May 2013 Progress report for the joint USGS-USFWS study:

The status and movements of an expanding population of Bristle-thighed Curlew (*Numenius tahitiensis*) on the James Campbell National Wildlife Refuge

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We initiated this study in 2012 because the Bristle-thighed Curlew is a species of conservation concern in all national, international, and state Shorebird Conservation Plans throughout its range. And, recently, the United Nations Environmental Programme (UNEP) amended the Convention on the Conservation of Migratory species (CMS) to place the Bristle-thighed Curlew on both its Appendix 1 list as a globally threatened species and on its list of species needing concerted regional action (one of only two shorebird species to have this status). A multi-national, range-wide action plan, involving all parties to the CMS (including the U.S.), will start to be developed in 2013. We hope that information from our study will help guide this effort since few data exist on many aspects of the winter ecology of curlews.

The curlew is a species of conservation concern because of its small population size of about 10,000 birds (including 6,400 breeders), restricted breeding areas (2 small regions of Alaska), and

increasing threats across its winter range related to predation, human activities, and sea-level rise (Marks et al. 2002). The curlew is the only migratory shorebird whose entire wintering population is restricted to the islands of the Pacific, the vast majority occurring on low-lying atolls. The curlew is also unique among shorebirds in that a portion of its population goes flightless during molt, thus intensifying its vulnerability to introduced mammals (Marks et al. 2002). Based on estimates from the late 1980s and early 1990s, the Northwestern Hawaiian Islands supports the highest concentration of curlews during winter, roughly 800 birds, or 8% of the estimated world population (Marks and Redmond 1994) across several widely scattered atolls and islands. The recent influx of curlews into James Campbell National Wildlife Refuge (NWR) on O'ahu provides a timely opportunity to investigate the species' behavioral flexibility and to assess its habitat needs on high islands. In the past 10 years, wintering counts on James Campbell NWR have increased from just a few sightings per year to counts of over 65 birds in winter. Interestingly, sightings also have recently increased on other main Hawaiian islands such as Moloka'i. Whether the growing population on James Campbell NWR represents a new population or displaced birds from the Northwestern Hawaiian Islands or elsewhere, is unknown. Regardless, threats to curlews are numerous in Oceania and increasing in scope. Major threats that are contributing to the loss of suitable wintering areas include human disturbance to winter habitats, predation by invasive mammals, climate change and accompanying sea level rise. Impacted traditional wintering areas will likely have to be augmented or even replaced at other locations to help perpetuate this species.

Our goals and objectives for this current effort are to measure key demographic parameters and monitor bird movements at various scales to better understand the current status of curlews on James Campbell NWR. Such information will help manage for their continued existence on the refuge and help anticipate potential range expansion onto the main Hawaiian Islands. Where possible, we will compare data across the only other wintering sites with curlew data (i.e., Jeff Marks' Laysan study in the 1990s and USFWS' current Palmyra dataset) to take advantage of the power of comparative approaches. Important to note is that within James Campbell NWR, the fenced 130 acre Ki'i wetland unit has an on-going, year-round exotic predator control program which excludes dogs (fencing) and targets other exotic predators such as mongoose, rats, and cats to benefit the endangered Hawaiian waterbirds that use these wetlands.

We plan to obtain the first measures of: (a) age structure of the refuge population (ratios of the 4 age classes will allow us to make inferences about population growth); (b) breeding origin and kinship of James Campbell and Palmyra birds (genetic links to the Alaska breeding areas and degree of relatedness of individuals within the populations from analysis of DNA samples); (c) local movements (in relation to time of day, habitat, and predator levels); (d) inter-island movements (to assess site fidelity and vulnerability); and (e) migratory movements (to help identify spring and fall routes and staging areas). To date we've made good progress on several of the objectives, and data collection and analysis are ongoing and will continue through next year. Below, please see some highlights:

Population size, sex and age structure

Since initiating the field work in September 2012, we have established a cohort of 35 individually marked birds on the refuge; we captured and marked 15 males and 18 females and resighted 1 male and 1 female that had previously been marked on the Yukon Delta NWR during Kristine Sowl's recent breeding study there. This cohort will make it possible to more accurately estimate the size of the population on the refuge during surveys and censuses. After experimenting with several capture

methods, we found that a bungee-powered whoosh net worked best for capturing birds in refuge habitats. Birds were sexed based on bill shape (later verified with molecular sexing) and were aged based on age-specific plumage and molt patterns. This photo shows an adult female in active molt with old outer primaries, new inner primaries growing in, and old tail feathers.

We conducted our initial age scans early in the fall when hatch-year and after-hatch-year birds were easily distinguishable. We will conduct further age scans to distinguish the 4 age classes at key times during the annual molt cycle as all 4 age classes time their prebasic molt differently. For example, second year birds begin their prebasic molt in April while third year birds begin in July.

Breeding origin and relatedness

We collected blood and feather samples from the 33 birds captured on James Campbell NWR plus 20 birds sampled on Palmyra during a different effort in 2011. We can assign these wintering individuals to 1 of the 2 distinct breeding areas in Alaska and also assess their degree of kinship using standard genetic techniques and molecular markers developed at USGS-ASC specifically for Bristle-thighed Curlews (Talbot et al. 2004, Williams et al. 2012). To date, all DNA has been extracted from samples and prepared for analysis. This analysis is expected to be completed by late fall.

Local movements and space use of the refuge

Between November and February, we conducted twice-weekly surveys along the road system of the refuge and some adjacent private lands where curlews were known to occur. During surveys, we mapped locations and assessed behavior of all banded and non-banded curlews observed. Concurrently, we collected information on environmental conditions (e.g., pond water levels). Once analyzed, these data will provide the first comprehensive picture of curlew use of refuge habitats. Importantly, the use and relationship of nearby private lands to the refuge population of curlews will also be better understood.

At a smaller scale, and to characterize diurnal movements, we set up 4 field cameras in representative portions of the main refuge ponds (Ki'i ponds) and took photos every 5 minutes for 2 months. A cursory assessment of the > 30,000 photos suggests that curlews can be present in the ponds at all times of day and night, and that use is highly variable.

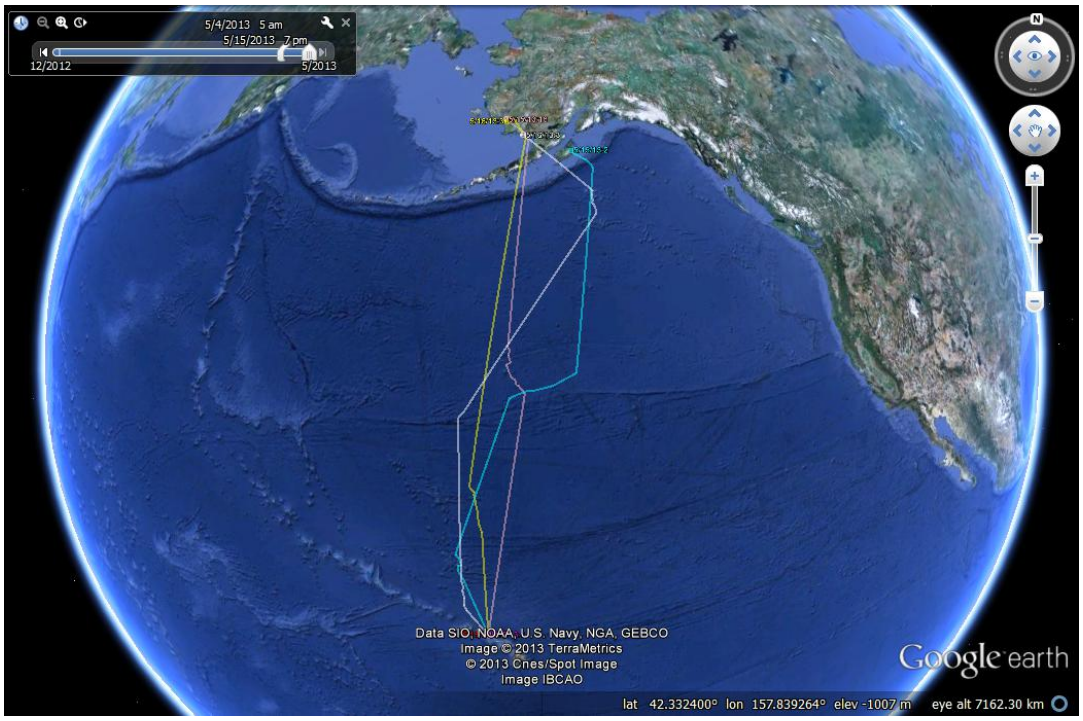
Inter-island and migratory movements

In December, we fitted 6 adult curlews (3 males, 3 females) with small solar-powered, Argos satellite transmitters to track larger scale movements. Four of the satellite tags are providing high quality data (~ 6 locations per bird every 1.5 days) and two are providing high quality, but fewer data (~ 2 locations per bird every 1.5 days). Differences in reporting appear to be related to battery charge levels. So far we have learned that, although these curlews appear to spend most of their time on the refuge, they also regularly use areas on private lands a few kilometers north (near the Old Runway ponds) and south (south point of Kahuku golf course) during the day. It also appears that tagged curlews routinely return to the refuge Ki'i Unit at night to roost. Please see the two figures at the end of this report for an example of these local movements.

Interestingly, we also tracked some late winter inter-island movements with individuals flying to Moloka'i and Ni'hau for a day, a bird flying a big loop (> 500 km) one night out over Kaua'i, and one bird flying to the south tip of Hawai'i Island and back to the refuge within 1.5 days. The image below depicts the Moloka'i and Kaua'i trips; birds are represented by different colors, dots are locations picked up by the Argos satellites, and lines show interpolated movements between data points. If we assume that the 6 satellite-tagged birds are representative of the population at large (and, that seems like a reasonable assumption), then it is likely many of the James Campbell curlews are making such trips. Reasons for such trips are unclear at the moment.

Northward migration recently commenced and, as of 16 May, four birds have reached Alaska. As expected, birds are flying nonstop and using the winds to their advantage. One bird took less than three days to make the >4,500 km flight. A bit unexpected, but reasonable in this year of a late spring, is that

the four have stopped in southwest Alaska as seen in the tracks in the image below. Questions we are hoping to start to answer are what types of weather systems the migrants use and the importance of pre-breeding staging sites in Alaska.



To increase our sample size to detect large scale movements, we've put light-level geolocators on 8 birds. The geolocators will provide information on migration timing, general routes, and inter-island movements, but we will need to recapture the birds to recover the data. Finally, we hope to assess the value of using another method (stable isotope analysis) to detect inter-island movements of curlews (or conversely, their winter site fidelity). We collected molted feathers on O'ahu, Midway, and Palmyra and, in a future effort, will investigate if the stable isotope signatures of these feathers reflect the island on which the birds grew them the previous year. If the signatures are different, then this would point to movements between years. Compared to satellite telemetry, stable isotope analyses of movements are relatively inexpensive and non-invasive, however, the spatial resolution is not as great.

Upcoming fieldwork for the current grant

Conduct age ratio surveys in mid-summer (late June) and early fall (late August or early September). Deploy the remaining geolocators in early fall <u>if</u> we are successful in recapturing the first geolocatored cohort. Conduct refuge-wide census in mid-summer and early fall using simultaneous count at all sites and the marked to unmarked ratios to assess detectability and movements. The census in mid-summer will estimate the size of the non-breeding portion of the population and the census in early fall will estimate the size of the entire wintering population on the refuge.

Some potential fieldwork for future grants

To gain a more comprehensive view of winter ecology of curlews it would be useful to conduct concurrent studies at other wintering areas, both those without curlew predators (e.g., Midway, Palmyra are relatively accessible) and those with predators (e.g., James Campbell NWR and most sites in Oceania, the latter not very accessible). For example, measuring the effects of food availability and predator levels on survival, health/body condition, and local movements could help guide local management plans in the region. Likewise, concurrent tracking of satellite-tagged individuals from different wintering areas would yield much insight into the migration ecology of the species, particularly in relation to environmental cues for migration and navigation of windscapes. Finally, performing the stable isotope analysis on the existing feather samples will help assess whether this is a viable method to look at inter-island movements.

Literature cited

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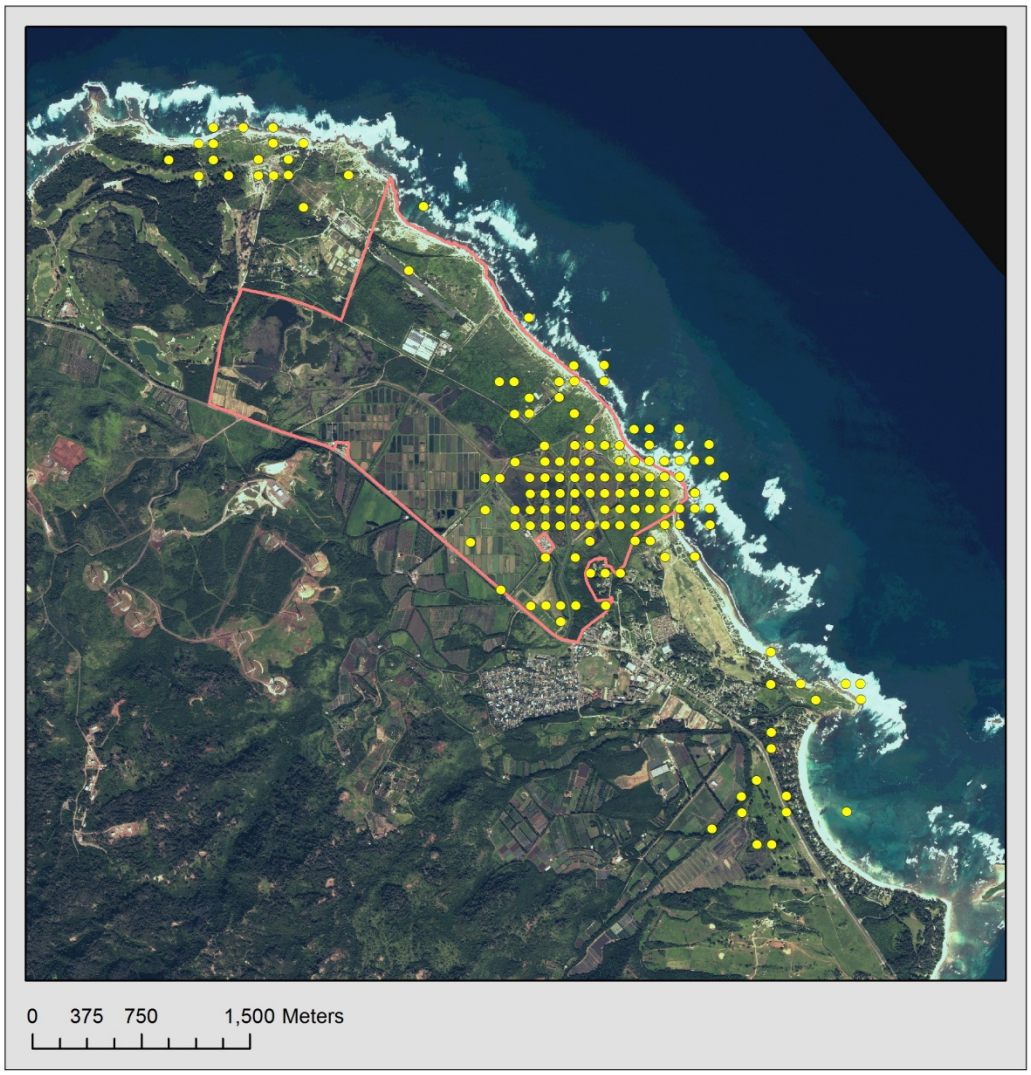

Daytime (0530-1830 hrs) locations of 6 satellite-tagged Bristle-thighed Curlews mid Dec - Mar. Only high quality locations (Argos class 3; n = 240) depicted here. Note that since Argos data are mapped at 0.001 degree resolution (~ 110 m grid) many locations are stacked on top of one another in this view.

Nighttime (1830-0530 hrs) locations of 6 satellite-tagged Bristle-thighed Curlews mid Dec - Mar. Only high quality locations (Argos class 3; n = 326) depicted here. Note that since Argos data are mapped at 0.001 degree resolution (~ 110 m grid) many locations are stacked on top of one another in this view.