

First GPS-tracking of small seabirds: Peruvian diving-petrels and Inca terns

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Background

Until recently, GPS-tracking on seabirds has been limited to large species (1 – 7 kg) [1,2,3]. New advances in GPS miniaturization have enabled the tracking of smaller species such as gulls and petrels (400 – 700 g) without losing spatial resolution [4,5]. Here, we present the first GPS-tracks of two smaller seabirds (~200 g average) endemic of the Humboldt Current.

Objectives

- To give first insights of the at-sea movements of small seabirds (~200 g) using small GPS tags (~9 g, including accessories).
- To examine the performance of GPS at low-power duty-cycles.
- To quantify bird recovery rates after GPS deployment using two different methods.

Study site and period

Isla La Vieja, Perú : 13° 30'S, 74° 15'W

Aug 2009, Nov 2009, Jun 2010



Species tracked

Peruvian diving-petrel (PDP)
Pelecanoides garnotii

Inca tern
Larosterna inca



Body weight: 195 - 250 g
Wing chord: 27 - 29.9 cm

Body weight: 172 - 226 g
Wing chord: 13.4 - 15.2 cm

Both spp. are burrow nesters

GPS tags

Manufacturer: Technosmart (Rome, Italy)
Model: GIPSY-2

Operating modes: Continuous and Trickle Power Mode
Sampling rates: 1 fix/1sec; 5 fixes/1, 3, 5 min
Battery characteristics: 145 mAh, 3.7V, 3g
Housing: heat-shrink plastic tubing
Total weight [GPS & accessories]: 8 – 9.5 g (4 – 4.5% of adult's body weight).

GPS attachment

- Chick-rearing birds were captured and recaptured in their burrows
- GPS attached to back's feathers with 2 strips of Tesa tape
- Deployment time was a single feeding trip (< 15 h)

Two methods for recapturing birds

A. Direct inspection of nests after sunset

(at 1930, 2100 & 0300 h in Aug and Nov 09).

B. Surveillance wireless infra-red cameras

placed close to the nest entrance (1800 – 2200 h, June 10)



Peruvian diving-petrel tracks



RESULTS

Image of a PDP resting outside the nest entrance at night as visualized by the infra-red camera



Birds spent some time resting on the sea surface near the colony before heading to their feeding areas



Foraging behavior

PDP are diurnal foragers with all trips completed within the same day (from sunrise to sunset).

Birds exploited an area (100% Minimum Convex Polygon) encompassing at least 1137 km²

Bird	Orientation (true/true point)	Maximum Foraging		Mean ± sd		Bird speed km/h	N fixes
		Distance (km)	Duration (h)	Distance (km)	Duration (h)		
1	NW	43.5	43 ± 20	80	109		
2	NW	12.4	53 ± 43	160	465		
3	E	17.2	35 ± 24	120	338		
4 (1st trip)	SE	36.1	42 ± 19	119	217		
4 (2nd trip)	NW	15.1	46 ± 23	119	237		
7	SE	18.8					
8	NW	15.1					
9	SE	47.1	47 ± 13	115	166		

GPS performance

Bird	Operating mode	Sampling options	Total recording interval (h)	Data collection		Track
				Regular	Truncated	
1	TPM	5 fixes/5min	2.5	Regular	Truncated	
2	Continuous	1 fix/1sec	2	Irregular/erratic	Truncated	
3	TPM	2 fixes/20 sec	3	Regular	Truncated	
4 (1st trip)	TPM	5 fixes/5min	6	Regular	Truncated	
4 (2nd trip)	TPM	5 fixes/5min	7.5	Regular	Truncated	
7	TPM	5 fixes/5min	4.5	Irregular/erratic	Truncated	
8	TPM	5 fixes/5min	6	Irregular/erratic	Truncated	
9	TPM	3 fixes/5min	2	Irregular/erratic	Truncated	

TPM = Trickle Power Mode

Recovery rate

Species	Recovery method	No. birds captured		No. birds recaptured		% GPS failure
		with data	without data	with data	without data	
Aug-09	Direct inspection	5	1	20%	1	0
Nov-09	Direct inspection	10	5	50%	2	2
Jun-10	Camera	10	9	90%	2	21

Inca tern tracks



Foraging behavior

Bird	Trip length (h)	Total Displacement (km)	Foraging Distance (km)	Bearing Max. For Dist. (°)	Flight speed (mean ± sd) km/h			N fixes
					Outbound	Search	Inbound	
1	5.35	175	68.8	176	37.66 ± 5.34	27.98 ± 11.13	48.99 ± 6.98	15913
2	5.5	-----	27.7	153	31.89 ± 11.7	29.15 ± 15.86	-----	1594

GPS performance

Bird	Operating mode	Sampling options	Data collection	Track
2	TPM	20 fixes/1 min	Irregular/erratic	Truncated

TPM = Trickle Power Mode

Recovery rate

Session	Recapture method	No. birds captured		Recapture rate	No. GPS with data		% GPS failure
		with data	without data		with data	without data	
Nov-09	camera	6	4	67%	1	3	66
Jun-10	camera	3	1	33%	1	1	0

* From the total number of birds that could not be recaptured only 1 deserted the nest



Conclusions

1. Although the quality of spatial resolution and number of fixes is still limited by the GPS's battery size and capacity, it is feasible to obtain basic information of the at-sea movements of small seabirds (~200 g) using miniaturized GPS dataloggers (< 10 g including accessories).
2. GPS performance using low-power duty-cycles was lower in the diving-petrels than in the terns because the former spend a higher proportion of the foraging time underwater and inside the burrow.
3. Recapture rates of Peruvian diving-petrels and Inca terns can substantially increase by using surveillance cameras placed close to the nest entrance. We recommend the use of control birds.
4. Ongoing technological advancements in miniaturization and performance of the units as well as more suited setting of the recording features will allow the tracking of small seabirds for more extended periods in the near future.

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