

Radar Surveys for Audubon's Shearwater on Saba, Netherlands Antilles



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Audubon's Shearwater (*Puffinus lherminieri*), known locally as *Wedrego* on Saba and St. Eustatius, is a medium-sized seabird species that feeds at sea and nests on islands throughout the Caribbean and worldwide. The species is known to nest on Saba, however estimates vary widely on the island population. The shearwaters are active on-island at night when they fly in off the sea to their nests which consist of burrows or natural cavities. Globally and in the Caribbean, Audubon Shearwater populations are threatened by introduced predators such as cats, rats, and goats.

Researchers have traditionally noted the extreme limitations of using conventional aural and visual methods when surveying species such as shearwaters that visit breeding areas only at night. Work on individual vocalization patterns has been developed for other species (Fernandez and Delnevo 2009), and on-going efforts are being pursued for *Wedrego*. These techniques are being developed, and tested for future use. However, currently, and in general, population estimates for this species can be fraught with uncertainty, variable accuracy, and broad statistical and biological confidence limits.

Marine radar has proven effective as an observation tool, to obtain accurate, reliable counts of species, their daily timing and pattern of movements, that are otherwise difficult or impossible to observe directly, such as the Marbled Murrelet (Day and Cooper 1995), and the Black-capped Petrel (Brown 2012; Brown 2013). These studies demonstrated that radar is an effective observation and monitoring tool that far extends researchers' ability to observe and monitor nocturnal seabirds, and enables accurate, consistent counts.

Little is known regarding the species on Saba, including how many individuals are present on the island, probable nesting areas, and flight paths the species use between at-sea foraging areas and on-island nest areas. Without a basic understanding of these parameters it is difficult to identify and prioritize conservation actions.

Herein, we describe a pilot study that used marine radar on Saba from 11-17 December 2014 to survey for Audubon's Shearwaters.

Methods

Our goal was to record shearwaters as they flew from the sea to their nest areas. Survey sites were based on previous knowledge about activity centers, including location where birds have recently been heard or seen. We surveyed from a different location each night with the intention to cover as much of the island as possible during our visit. Surveys started at sunset each night and ran for three hours, ending after the shearwater's nightly marine to terrestrial grounds migration had slowed.

For surveys we set up our radar within 1.5km of the potential nesting site or flight path. Although radar can detect targets at much greater distances, resolution suffers greatly. Setting the range at 1.5 km is standard practice when surveying for seabirds as it allows the surveyor to detect targets at a substantial range while recording a clear and powerful target on the radar (Cooper et al. 1991). A laptop computer was attached to the radar unit and recorded all radar images, for subsequent review and analysis.

The radar operator monitored all targets that appeared on the radar's monitor, and recorded time, direction of flight (to the nearest degree), flight behavior (e.g. straight, erratic), velocity (to the nearest 5 km/hr), and if known, noted species and number of individuals detected.

At survey locations, in addition to using radar, we simultaneously used a 3rd generation 10-power night vision scope to observe birds visually as well as listen for birds aurally.

Results

EPIC successfully located Audubon's Shearwaters at seven sites on Saba (Figure 1). Overall, 465 Audubon's Shearwaters were recorded with radar over seven nights of surveys (Table 1).

Sites

SAB1

The Bottom

19 December 2014

Elevation: 340 m

Distance From Sea: 1.2 km

Audubon's Shearwater Targets Detected: 89

The radar site for this location was located on the main road on the ridge-top to the east of the Bottom. The radar was able to detect birds flying to and from the sea to the two large valleys that funnel down the south side of Mount Scenery. At this site, we also observed numerous shearwaters with the night vision scope. Additionally, there are steep cliff faces northeast of the station location near a prominent gap in the ridgeline.

SAB2

Sulphur Mine/Pirate Cliffs

11 December 2014

Elevation: 260 m

Distance From Sea: 0.25 km

Audubon's Shearwater Targets Detected: 54

The radar site for this location is at the beginning of the trailhead towards Sulphur Mine and the Pirate Cliffs. At this site, we were able to detect birds flying up/down the prominent valley west of the Sulphur Mine and Pirate Cliffs. A small portion of birds appeared to fly towards the Sulphur Mine area, but a large majority of birds were flying to or from the Pirate Cliffs area southwest of the radar station. This valley has prominent cliff faces along its eastern side and small numbers of nests have been previously located at this site (EPIC unpublished data). During the day following the radar survey (12 December 2014), a ground survey was done where two EPIC staff scoured the bases of the Pirate Cliff face, looking for nests, although none were found.

SAB3

Past Lambree Pullout

12 December 2014

Elevation: 300 m

Distance From Sea: 0.96 km

Audubon's Shearwater Targets Detected: 77

The radar at this site was located at the large curve in the road between St. Johns and Windwardside. This site was on a small ridge between two drainages, one leading from the sea to a substantial cliff face above St. Johns, and the other leading to the cliff faces below and southwest of Booby Hill and Windwardside. We had birds flying to both locations; however, we had a larger proportion of birds flying towards the cliffs above St. Johns.

SAB4

Agricultural Station/Spring Bay

13 December 2014

Elevation: 330 m

Distance From Sea: 1.39 km

Audubon's Shearwater Targets Detected: 90

The radar at this station was located just below the agricultural station on a cement platform adjacent to the trailhead to Spring Bay. From this station we were able to survey from the sea, Old Booby Hill, the cliffs below Hells' Gate, and Booby Hill/Windwardside. The staff from SCF reported having heard shearwaters on the cliffs below the church in Hell's Gate and this radar station covered this area of previous activity. During the survey, the majority of birds detected were flying to and from the cliffs below Hell's Gate while a smaller number of birds were detected flying towards Booby Hill/Windwardside.

SAB5

St. Johns

14 December 2014

Elevation: 310 m

Distance From Sea: 0.61 km

Audubon's Shearwater Targets Detected: 64

The radar at this station was trained to detect shearwater activity in the area of Fort Bay and the landfill area. This area was thought to be habitat for a large portion of shearwaters (fide M. McGhee). Our radar was able to monitor birds coming off the water, the large coastal boulder field, and the large cliff faces above Fort Bay and the landfill. We detected the majority of birds flying to the cliff faces above the landfill and smaller portions of birds flying to cliff above Fort Bay as well as to the coastal boulder field.

SAB6

Well's Bay

15 December 2014

Elevation: 185 m

Distance From Sea: 0.38 km

Audubon's Shearwater Targets Detected: 53

The radar at this station was located at a platform that allowed us to survey the two well-defined drainages that come down from Mt. Scenery to Well's Bay. In 2010, EPIC staff doing the Lesser Antilles Seabird Atlas heard shearwaters at this site, while anchored offshore of Well's Bay. We detected birds in both drainages, both flying inland as well as out towards the sea.

SAB7

Windwardside

16 December 2014

Elevation: 411 m

Distance From Sea: 1.58 km

Audubon's Shearwater Targets Detected: 38

The radar at this site was located on a large deck that allowed us to survey the cliff faces on both the north and south side of Booby Hill. During this survey, for the only time during the week of surveys, we had some rain that eliminated 1 hour of survey time just after sunset. When there is rain that radar monitor fills of with rain clutter and we are unable to see other targets moving across the screen. Therefore, it is likely we missed some shearwaters at this survey location due to inclement weather. However, the majority of shearwaters we did detect were flying along the cliffs on the north side of Booby Hill, while a smaller portion of shearwaters were detected along the cliffs on the south side of Booby Hill.

Recommendations and Next Steps

The Audubon's Shearwater on Saba appears to be widespread but not overly abundant. Estimations in the year 2000 of thousands of individual shearwaters appear to be higher than what populations currently exist in 2014. Our surveys provide a valid snapshot of shearwater activity around the island as well as provide insight into shearwater densities in specific island areas. The numbers of shearwater targets we detected should not be considered the total population, but rather an index number of population at individual areas.

Locations of shearwater flight corridors were noted to be in close proximity to communication towers. Towers are often located on high points or ridge tops. Communication towers are often guyed out for stability and lit for either safety or navigation. Communication towers are a well-known flight hazard to animals that fly, particularly those that fly at night. While no strikes were noted during our visit to Saba, the likelihood that shearwaters strike towers.

The locations near Hells' Gate and above The Bottom initially appear to have the largest densities of individual birds. In the area of Hell's Gate, the cliff faces that are below the church in town appeared to have substantial shearwater activity. The steep forested and small cliff faces on the slopes of Mt. Scenery above The Bottom had considerable shearwater activity as well.

In the future, we recommend:

- Additional radar surveys to locate additional flight corridors and nest locations
- Additional radar surveys to monitor known flight corridors and nest locations to monitor changes to population indices
- Follow up radar surveys with nest searches at cliff areas where we detected shearwater activity
- Locate and map all communication towers on Saba and overlay imagery with detected shearwater activity areas. Any towers that lie along these flight paths should be visited regularly for bird strikes. If strikes are noted, actions should be taken that include removing guying or offending lights on structure
- Initiate radar survey efforts for Audubon's Shearwaters on St. Eustatius to determine flight corridors and nest locations on that island

Table 1. Survey results from Audubon Shearwater radar surveys on Saba, including names, locations, and total shearwater-like targets.

Station	Date	Location	Lat	Lon	Heading	Shearwater-like targets
SAB1	12/10/2014	Above The Bottom	17 37 29.3	063 14 41.1	348	89
SAB2	12/11/2014	Sulphur Mine Trailhead	17 38 40.1	063 13 51.6	328	54
SAB3	12/12/2014	Past Lambee Pullout	17 37 23.7	063 14 17.6	200	77
SAB4	12/13/2014	Agricultural Station	17 37 59.3	063 13 40.6	150	90
SAB5	12/14/2014	St. Johns	17 37 11.3	063 14 40.2	286	64
SAB6	12/15/2014	Well's Bay	17 38 13.4	063 15 03.6	45	53
SAB7	12/16/2014	Windwardside	17 37 46.4	063 13 56.2	100	38

Figure 1. Map of Audubon Shearwater radar station and flyway locations on Saba.

