

Project report to the CEC: May 2007

Understanding the North American Migration and Wintering Habitat Use Patterns of the  
Pink-footed Shearwater (*Puffinus creatopus*)

Prepared by Peter J. Hodum and K. David Hyrenbach

Personnel involved in project:

Dr. Peter Hodum, Juan Fernández Islands Conservancy and Oikonos Ecosystem Knowledge

Dr. David Hyrenbach, Duke University and Oikonos Ecosystem Knowledge

Michelle Hester, Oikonos Ecosystem Knowledge

Kevin Mack, Progressive Animal Welfare Society

### **Introduction**

The North American Conservation Action Plan for the Pink-footed Shearwater (*Puffinus creatopus*) calls for an improved understanding of the status of the species, focusing on conservation issues within CEC waters. Understanding how shearwaters use CEC waters is critical to defining critical habitat needs for the species and identifying potential threats on their wintering grounds. As a first step towards developing this understanding, this project utilized satellite tracking technology to investigate their migratory routes, habitat use and residency in North American waters during the post-breeding migration. As a complement to the research program, the project used the tracking data to develop education and public outreach resources.

### **Methods**

In early January 2006, Hodum traveled to the Juan Fernández Islands to begin the field season. From January to March 2006, we did preparatory fieldwork in the study area in the Juan Fernández Islands, established the relationship with the Seaturtle.org website to post our data as publicly accessible maps online, and tested the five satellite tags once they were received from Microwave Telemetry.

In mid-April, Kevin Mack, a wildlife biologist from the Progressive Animal Welfare Society (PAWS), traveled to the archipelago to help Peter Hodum attach the satellite tags to five breeding shearwaters. Kevin has extensive bird handling experience and was trained in the necessary tag attachment techniques by Dr. John Huckabee, the resident wildlife veterinarian for PAWS.

We conducted the fieldwork in the Vaquería shearwater breeding colony on Robinson Crusoe Island. The study plot is located on a slope in native luma (an endemic tree) forest at an elevation of approximately 225m above sea level. Prior to beginning tagging, we used an infra-red camera probe (Sandpiper Technologies Peep-a-Roo) to determine which burrows within the study area were occupied by breeding birds. Because the shearwaters are

nocturnal in their activity in the colony, we conducted the tagging at night. Fieldwork took place over three nights and four days, from 21-24 April 2006, between 21:30-01:30h each night. Using a burrow net set at the burrow entrance, we captured five adult breeding shearwaters, each with a late-stage chick, as they departed their burrow. Birds were captured after they had fed their chick to minimize disturbance to both the adult and chick and to ensure that the chick received the full meal carried in by the adult. We attached a tag to the back of each bird using four parallel surgical sutures in the skin and epoxy on the feathers. We released each bird directly back into its burrow at the conclusion of the attachment process. We tagged one, three and one bird(s) on the nights of 21, 22 and 23 April, respectively. Following the release of the tagged bird, we placed a lattice of toothpicks in the entrance of each burrow to confirm that the tagged bird departed the burrow. We checked the lattices each morning to determine if they had been knocked down, which would indicate that the bird had left. Four of the five birds departed the burrow the same night that they were tagged, with one bird remaining in the burrow overnight and departing the following night.

## **Results**

### *Duration of tag deployments*

Given that the Microwave Telemetry solar satellite transmitters we used had not previously been deployed on a diving bird, this project served as a pilot study on the suitability of such transmitters for long-term studies of other diving birds. To ensure the hollow tags would withstand the pressure from the immersion in water to depths up to 30 meters (4 atmospheres), Microwave Telemetry used a non-compressible “jelly-like” substance to encase the electronic components. Nevertheless, there was no way to pressure-proof the solar panels on the outside of the tag. Therefore, this deployment constituted the first test of a novel approach to study diving birds with solar-powered satellite tags.

The performance of the five satellite transmitters was quite variable (Table 1), with two transmitting for only 16 and 20 days, considerably less time than we had expected, given the anticipated life-span of the sutures (approximately 3 months). We suspect that one of those two tags failed prematurely, while we believe the second bird was incidentally taken in a gillnet. The performance of the second tag and the inferred behavior of the bird during the last day of transmission were suggestive of the possibility that the bird was caught in a fishery and tossed overboard. The remaining three tags transmitted for an average of  $75 \pm 23$  days (53, 73 and 100 days each).

### *Initial migratory movements*

Of the five tracked birds, three began their migration within days of being tagged, not returning to the colony to feed their chick again. One bird completed a single foraging trip and then began its migration. The fifth bird completed two foraging trips to provision its chick before departing on migration. All three of the chick-provisioning trips were to an area of the Chilean continental shelf, the Talcahuano region, that we have documented as a foraging hotspot for shearwaters during previous breeding season satellite tracking projects.

Upon beginning their migration, all five birds flew eastward towards the South American continent before heading rapidly northward (Fig. 1). The birds traveled primarily over the relatively shallow waters of the continental shelf (< 200m depth) and the shelf break / slope (200-2000m depth) during this northward movement. All four of the shearwaters whose tags transmitted for a sufficient period of time reached Peruvian waters (Table 1). The tag of the fifth individual stopped transmitting after 20 days, immediately prior to the bird's arrival in Peruvian waters, but its track was comparable to the other four to that point. Large-scale movement rates are reflected by the proportion of time spent in waters of the various countries. As Table 2 indicates, the three birds whose tags transmitted for >30 days spent little time in Chilean waters (range 10-33%).

#### *Use of Peruvian waters*

All three birds with long deployments (> 30 days) traveled to the same region off the coast of central Peru (Fig. 2). Once birds reached this region, daily movement rates dropped as individuals moved more locally. In Peruvian waters, shearwaters remained in shallow waters of the continental shelf out to the shelf break. Two of these birds remained in central Peruvian waters until their tags ceased transmitting, well into early June and early July.

#### *Migration to CEC waters*

One bird continued its northwards migration beyond Peruvian waters (Fig. 1). It is possible that other tagged birds also migrated beyond Peru, but their transmitters had already stopped functioning.

Once it left Peruvian waters, this bird moved quickly across the sub-tropical and tropical deep oceanic waters off Ecuador and Central America, eventually reaching the southern tip of Baja California. After reaching the southern tip of Baja California, the bird utilized highly localized movements, slowly working its way along the Pacific coast of Baja to the Bahía Magdalena region (Fig. 3). It remained in this general area until its transmitter failed in mid August, 100 days after attachment. The bird remained over shallow continental shelf waters during its time in Baja waters (Table 3).

#### *Habitat use patterns*

Aside from one bird (64379), whose tag failed prematurely on its migration towards Peru, all others spent little time in oceanic/deep waters (range 5-20% of their time) (Table 3). The tagged birds tended to move quickly through these oceanic waters until reaching shelf and shelf-break waters. Overall, the five birds spent an average of 77.5% of their time in shelf and shelf-break waters. The importance of shallow shelf-slope waters for foraging after the initial migratory period away from Chile, is underscored by the fact that the three birds tracked for >30 days spent on average only 13.8% of their time in oceanic waters. Moreover, the one bird that entered CEC waters off Baja California, exhibited a very strong affinity for shelf-slope waters in the Bahía Magdalena region, where it spent 100% of its time. These data suggest the importance of inshore shelf and shelf-break waters for shearwaters during the non-breeding stage of their annual cycle.

## Community outreach

To date, we have accomplished the following:

1. Collaboration with Seaturtle.org to post and regularly update maps of the movements of the tracked shearwaters. These maps remained active throughout the project (updated every two days) and were subsequently archived on the site, thus allowing the data to be used by educators and interested members of the public in the future. The project page on Seaturtle.org received >600 visits during the period that the satellite tags were active.
2. Radio interview on the local island radio station in the Juan Fernández Islands in which we explained the project and invited the public to follow the movements of the birds (April 2006).
3. Presentation to island students about our general conservation programs in the archipelago, including a section about the satellite tracking project (April 2006).
4. Donation of world maps and colored pins to both the Casa de la Cultura / library and the school in the Juan Fernández Islands to create a dynamic exhibit in which the school and the library regularly updated the maps, allowing students and the island community to track the movements of the birds (April 2006).
5. Public presentations by Peter Hodum to local Audubon Society chapters in the Puget Sound region East Lake Washington Audubon Society (May 2006) and Kitsap Audubon Society (Nov. 2006), a part of which focused on this satellite tracking project and the Seaturtle.org website. Similar talks to other local conservation groups are also being planned.
6. Oral presentation on satellite tracking pink-footed shearwaters at the Society for Conservation Biology annual meeting (June 2006).
7. Oral presentation on satellite tracking pink-footed shearwaters, with an emphasis on the migration tracking project, at the Pacific Seabird Group annual meeting (Feb. 2007).
8. A webpage dedicated to the pink-footed shearwater, a part of which will address the tracking program, is currently being developed. The page will provide photos and text about the ecology and conservation of the species as well as summaries of research programs and publications. This will be hosted on the Oikonos website and will be articulated with the CEC website.
9. Article published in Microwave Telemetry newsletter describing preliminary results of this study. ([http://www.microwavetelemetry.com/newsletters/winter\\_06page3.pdf](http://www.microwavetelemetry.com/newsletters/winter_06page3.pdf))
10. Presentations to classes of high school students at Henry Foss High School, Tacoma, WA, with an emphasis on the results and significance of the migration tracking project (May 2007).
11. Presentations at the Trilateral Committee meeting, Migratory Bird and Species of Common Concern working tables, sections of which presented results of this study and their implications for transnational conservation (May 2007).

## Discussion

This study demonstrated the practicality of using lightweight, solar-powered satellite transmitters for tracking diving seabirds over long deployments. Based on the premature failure of at least one tag, however, we recommend using additional pressure-resistant protective coating on the transmitters.

Consistent with the behavior of pink-footed shearwaters provisioning chicks, post-breeding shearwaters tended to move quickly through oceanic habitats and spend most of their time (> 75%) in shelf and shelf-break waters. These habitats are typically characterized as being colder and more productive than deep oceanic waters, especially in upwelling regions where deep, nutrient-rich waters are deflected towards the surface. In most marine systems, higher productivity is highly correlated with abundance of fish and higher trophic level predators. Not surprisingly, these upwelling and high productivity marine areas also receive a disproportionate share of commercial and artisanal fishing effort.

This pattern is certainly true of the waters used heavily by the tracked shearwaters in central Peru. That region has long been recognized as one of the richest and most productive upwelling regions in the world's oceans. It is, therefore, not surprising that the area appears to be an important wintering area for pink-footed shearwaters. This region also supports the majority of fishing activities in Peruvian waters. Our tracking results indicate the urgent need to develop a better understanding of the extent to which that region is used by pink-footed shearwaters and the degree to which fisheries may interact with the species.

Although only one bird was successfully tracked into CEC waters, its movement patterns were extremely instructive. Conclusions drawn from a single individual are obviously limited, but the extensive use of the Bahía Magdalena region does suggest that the area may potentially serve as an important wintering hotspot for the species. There is an important localized upwelling system immediately south of the mouth of the bay, which is also the location of important aggregations of marine mammals, sea turtles and other seabirds. As in Peru, these results suggest the need to assess the importance of this region to the species and the degree to which fisheries bycatch may be an issue.

Community outreach activities have generally been quite effective at the local scale, but more visible and broadly accessible programs are needed. We hope that the in-progress pink-footed shearwater webpage will help draw additional attention to the species. Projects that reveal dramatic migrations of species, such as that of the pink-footed shearwater, have the potential to capture and engage the public's imagination, thereby drawing attention to the broader issues of conservation that may confront not just the focal species but also other species that share their marine habitats and threats. This work has the potential to connect fishers and conservationists and provides information that can help them work cooperatively to develop mutually beneficial solutions. And for a wide-ranging, trans-hemispheric species such as the pink-footed shearwater, there exists the potential to use the species and its vast movements to link local communities across the three CEC nations as well as across the Americas.

## **Recommendations**

This initial pilot study yielded promising results and allows us to make recommendations for future research priorities, community outreach programs and possible policy considerations, some of which are beyond the scope of CEC activities but nonetheless warrant comment. Following are our recommendations:

1. Conduct at least one more colony-based migration tracking season to replicate the current study, thereby increasing sample sizes and allowing more robust conclusions about migratory routes and habitat usage patterns. Because of the small sample size of this study, the conclusions about migratory routes and habitat usage are necessarily limited.
2. Conduct at least one more at-sea tracking study in CEC waters (a replicate of the tagging project to be conducted in July 2007) to allow for more rigorous conclusions about habitat usage and movement patterns within shearwater wintering grounds.
3. With Mexican scientists, develop and implement a program of at-sea surveys in the Bahía Magdalena region of Baja California to assess that area as a potential hotspot for wintering pink-footed shearwaters. This will enable resource managers to map the spatial extent of the areas of shearwater wintering concentrations and to estimate their abundance throughout the summer / fall.
4. With Mexican scientists and local community members in the Bahía Magdalena region, develop seabird bycatch assessment surveys and educational materials about seabird bycatch for the fishing communities in the region. We can use the Pro Delphinus ([www.prodelphinus.org](http://www.prodelphinus.org)) methodology, successfully developed in Peru, as a model for this objective.
5. Develop a database of pink-footed shearwater distribution and abundance data from previously conducted at-sea surveys in CEC waters. This will enable resource managers to assess pre-existing data for possible use in determining population trends for the species.
6. Develop educational resources for general public, e.g. children's books, that address seabird conservation, using the pink-footed shearwater as a case study.
7. While the following priority is beyond the CEC mandate it is potentially an important topic for conservation of seabirds in general, and of pink-footed shearwaters in particular. We endorse efforts to increase at-sea monitoring of seabird interactions with fisheries in Peru, an important area for many threatened seabirds, including shearwaters, albatrosses and penguins. From the perspective of the pink-footed shearwater, the shelf and shelf-break waters of central Peru appear to be an important wintering region/stopping-over area for the species.

Table 1. Tracking information for five post-breeding pink-footed shearwaters tagged in the Juan Fernández Islands, Chile from 21-23 April 2006.

Transmitter #	Tracking duration (days)	Number of tracking locations	Date of arrival in Peru waters	Date of arrival in Mexico waters
64379	16	100	May 4	-
64377	20	68	-	-
64376	53	166	May 7	-
64375	73	233	May 7	-
64378	100	327	May 3	May 19

Table 2. Percentage of time spent in waters of South American countries by five post-breeding pink-footed shearwaters. Percentages calculated based on number of satellite locations obtained from each bird in each jurisdiction.

Transmitter #	Percentage of time spent in jurisdictional waters				
	Chile	Peru	Mexico	Ecuador	High Seas
64379	67.9	32.1	0.0	0.0	0.0
64377	100.0	0.0	0.0	0.0	0.0
64376	33.7	66.3	0.0	0.0	0.0
64375	13.7	86.3	0.0	0.0	0.0
64378	11.0	10.1	74.9	0.6	3.4

Table 3. Percentage of time spent in three different oceanographic habitats by five post-breeding pink-footed shearwaters. Percentages calculated based on number of satellite locations obtained from each bird in each habitat.

Transmitter #	% Continental shelf (< 200m)	% Shelf break (200 - 2000 m)	% Oceanic/deep water (> 2000 m)
64379	5.5	29.1	65.4
64377	69.1	25.0	5.9
64376	21.0	70.4	8.6
64375	10.5	76.9	12.6
64378	56.4	23.5	20.1
Mean ± SD	32.5 ± 28.6	45.0 ± 26.3	22.5 ± 24.6

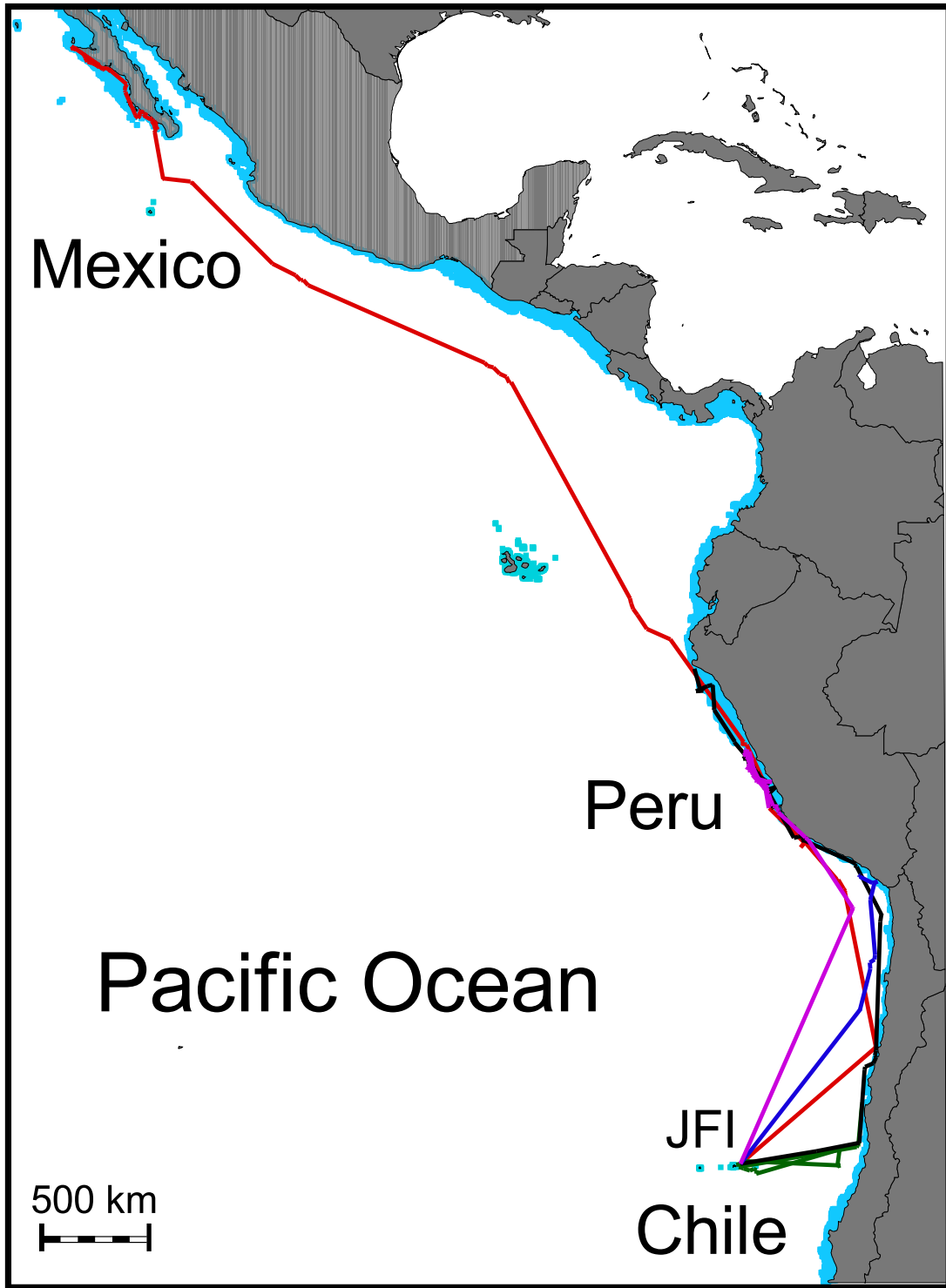


Figure 1. Tracks of five post-breeding, migrating pink-footed shearwaters from JFI, color-coded by individual. The extent of the continental shelf (depth < 200m) is denoted by the light blue shading.

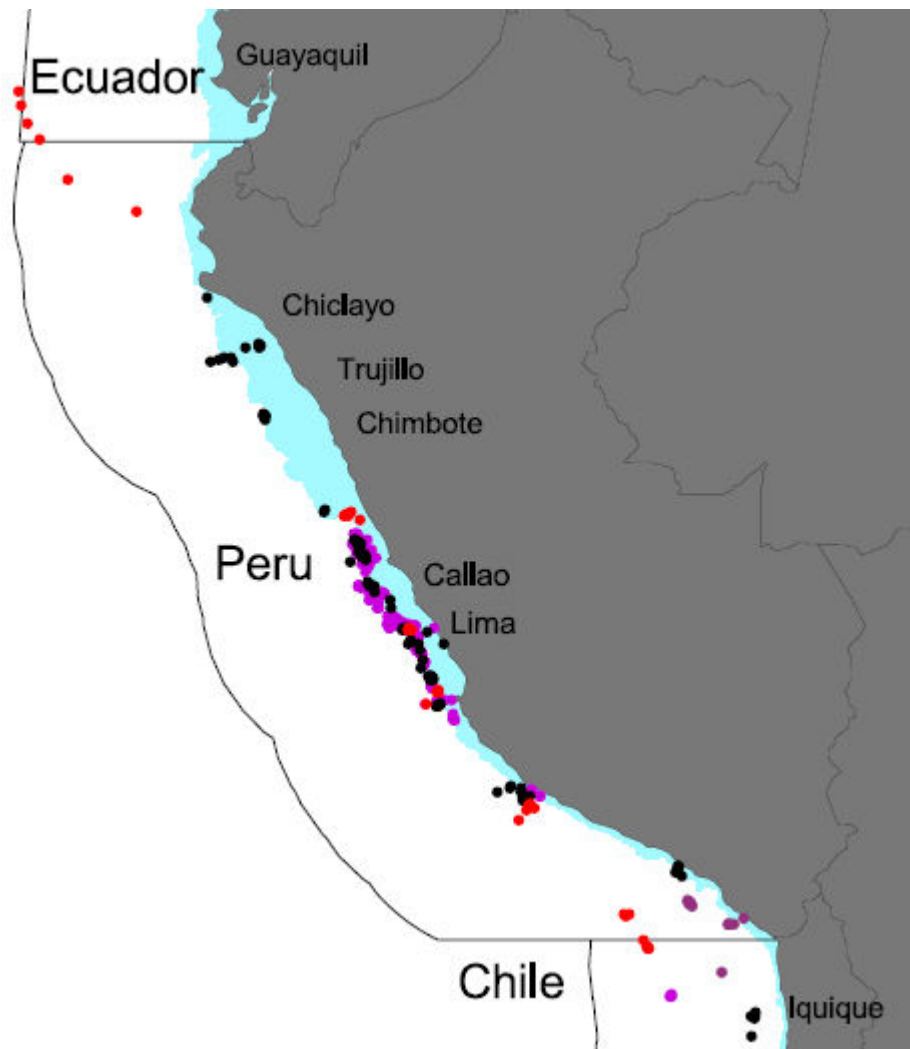


Figure 2. Locations of three pink-footed shearwaters with long deployments (> 30 days), color-coded by individual, superimposed over the 200-mile Economic Exclusive Zones (E.E.Z.s) of range countries. The extent of the continental shelf (depth < 200m) is denoted by the light blue shading.



Figure 3. Locations of one pink-footed shearwater tracked into CEC waters off Mexico. Note the concentration of activity at the mouth and to the south of Bahía Magdalena. The extent of the continental shelf (depth < 200m) is denoted by the light blue shading.