a small passerine bird in the family Acrocephalidae. It is endemic to the Northern Line Islands and currently occurs on Kiritimati (Christmas) Island and Teraina (Washington) Island in the Republic of Kiribati. It formerly occurred on Tabuaeran (Fanning) Island (Tristram 1883*a*, Wetmore 1924) but was extirpated sometime between 1924 and 1963 (Bakus 1967, Clapp and King 1975). The I-Kiribati (Gilbertese) name sometimes has been written as Kokikokiko (Gallagher 1960, Clapp and King 1975), but Bokikokiko is the correct spelling. The most commonly used English name for the species is Christmas (or Kiritimati) Island Warbler (Birdlife International 2014), but some references have referred to it as the Line Island Warbler (Clapp and King 1975).

The first mention of the species was by Captain James Cook, who landed on

[1] The work on Kiritimati Island was funded by the Government of Kiribati, the New Zealand Ministry of Foreign Affairs and Trade, the New Zealand Department of Conservation, the Invasive Species Specialist Group (IUCN, Auckland, New Zealand), the Secretariat for the Pacific Regional Environment Programme (Apia, Samoa), and the British High Commission. Manuscript accepted 18 April 2016.

[2] Pacific Rim Conservation, 3038 O'ahu Avenue, Honolulu, Hawai'i 96822.

[3] 165 Stoney Creek Road, Speewah, Queensland 4881, Australia.

[4] Wildlife Conservation Unit, Kiritimati (Christmas Island), Kiribati.

[5] Corresponding author (e-mail: eric@pacificrimconservation.com).

Pacific Science (2016), vol. 70, no. 4:437–446
doi:10.2984/70.4.4

(CS6) UHP (7″×10″) Janson Text J-3077 Pacific Science, 70:4 pp. 437–446 PS_70-4_04 (p. 437)
PMU: (idp) 1/8/2016 15 August 2016 2:23 PM

Kiritimati Island on 25 December 1777, naming the island for the occasion of his visit, and described a "small bird like a hedge sparrow" (King 1955, in litt.; Gallagher 1960). The warblers on Teraina and Tabuaeran Islands originally were described as a separate species [*A. pistor* (Tristram 1883*b*)] from that on Kiritimati Island and were treated that way for some time (Wetmore 1925), but the birds from all three islands are now regarded as a single species with two subspecies, *A. a. aequinoctialis* on Kiritimati Island and *A. a. pistor* on Teraina and Tabuaeran (Clapp and King 1975). Higher-level taxonomy of this group of warblers also has changed. They were temporarily placed in the genus *Conopoderus* (Wetmore 1925, Gallagher 1960), and the family Acrocephalidae was recently split from the larger family Sylviidae (Fregin et al. 2009). There is no consistent difference in plumage color among birds on the three islands, but the birds on Kiritimati Island are significantly smaller than those on Washington and Fanning, and males on Tabuaeran tended to be slightly smaller than those on Teraina (Clapp and King 1975). There is thus a gradient of increasing body size with increasing latitude, following Bergmann's rule (VanderWerf 2011). Males are larger than females in average wing length, but there is some overlap (Clapp and King 1975).

The Bokikokiko is considered endangered by the International Union for the Conservation of Nature (Birdlife International 2012). Primary threats to the species are predation by nonnative black rats (*Rattus rattus*), Pacific rats (*R. exulans*), and feral cats (*Felis catus*); habitat loss and degradation from human development; clearing of land for coconut plantations; wildfires; sea-level rise; and the limited range and small population size of the species (Birdlife International 2012).

Black rats arrived recently on Kiritimati Island, possibly involving multiple introductions in the past 35 yr (Pierce et al. 2013). Predation by black rats has caused the decline and extinction of many island birds (Atkinson 1985, Blackburn et al. 2004, Steadman 2006, Trevino et al. 2007, VanderWerf 2009). The spread of black rats on Kiritimati Island has been surprisingly slow so far and they currently occur primarily in areas inhabited by people and along the coast on the northeastern side of the atoll (Pierce et al. 2013). Bokikokiko have disappeared from some areas in the northern part of the atoll where increasing human settlement has altered the vegetation, but otherwise we have not seen any obvious decline in Bokikokiko. It is possible, however, that black rats could increase on the island quickly and cause rapid population decline or even extirpation of the Bokikokiko. Introductions of black rats have had little effect on reed-warbler populations in the Marquesas and Tuamotu archipelagoes (Thibault et al. 2002, Cibois et al. 2009). However, the severity of the threat posed by rat predation may vary among and within species based on various life history attributes and environmental factors, such as nest height, nest position within a tree, plant species used for nesting, and distribution and availability of other rat food (Cibois et al. 2008, VanderWerf 2012).

There is scant historical information about the distribution and abundance of the Bokikokiko. Clapp and King (1975) estimated the population on Kiritimati Island to be 300–400 birds in the 1960s, and Schreiber (1979) suspected that estimate was still accurate. Sherley (2001) reported that the population was 400 birds. On Washington Island, Clapp and King (1975) reported that estimates from five visits ranged from less than a hundred birds to perhaps 2,000, with a few hundred birds probably a reasonable assumption. However, all of those estimates were based on anecdotal information and not on surveys, and the actual population sizes are unknown. There is no information about population trend, and no quantitative baseline against which to measure any changes in abundance.

In 2007, we began surveys of Bokikokiko on Kiritimati Island using point counts with playbacks in an effort to measure abundance and monitor for possible declines associated with the spread of black rats across the atoll (Pierce et al. 2007, VanderWerf and Young 2007, Pierce et al. 2013). We also collected vegetation data at survey points to investi-

(CS6) UHP (7″×10″) Janson Text J-3077 Pacific Science, 70:4 pp. 438–446 PS_70-4_04 (p. 438)
PMU: (idp) 1/8/2016 15 August 2016 2:23 PM

gate habitat characteristics that influence Bokikokiko abundance.

MATERIALS AND METHODS

We used point counts to measure abundance of Bokikokiko in different regions of Kiritimati Island. During trials in June 2007, we conducted 3-min surveys with and without playbacks of recorded male Bokikokiko territorial songs at 12 points to determine whether playbacks increased detection probability and survey efficiency. We used a paired *t* test to compare the numbers of birds detected with versus without playback. Playbacks increased the detection rate by 263% over passive surveys (see Results). We therefore used playbacks in all subsequent surveys.

We established 83 survey points at 200-m intervals along 12 transects in several regions in the northern half of the atoll (Figure 1). Transects varied in length depending on the distribution of suitable habitat. We surveyed some transects only once, in 2007, but other transects were surveyed again in 2009, 2010, and 2012. All surveys were conducted from April to June during the Bokikokiko breeding season. At each point, we broadcast Bokikokiko vocalizations for 1 min using a hand-held speaker, then looked and listened

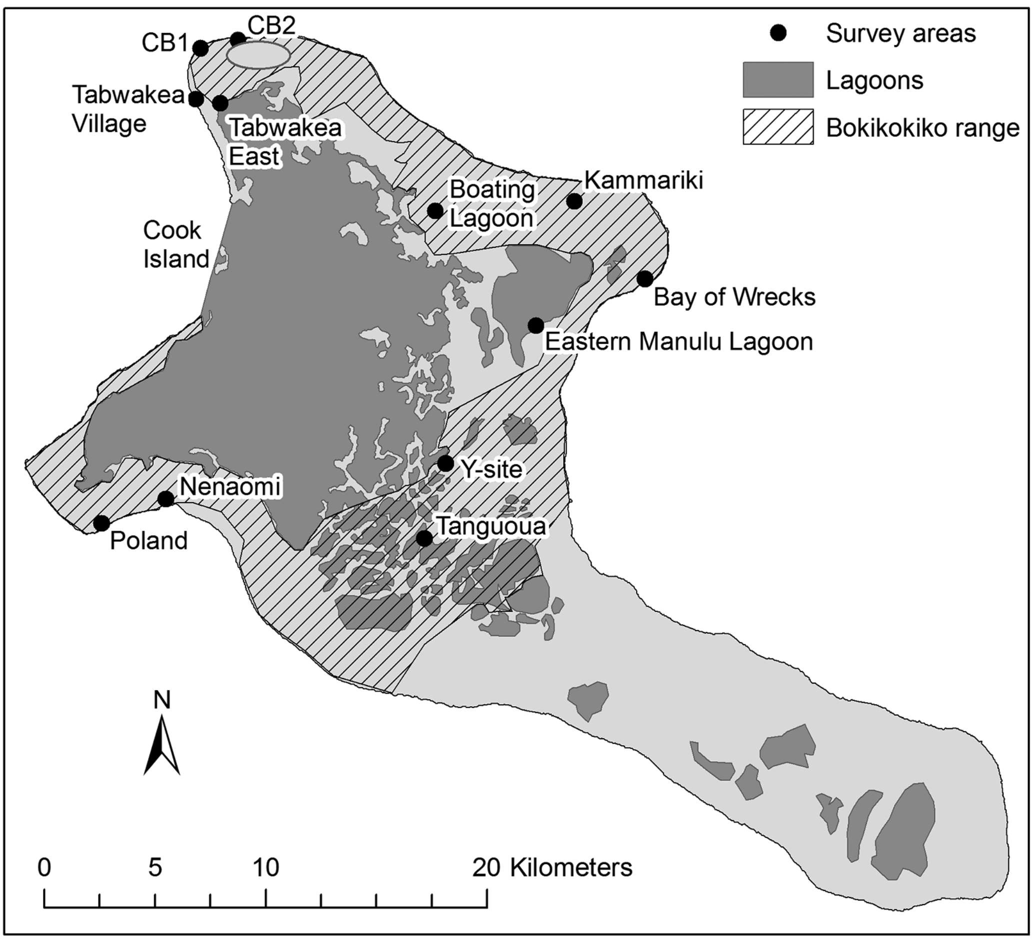

FIGURE 1. Range of the Bokikokiko and survey locations on Kiritimati Island, Kiribati.

for birds for an additional 2 min. All birds observed during the 3-min count period were noted. The area effectively surveyed from each point varied depending on the vegetation density and height, but the same birds were only occasionally detected at consecutive points. We estimated that the effective detection radius was about 75 m on average, in which case the area we surveyed at each point was about 1.77 ha. We calculated a population density estimate by dividing the number of birds detected by the area surveyed at each point. For transects that were surveyed more than once, we used data from 2007 to calculate baseline abundance, and we calculated abundance in subsequent years separately to examine patterns over time.

We constructed a range map of the Bokikokiko based on the locations where we did and did not observe birds, supplemented with anecdotal observations made during the surveys and experience of the Kiritimati Island Wildlife Conservation Unit. In areas where there were no surveys or anecdotal observations, we used presence of suitable habitat to determine whether an area should be included, based on either direct observation or inspection of Google Earth images. We calculated a rough estimate of the total population by multiplying the average density of birds detected during surveys by the total range.

At each point we collected the following habitat data: maximum height of the two most common and tallest plant species (*Scaevola taccada* and *Heliotropium foertherianum*), percentage cover of all plant species, and percentage bare ground. We deliberately located transects in areas where Bokikokiko were known to occur or with dense habitat that appeared suitable for Bokikokiko, so the plant abundances reported below are higher than average for the atoll as a whole. We recorded presence or absence of *Cassytha filiformis* instead of percentage cover because this vine often grew on top of other plants. We investigated habitat preferences of Bokikokiko with a multiple regression analysis, using number of Bokikokiko recorded at each point as the response variable and the previously listed habitat measures as predictive variables.

RESULTS

During trials in June 2007, we detected more birds during 3-min surveys at the same 12 points with playbacks (2.42 ± 0.36) than during 3-min passive surveys without playback (0.92 ± 0.26; $t = 9.95$, $P < .001$), resulting in a 263% increase in detection rate. Bokikokiko usually responded quickly to the playbacks; the average time to the first response was 20 ± 4 sec (range 2–50 sec). Often males and females, and sometimes family groups, responded together.

The average number of Bokikokiko we detected at all points surveyed in 2007 (±1 SE) was 0.63 ± 0.11. This corresponded to an average abundance of 0.36 ± 0.06 birds per hectare. Abundance varied among different regions of the island, and no birds were detected in some areas with apparently suitable habitat (Table 1). The estimated range of the Bokikokiko encompassed an area of 14,180 ha (Figure 1), though we suspect that they actually occupied only about half of that area because it was fragmented by unsuitable habitat such as lagoons and bare ground. When the average density was extrapolated to half the area of the entire range, the total estimated population size was $2,550 \pm 425$ birds.

In regions that were surveyed in more than 1 yr, abundance of Bokikokiko appeared

TABLE 1

Bokikokiko Abundance on Kiritimati Island by Region

Region	No. of Survey Points	Detections (Birds/Point)	Abundance (Birds/ha)
Bay of Wrecks	3	0	0
Boating Lagoon	10	0.20 ± 0.13	0.11 ± 0.07
Crystal Beach 1	10	0.50 ± 0.22	0.28 ± 0.12
Crystal Beach 2	10	0.70 ± 0.40	0.40 ± 0.23
Eastern Manulu Lagoon	5	0	0
Kammariki	10	1.63 ± 0.39	0.92 ± 0.22
Nenaomi	3	0	0
Poland	3	0.67 ± 0.33	0.38 ± 0.19
Tabwakea Village	5	0	0
Tabwakea East	9	0.11 ± 0.11	0.06 ± 0.06
Tanguoua	10	1.10 ± 0.28	0.62 ± 0.16
Y site	5	0.40 ± 0.40	0.23 ± 0.23
Total all regions	83	0.63 ± 0.11	0.36 ± 0.06

(CS6) UHP (7″×10″) Janson Text J-3077 Pacific Science, 70:4 pp. 440–446 PS_70-4_04 (p. 440)
PMU: (idp) 1/8/2016 15 August 2016 2:23 PM

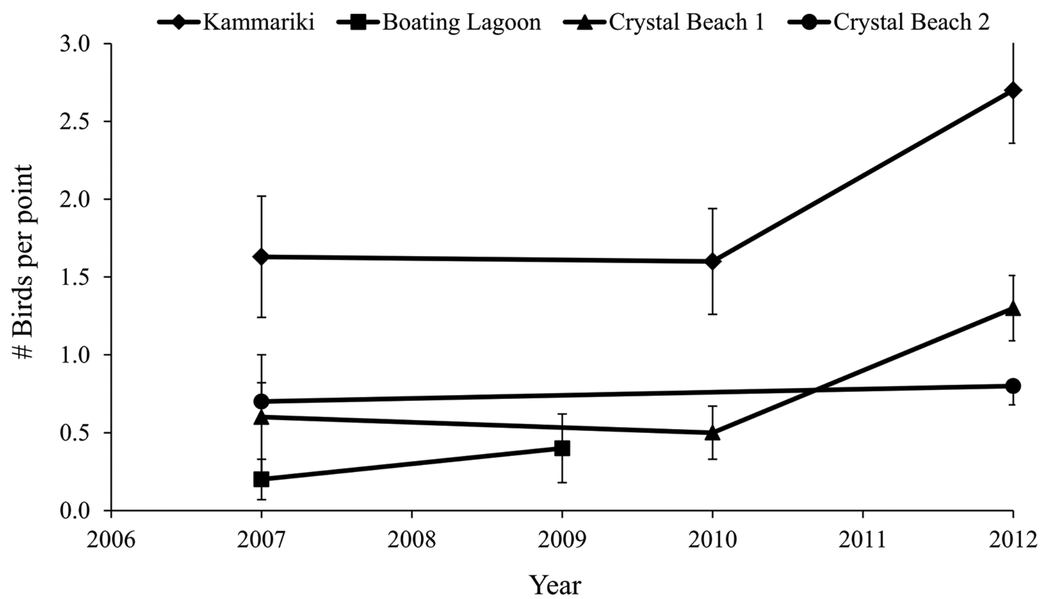

Figure 2. Abundance of Bokikokiko over time in four regions of Kiritimati Island.

TABLE 2

Habitat Measurements on Kiritimati Island at Survey Points for Bokikokiko, and Results of Multiple Regression Analysis Used to Investigate Habitat Preferences of Bokikokiko

Habitat Variables	Mean ± SE	Regression Coefficient	*t* Value	*P* Level
Scaevola height (m)	1.6 ± 0.1	0.40	2.42	.02
Heliotropium height (m)	3.1 ± 0.1	0.19	2.14	.03
Scaevola cover (%)	22.4 ± 1.4	0.01	0.95	.35
Bare ground (%)	20.1 ± 1.3	–0.02	–2.62	.01
Grass cover (%)	17.1 ± 1.3	–0.02	–2.26	.03
Heliotropium cover (%)	10.2 ± 0.5	0.01	0.73	.47
Suriana cover (%)	10.0 ± 1.4	–0.01	–2.10	.04
Cocos cover (%)	9.7 ± 1.0	–0.01	–0.92	.36
Sesuvium cover (%)	2.4 ± 0.6	—	—	—

Note: Positive regression coefficients indicate preference, negative regression coefficients indicate avoidance. Grasses included *Lepturus repens*, *Digitaria setigera*, and *Eragrostis tenella*.

generally stable over time, though the small sample sizes and short time series prevented quantitative assessment (Figure 2). Abundance was higher in 2012 at Kammariki and Crystal Beach 1 because more juveniles were detected that year.

The plant species with greatest cover in Bokikokiko habitat on Kiritimati Island were, in descending order, *Scaevola taccada*, grasses (including *Lepturus repens*, *Digitaria setigera*, and *Eragrostis tenella*), *Heliotropium foertherianum*, *Suriana maritima*, and coconut (Table 2). All other plant species accounted for <2% of ground cover. Bare ground also was common, accounting for 20% of the land area.

Regression analysis showed that Bokikokiko abundance on Kiritimati Island was related to habitat ($F = 3.56$; df = 8, 145; $P = .001$). Significant predictors of Bokikokiko abundance included *Scaevola* height, *Heliotropium* height, grass cover, *Suriana* cover, and amount of bare ground (Table 2). Bokikokiko were more abundant in areas with taller *Heliotropium* and taller *Scaevola*, and less abundant in areas with more *Suriana*, bare ground, and grass. The regression analysis did not detect a relationship between abundance of Bokikokiko and coconut trees (Table 2), but Bokikokiko were found only in areas with low coconut abundance, no greater than 25% canopy cover; they were not found in dense coconut plantations.

DISCUSSION

This study provides the first large-scale data on abundance and distribution of the Bokikokiko. The average population density we found, 0.36 ± 0.06 birds per hectare, was somewhat lower than that found in a small area by Milder and Schreiber (1982), who reported six pairs in a 20-ha area, or an average territory size of 3.3 ha and a population density of 0.61 birds per hectare. Birdlife International (2012) reported the territory size to be 1.8–2.3 ha, but the source of that information was not provided. Our results also showed that population density varied among different regions of the atoll, and that birds were absent from some regions with apparently suitable habitat.

Our population estimate of $2{,}550 \pm 425$ birds may be an overestimate and should be interpreted with caution. Our surveys did not include areas with unsuitable habitat and deliberately were focused on areas where Bokikokiko were known or likely to occur, with the goal of monitoring abundance for any signs of decline (Pierce et al. 2013). Bokikokiko are thought to be sparsely distributed or absent in the southern half of the atoll, but more thorough searching might reveal some birds in that region.

The range of the Bokikokiko was geographically complex and fragmented by the large central lagoon, many smaller lagoons, and large areas of bare ground. Bokikokiko are sedentary and generally do not cross large gaps of open water or other unsuitable habitat. They have crossed water gaps up to 200 m wide to recolonize small islets from which rats have been eradicated, but Cook Island, 2 km from the peninsulas on either side of the mouth of the central lagoon, is not occupied and contains suitable habitat. The effective population size therefore is smaller than the estimated population size because birds cannot disperse freely among many parts of the range. The Bokikokiko could qualify for endangered status under IUCN criteria based on the population estimate, the limited geographic range on just two small atolls, and the potential for declines in population size and range caused by predation by black rats and habitat degradation (IUCN 2001).

The preference shown by Bokikokiko for taller *Heliotropium* and *Scaevola* is not surprising given their ecology and behavior. All Bokikokiko nests found on Kiritimati Island have been in *Heliotropium foertherianum* trees, and always in a branch fork just below the crown, including 15 nests found by Schreiber (1979), one by Milder and Schreiber (1982), and three by E. VanderWerf and R. Pierce in June 2007 and June 2012 (Figure 3). Schreiber (1979) speculated that this position in the tree and the large leaves of this plant helped to shield the nest from sun and rain. The average height of 15 nests found by Schreiber (1979) was 5.3 m (range 1.8–8.2 m). Milder and Schreiber found a nest 2 m high in a 5-m-tall heliotrope. Schreiber (1979) and Milder and Schreiber (1982) both commented that only large, mature heliotrope trees were used for nesting, and that the abundance of suitably large trees might limit the population. Our results support this conclusion; the average height of nests found by Schreiber (1979; 5.3 m) was higher than the average height of *Heliotropium* trees in our study (3.1 m). Although Bokikokiko sometimes forage on the ground and use grass in making nests, they were less numerous in areas with more bare ground and grass. The shrub *Suriana maritima* also had a negative relationship with Bokikokiko abundance, probably because it often grew in poor alkaline soil on

Figure 3. Bokikokiko nests. *Left*, in *Heliotropium foertherianum* tree on Kiritimati Island, June 2007 (photo: E. VanderWerf). *Right*, in *Cyperus javanicus* sedges on Teraina Island, September 2012 (photo: R. Bebe).

lagoon edges that supported only sparse vegetation.

On Teraina Island, Bokikokiko have been observed foraging and nesting in different plant species that are rare or do not occur on Kiritimati Island. In September 2005, Alex Wegmann (University of Hawai'i) observed Bokikokiko foraging in *Pisonia grandis* and *Neisosperma oppositifolium* trees. Only a single inactive nest has been reported on Teraina Island, which was found in September 2012 by R. Bebe and was located in dense sedges (*Cyperus javanicus*) surrounding a freshwater lake (Figure 3). These observations demonstrate that Bokikokiko can use a variety of plant species and probably are adaptable. Additional observations on Teraina Island, where the habitat differs from and is wetter than that on Kiritimati Island, likely would reveal use of a wider variety of plants.

Warblers of the genus *Acrocephalus* exhibit considerable behavioral and ecological flexibility, and this adaptability has allowed various species to colonize some of the most remote islands in the Pacific and Indian Oceans (Pratt et al. 1987, Cibois et al. 2011). Most *Acrocephalus* species in Eurasia, Africa, Australia, and the islands of Micronesia and Melanesia inhabit wetlands (del Hoyo et al. 2006), leading to their common name of "reed-warblers." In contrast, on Polynesian islands *Acrocephalus* warblers inhabit a variety of habitats, including humid forest in montane areas; shrubby vegetation in dry, lowland areas; secondary forests and cultivation in valleys or along the shore; and even village gardens (Thibault and Cibois 2006, Cibois et al. 2007, 2008). Reed-warblers thus exhibit broader habitat use on remote islands than their continental counterparts (Cibois et al. 2007), thereby illustrating a typical pattern of insular niche enlargement (Keast 1970).

The small population size of the Bokikokiko and its restricted distribution on two low-lying atolls, in addition to the potential spread of black rats on Kiritimati Island, are cause for concern about the persistence of the species. In an effort to create rat-free refugia on Kiritimati Island, black rats and Pacific rats have been removed from 20 small islets within the lagoons, some of which have been colonized by Bokikokiko (R. Pierce and Kiritimati Wildlife Unit, unpubl. data). Protecting areas of preferred habitat consisting of tall

Heliotropium and *Scaevola* from development and fire also would aid in the conservation of the species. The status and abundance of Bokikokiko on Teraina Island are poorly known; additional information about that population is needed. Establishing additional populations by translocation to rat-free islands would decrease extinction risk (Seddon et al. 2007, Seddon 2010). A second population of a related species, the Millerbird (*A. familiaris*), was created recently by translocation from Nīhoa to Laysan in the Hawaiian Islands (Freifeld et al. 2016). Black rats were eradicated from Palmyra Atoll in 2011 (Wegmann et al. 2012), which is located in the Northern Line Islands 640 km northwest of Kiritimati Island. Palmyra contains suitable habitat for Bokikokiko and supports higher densities of the preferred plant species (VanderWerf 2014), and is now a suitable translocation site for the Bokikokiko. Within the Republic of Kiribati, rat eradications are planned on several atolls in the Phoenix Islands Protected Area, of which Orona would be a good candidate for Bokikokiko translocation. Finally, eradication of rats from all of Kiritimati Island would greatly benefit the Bokikokiko but would be a complex undertaking that would require considerable preparation. Translocation of Bokikokiko to other rat-free locations in the interim would help to secure the species in the short term.

ACKNOWLEDGMENTS

For assistance with Bokikokiko surveys, we thank Aobure Teatata, Uriam Anterea, Bio Eberi, Ibeatabu Katabanin, Ngauea Rabaua, Aana Tetari (all Wildlife Conservation Unit, Kiritimati), and Richard Anderson, Lindsay Young, and Henry Genthe. We also thank Alex Wegmann for his observations on Bokikokiko from Teraina Island, and Reuben Wolff for assistance with GIS files and maps. The manuscript was improved by comments from two anonymous reviewers.

Literature Cited

Atkinson, I. A. E. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on island avifaunas. Pages 35–81 *in* P. J. Moors, ed. Conservation of island birds. ICBP Technical Publication no. 3. International Council for Bird Preservation, Cambridge.

Bakus, G. J. 1967. Changes in the avifauna of Fanning Island, central Pacific, between 1924 and 1963. Condor 69:207–209.

BirdLife International. 2012. *Acrocephalus aequinoctialis*. *In:* IUCN, 2013, IUCN Red List of Threatened Species. Version 2013.2. www.iucnredlist.org. Accessed 29 May 2014.

Blackburn, T. M., P. Cassey, R. P. Duncan, K. L. Evans, and K. J. Gaston. 2004. Avian extinction and mammalian introductions on oceanic islands. Science (Washington, D.C.) 305:1955–1958.

Child, P. 1956. Birds of the Gilbert and Ellice Islands Colony. Education Department, Gilbert and Ellice Islands Colony.

Cibois, A., J. S. Beadel, G. R. Graves, E. Pasquet, B. Slikas, S. A. Sonsthagen, J.-C. Thibault, and R. C. Fleischer. 2011. Charting the course of reed-warblers across the Pacific islands. J. Biogeogr. 38:1963–1975.

Cibois, A., J.-C. Thibault, and E. Pasquet. 2007. Uniform phenotype conceals double colonization by reed-warblers of a remote Pacific archipelago. J. Biogeogr. 34:1150–1166.

———. 2008. Systematics of the extinct reed warblers *Acrocephalus* of the Society Islands of eastern Polynesia. Ibis 150:365–376. doi:10.1111/j.1474–919X.2008.00800.x.

———. 2010. Influence of quaternary sea-level variations on a land bird endemic to Pacific atolls. Proc. R. Soc. Lond. B Biol. Sci. 2010:277. doi:10.1098/rspb.2010.0846.

Clapp, R. B., and W. B. King. 1975. Status of the Kokikokiko *Acrocephalus aequinoctialis*. Bull. Br. Ornithol. Club 95:2–3.

del Hoyo, J., A. Elliot, and D. Christie, eds. 2006. Handbook of the birds of the world. Vol. 11. Old World flycatchers to Old World warblers. Lynx Edicions. ISBN 84-96553-06-X.

Fregin, S., M. Hasse, U. Olsson, and P. Alström. 2009. Multi-locus phylogeny of the family Acrocephalidae (Aves: Passeriformes): The traditional taxonomy overthrown. Mol. Phylogenet. Evol. 52:866–878.

Freifeld, H., S. Plentovich, C. Farmer, R. Kohley, P. Luscomb, T. Work, D. Tsukayama, G. Wallace, G. Wallace, M. MacDonald, and S. Conant. 2016. Nihoa Millerbird translocation from Nihoa to Laysan, Northwestern Hawaiian Islands, USA. Pages 111–116 *in* P. S. Soorae, ed. Global re-introduction perspectives: 2016. IUCN/SSC Re-introduction Specialist Group. Gland, Switzerland.

Gallagher, M. D. 1960. Bird notes from Christmas Island, Pacific Ocean. Ibis 102:489–502.

Keast, A. 1970. Adaptive evolution and shifts in niche occupation in island birds. Biotropica 2:61–75.

Milder, S. L., and R. W. Schreiber. 1982. Notes on the nesting behavior of *Acrocephalus aequinoctialis*. Bull. Br. Ornithol. Counc. 102:20–22.

Pierce, R., R. Anderson, E. VanderWerf, and L. Young. 2007. Surveys and capacity building in Kiritimati (Christmas Island, Kiribati), June, to assist in restoration of populations of Bokikokiko and seabirds. Unpubl. report to the Government of Kiribati and the Secretariat for the Pacific Regional Environment Programme.

Pierce, R., D. Brown, and E. VanderWerf. 2013. Guidelines for monitoring birds and invasive species at Kiritimati, Kiribati. Unpubl. report to the Government of Kiribati, Department of Conservation, and the Secretariat for the Pacific Regional Environment Programme. October.

Pratt, H. D., P. L. Bruner, and D. G. Berrett. 1987. A field guide to the birds of Hawaii and the tropical Pacific. Princeton University Press, Princeton, New Jersey.

Schreiber, R. W. 1979. The egg and nest of the Bokikokiko *Acrocephalus aequinoctialis*. Bull. Br. Ornithol. Club 99:120–124.

Seddon, P. J. 2010. From reintroduction to assisted colonization: Moving along the conservation translocation spectrum. Restor. Ecol. 18:796–802.

Seddon, P. J., D. P. Armstrong, and R. F. Maloney. 2007. Developing the science of reintroduction biology. Conserv. Biol. 21:303–312.

Sherley, G. 2001. Bird conservation priorities and a draft avifauna conservation strategy for the Pacific islands region. South Pacific Regional Environment Programme, Samoa.

Steadman, D. W. 2006. Extinction and biogeography of tropical Pacific birds. University of Chicago Press, Chicago.

Thibault, J., and A. Cibois. 2006. The natural history and conservation of *Acrocephalus rimitarae*, the endemic reed-warbler of Rimatara Island, Oceania. Bull. Br. Ornithol. Club 126:201.

Trevino, H. S., A. L. Skibiel, T. J. Karels, and F. S. Dobson. 2007. Threats to avifauna on oceanic islands. Conserv. Biol. 25:125–132.

Tristram, H. B. 1883*a*. Notes on the birds of Fanning Island, Pacific. Ibis 25:46–48.

———. 1883*b*. On the position of the acrocephaline genus *Tatare*, with descriptions of two new species of the genus *Acrocephalus*. Ibis 25:38–46.

VanderWerf, E. A. 2009. Importance of nest predation by alien rodents and avian poxvirus in conservation of Oahu elepaio. J. Wildl. Manage. 73:737–746.

———. 2011. Ecogeographic patterns of morphological variation in elepaios (*Chasiempis* spp.): Bergmann's, Allen's, and Gloger's rules in a microcosm. Ornithol. Monogr. 73:1–34.

———. 2012. Evolution of nesting height in an endangered Hawaiian forest bird in response to a non-native predator. Conserv. Biol. 26:905–911.

———. 2014. Assessment of Palmyra Atoll as a translocation site for the Bokikokiko or Line Island Warbler. Unpubl. report prepared for Island Conservation, the U.S. Fish and Wildlife Service, and The Nature Conservancy.

VanderWerf, E. A., and L. C. Young. 2007. Training with Wildlife Conservation Unit of Kiritimati for bird and invasive pest monitoring. Unpubl. report to the Wildlife Conservation Unit, Kiritimati Island, Kiribati. June.

Wegmann, A., E. Flint, S. White, M. Fox, G. Howald, P. McClelland, A. Alifano, and R. Griffiths. 2012. Pushing the envelope in paradise: A novel approach to rat eradication at Palmyra Atoll. Pages 48–53 *in* R. Mimm, ed. Proceedings of the 25th Vertebrate Pest Conference, University of California, Davis.

Wetmore, A. 1925. A note on the Fanning Island Warbler. Condor 27:212.

(CS6) UHP (7″×10″) Janson Text J-3077 Pacific Science, 70:4 pp. 446–446 PS_70-4_04 (p. 446)
PMU: (idp) 1/8/2016 15 August 2016 2:23 PM