

PROSPECTS FOR THE MANX SHEARWATER COLONY ON MIDDLE LAWN ISLAND, NEWFOUNDLAND, CANADA

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Manx Shearwaters (*Puffinus puffinus*) are relatively long-lived, pelagic seabirds for which the main breeding populations are in Great Britain and Ireland (Perrins *et al.* 1973, Brooke 1990). In eastern North America they are uncommon but regular visitors, and rarely breed (Lee & Haney 1996). In 1977, Manx Shearwaters were found to have established a colony on Middle Lawn Island (MLI), off the south coast of Newfoundland, Canada (Figure 1; Storey & Lien 1985). Their presence in the region had been documented through the recovery of bands since 1954 (Storey & Lien 1985). In 1974 and 1976, Storey and Lien (1985) confirmed the presence

of Manx Shearwaters on MLI, but found no evidence of breeding. Between 1977 and 1981, the number of burrows (i.e., burrows with evidence of some activity such as digging) grew from 76 to 221, and the estimated population size (total number of birds present on MLI based on mark-recapture) rose from 200 to over 350 birds (Storey and Lien 1985). Yet, during this time, the proportion of breeding burrows (i.e., with eggs/chicks) was 9% or less (Storey & Lien 1985). In 1989, Lien and Ledwell (1990) estimated 500 burrows, but, in 1990, no breeding could be confirmed (see Robertson 2002). By 2001, the colony was still active (i.e., prospecting behavior occurring at the colony), although breeding was confirmed in only two of 64 burrows, and the size of the population was estimated to be about 100 birds (Robertson 2002).

Middle Lawn Island is located off the south coast of Newfoundland (46.869°N, 55.616°W) and comprises 4.17 km² of steep, vegetated terrain (Important Bird Areas 2012; Fig. 1). The island was assigned Provisional Ecological Reserve status in 2009 by the Wilderness and Ecological Reserves Advisory Council, due primarily to the presence of Manx Shearwaters (Government of Newfoundland and Labrador 2009).

In this note, we analyze local survivorship, estimated population size and the projected persistence of this colony of Manx Shearwaters on MLI based on a mark-recapture study initiated in 2000 (Robertson 2002) and continued until 2009. We also assess burrow contents during this period.

Each year from 2000–2009, we visited MLI in the first half of July, during the new moon, if possible, to maximize the likelihood

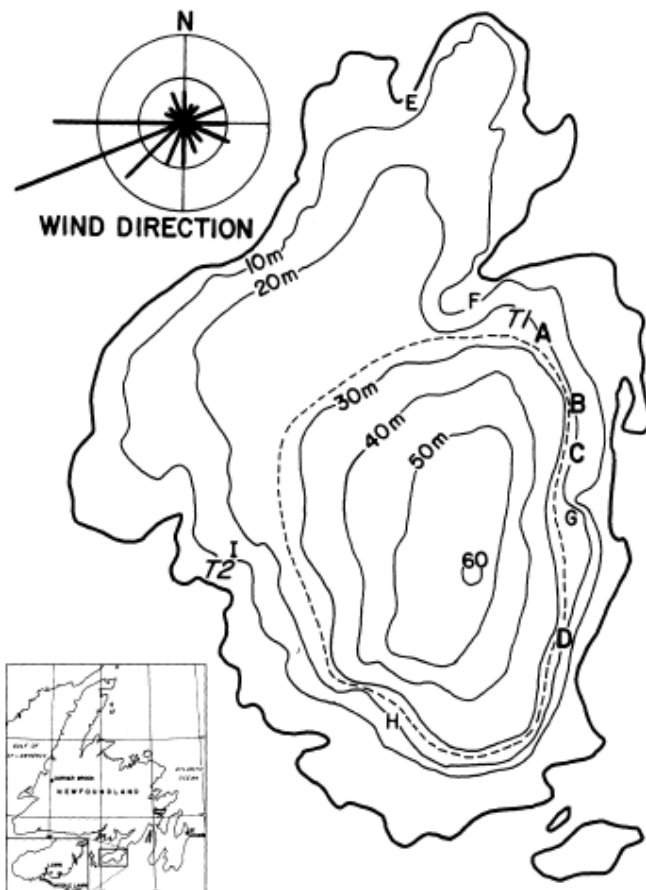


Fig. 1. The main areas Manx Shearwaters were captured (indicated by letters) on Middle Lawn Island, off the Burin Peninsula, Newfoundland. The dotted line indicates the highest density of Leach's Storm-petrel burrows. Map reprinted from Storey and Lien (1985:396) with permission from *The Auk* and A. Storey.

TABLE 1
Results of Manx Shearwater burrow surveys conducted during early July on Middle Lawn Island, NL

Year	Number of burrows searched	Number (%) of apparently occupied burrows	Confirmed production (%)
2000 ^a	72	11 (15.3)	2 eggs (2.8)
2002	309	5 (1.6)	Nil (0)
2003	108	1 (0.9)	1 egg (0.9)
2006 ^b	92	13 (14.1)	6 eggs (12) 5 chicks
2008	66	7 (10.6)	5 eggs (9.1) 1 chick

^a Robertson (2002).

^b In 2006 and 2008 a burrow scope was used.

of finding birds at night on the surface (see Harris 1966a). This date coincided with incubation by breeding birds, as well as the period during which prospecting birds visit the island (Storey & Lien 1985). We searched for and captured birds on the surface or outside the entrance to burrows at night (average three nights per year; range one to nine); sections A, B, C, D, E and G were always searched (Fig. 1). To minimize investigator disturbance, we did not handle or band birds in burrows. Birds were captured either directly by hand or with a hand-held net, and either the band number was recorded or the bird banded using United States Geological Survey incoloy metal bands.

In 2000, 2002 and 2003, we checked all burrows larger than a Leach's Storm Petrel (*Oceanodroma leucorhoa*) burrow (the island is home to a significant colony of storm petrels, estimated in 2001 at 8 733 breeding pairs; Robertson *et al.* 2006) using a flashlight and grubbing where necessary (Table 1). In 2006 and 2008, we did the same but used a burrow scope (Peeper 2000, Sandpiper Technologies Inc.) to verify the presence of birds or eggs.

Mark-recapture data were analyzed using the Jolly-Seber model in Program MARK v5.1 (White & Burnham 1999) to estimate

population size at the start of the study, local survival and population trend (Schwarz & Arnason 1996, Cooch & White 2012). Due to the very low number of laying birds (Table 1), we focused on birds active at the surface and thus the analysis was of birds captured at night of unknown breeding status. Due to the relatively small number of birds captured, we did not attempt to model annual variation in the rates of interest, and simply estimated mean rates for the entire 10-year time span. Recapture rate was allowed to vary across years, as the amount of effort devoted to catching birds each year varied (see below). Goodness of fit was assessed with an inspection of TESTs 2 and 3 in Program RELEASE (Burnham *et al.* 1987), and we found no obvious signs of heterogeneity in the data (global $\chi^2 = 14.6$, $df = 22$).

Based on 220 banded birds and 79 recapture events, we estimated mean (\pm SE) annual adult local survivorship of 0.70 ± 0.04 (95% CI 0.60–0.78), mean starting population size of 194 ± 43 (95% CI 130–301) individuals, and a projected mean population trend of $\lambda = 0.94 \pm 0.04$ (95% CI 0.86–1.02). Decomposing the population trend, 74% is due to the return of marked animals (0.70/0.94), while 26% is due to unmarked birds recruiting into the population. Annual recapture rates varied from 0.07 to 0.31. Of the recaptured birds,



Middle Lawn Island, 2008, from the northeast corner of the island. The dead vegetation (west side) was likely caused by Canada Goose grazing. The primary Manx Shearwater areas (sections A–D on map) are in the distance (steeper parts of the slope). A few burrows were located in the foreground of the photo on the gentler slope. (Photo courtesy Gail Fraser)

28 were recaptured in the year immediately following banding, 32 were recaptured in a non-consecutive year, and 15 were re-captured two to four times. There was an interval of 3.0 (SD 1.4) years between captures of birds caught in non-consecutive years, and one bird was recaptured eight years after initial capture. Only one foreign recapture was recorded; in 2003 a bird banded as a chick in 1996 on the Isle of Rum, Scotland, was recaptured on MLI.

Burrow occupancy (total number of burrows with birds) varied from 0.9% to 15%, and burrows with confirmed laying ranged from 0 to 12% over the five years sampled (Table 1).

Similar to the last quarter of the 20th century, the number of Manx Shearwaters frequenting MLI continues to hover in the low hundreds, with only a handful of birds actually breeding. Our estimate suggests that the population has declined from the estimated 220–360 individuals present during 1977–1981, and that the current population may have continued to decline during the 2000s, although the confidence limits on these estimates are wide, and the estimate of trend for the 2000s (0.94) includes 1.00 (stable) in its 95% confidence limit. Based on this study and prior work, this colony has low burrow occupancy and even lower numbers of burrows with confirmed laying (Storey & Lien 1985). In contrast, burrows in large colonies in the center of the species' range are rarely unoccupied (Brooke 1990; Lee & Haney 1996).

The local adult annual survivorship, which is the product of true survival and site fidelity, of 70% at MLI is low compared to that at colonies in Wales: 90% (Skokholm; Perrins *et al.* 1973), and 93%–96% (Skokholm; Harris 1966b). However, the estimates from Skokholm are based on banding of primarily breeding birds and are likely close to true survival rates. The difference almost certainly indicates significant permanent emigration and reduced site tenacity at MLI, especially as most of the marked birds are non-breeders (Robertson 2002). While MLI attracts prospecting birds (26% of the annual change in population size is attributed to new birds, and a chick banded in Scotland was recaptured on MLI), recruitment to the breeding population appears limited.

The relatively low site tenacity to MLI may contribute to the apparent decline of this colony (or at the very least, to its lack of growth), suggesting that one or more breeding requirements are not being met. The very low number of birds breeding implies low colony productivity. The persistence of this colony relies on continued immigration of prospecting birds, recruitment to the breeding population and breeding success. Robertson (2002) suggested the expansion of the MLI Manx Shearwater colony may be limited by unfavorable oceanographic conditions and/or predation pressure. Newfoundland waters were in cold-phase in the early 1990s; however, sea surface temperatures have since warmed (Regular *et al.* 2009, Spielhagen *et al.* 2011) presumably improving conditions for the temperate-breeding Manx Shearwater. Predation pressure remains a probable cause for concern. In addition to predation pressure from large gulls (Robertson 2002), in recent years, evidence of mammalian predation (suspected to be American Mink *Mustela vison*) has been seen on MLI (Roul 2010). Robertson *et al.* (2006) suggest predation by gulls has contributed to the decline of Leach's Storm-petrels on MLI (while at other nearby colonies, Grand Colombier and Green Island, the number of Leach's Storm-petrels has increased dramatically, Lormée *et al.* 2012, Robertson *et al.* 2006) suggesting a local impact on MLI.

Given the small number of birds breeding at MLI after a presence of at least 40 years, the presence of other nearby potential breeding habitat with confirmed attendance by Manx Shearwaters (Roul 2010) may be important for the potential growth and sustainability of this population.

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