SIZE AND TRENDS OF LEACH'S STORM-PETREL
*OCEANODROMA LEUCORHOA* BREEDING
POPULATIONS IN NEWFOUNDLAND

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INTRODUCTION

The east coast of Newfoundland harbours some of the largest Leach’s Storm-
Petrel *Oceanodroma leucorhoa* colonies in the world (Sklepkovych & Montevcechi 1989). In spite of their global significance, by 2000 most major
colonies had not been surveyed since the late 1970s or early 1980s (Cairns *et al.* 1989), so little data existed to assess current population trends in this species.
This was largely due to the extensive and time-consuming field work needed to effectively monitor this nocturnal, burrow-nesting seabird. To begin to fill this information gap, surveys of breeding populations of several important Leach’s Storm-Petrel colonies were begun in the summer of 2001 and have continued annually since then.

This paper updates population size estimates of Leach’s Storm-Petrel colonies in Newfoundland, assesses trends where historical data were available and discusses possible factors influencing the population size and trend of this species.

METHODS

Information from older surveys (pre-2001) was extracted from Cairns et al. (1989) and the associated Atlantic Seabird Colony Register, a database of seabird colony surveys maintained by the Canadian Wildlife Service. In addition, all available survey documentation was consulted directly, e.g. Sklepkovych & Montevecchi (1989) and Stenhouse et al. (2000). The methods used in older surveys were variable, and in some cases not known. For trend analysis, we only included surveys that were based on quantitative estimates of colony size. Surveys since 2001 were conducted in a standardized manner, and details are presented in Robertson et al. (2001) and Robertson & Elliot (2002).

Islands with larger populations, so that more of the global population could be sampled, accessible islands and islands with previous population estimates were selected for re-census. The methods used in recent surveys are outlined below.

As previous surveys did not always document the area used by breeding Leach’s Storm-petrels, island-wide grids were established to, 1) determine the limits and area of Leach’s Storm-petrel breeding habitat, and then, 2) determine occupied burrow densities. On maps of each island, a georeferenced grid was laid out which included at least 100 intersection points. These grid lines ranged from 25-75m wide, depending on the size of the island. In the field, grid intersection points were located by a hand-held GPS, or with tape measures and compass. At the intersection of all grid lines, a 16 m² circular plot was established by placing a stake at the centre of the plot and marking a circle on the ground with a can of spray paint tied to a cord of appropriate length (2.26 m). All burrow entrances in the plot were counted, and the contents assessed. Burrow entrances were recorded as leading to either: a burrow too short to hold a pair of breeding petrels, an empty burrow, an occupied burrow (adult and/or egg present), a burrow for which the contents could not be assessed (unknown), or as an additional entrance to a burrow already recorded as falling into one of the above categories. Contents of each burrow were assessed by grubbing (reaching into the burrow by hand). In rare cases an access hatch was dug in the peat to assess the contents of longer burrows.
Figure 1. Distribution and size of Leach’s Storm-Petrel colonies in Newfoundland and Labrador, Canada and St. Pierre and Miquelon, France. Inset map shows 500 m isobath.

Figuur 1. Verspreiding en grootte van kolonies van Vaal Stormvogeltje in Newfoundland en Labrador (Canada) en St. Pierre en Miquelon (Frankrijk). De inzet laat de 500 m isobath zien.
Figure 2. Population size (log 10) and trends of Leach’s Storm-Petrel colonies monitored in Newfoundland, Canada. Data sources for older information can be found in Stenhouse et al. (2000), Robertson et al. (2002) and Robertson & Elliot (2002) and 95% confidence are presented where available.


For analysis, if a grid intersection had at least one burrow in the 16 m² plot the surrounding area, specifically half the distance to the next grid line, was considered occupied habitat. Technically, plots without burrows could be included to calculate occupied burrow densities and then multiplied by total island area to obtain a population estimate. However, we chose not to include these unoccupied plots in the analysis, as it had the undesirable effect of skewing the distribution of occupied burrow densities due to the large number of 0s. Removing unoccupied habitat and 0 occupied burrow densities had two statistical advantages, firstly it allowed the standard error to be calculated on a distribution that approximated a normal distribution, and second, if effectively reduced the standard error of the estimate of population size. For islands with
steep topography, the occupied area was further corrected by the mean angle of all plots, measured with a clinometer. Occupied burrow densities for each plot were calculated by multiplying occupancy rates (excluding unknown burrows as the contents of these burrows was not known) by the burrow density in each plot (including unknown burrows). Mean occupied burrow densities were then calculated from all plots which had burrows. Finally, the total corrected occupied area was multiplied by the mean occupied burrow density to obtain a final population estimate. Standard errors and 95% confidence intervals are available in the original reports.

Table 1. Estimated population sizes, most recent census year, occupancy rates, burrow densities and occupied burrow densities for the largest known Leach’s Storm-Petrel colonies in Newfoundland and Labrador, Canada and St. Pierre and Miquelon, France.

<table>
<thead>
<tr>
<th>Colony</th>
<th>Year</th>
<th>Size (pairs)</th>
<th>Occupancy rate</th>
<th>Burrow density (m⁻²)</th>
<th>Occupied burrow density (m⁻²)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baccalieu Island</td>
<td>1984</td>
<td>3,360,000</td>
<td>0.680</td>
<td>0.046-4.166</td>
<td>0.017-2.495</td>
<td>1</td>
</tr>
<tr>
<td>Gull Island (Witless Bay)</td>
<td>2001</td>
<td>351,866</td>
<td>0.722</td>
<td>1.070</td>
<td>0.772</td>
<td>2</td>
</tr>
<tr>
<td>Great Island (Witless Bay)</td>
<td>1997</td>
<td>269,765</td>
<td>0.659</td>
<td>1.870</td>
<td>1.233</td>
<td>3</td>
</tr>
<tr>
<td>Grand Colombier, St Pierre</td>
<td>2004</td>
<td>142,783</td>
<td>0.617</td>
<td>0.670</td>
<td>0.451</td>
<td>4</td>
</tr>
<tr>
<td>Corbin Island</td>
<td>1974</td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Green Island (Fortune Bay)</td>
<td>2001</td>
<td>65,280</td>
<td>0.747</td>
<td>0.874</td>
<td>0.653</td>
<td>2</td>
</tr>
<tr>
<td>Little Fogo Islands</td>
<td>1975</td>
<td>38,000</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Middle Lawn Island</td>
<td>2001</td>
<td>13,879</td>
<td>0.709</td>
<td>0.666</td>
<td>0.472</td>
<td>2</td>
</tr>
<tr>
<td>Iron Island</td>
<td>1974</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Small Island</td>
<td>2001</td>
<td>1,038</td>
<td>0.338</td>
<td>0.223</td>
<td>0.076</td>
<td>6</td>
</tr>
</tbody>
</table>


RESULTS

The distribution of Leach’s Storm-petrel breeding colonies in Newfoundland and Labrador is shown in Figure 1, with details for the larger colonies in Table 1. In addition to the colonies in Table 1, another 7 have population sizes in the 1,000-10,000 range, 12 are in 100-1,000 range and 32 have between 1-100 breeding pairs. The information available on trends for Newfoundland shows that most larger colonies appear stable, while two smaller colonies showed declines since the early 1980s (Figure 2). As the estimate of 533,186 pairs
available for Gull Island in 1979 (Cairns & Verspoor 1980) was based on a single transect through habitat that had unrepresentatively high burrow densities, the apparent decline from 1979 to 1984 is a sampling artefact. Occupancy rates were relatively consistent among colonies, while burrow densities were much more variable (Table 1).

**DISCUSSION**

Newfoundland harbours some of the largest Leach’s Storm-petrel colonies in the world, totalling over 4 million breeding pairs. The distribution of colonies is highly skewed, with Baccalieu Island holding 3.36 million pairs (Sklepkovych & Montevecchi 1989), a few colonies harbouring 100s or 10s of thousands of pairs and a collection of smaller colonies of tens, hundreds or thousands of pairs. All large colonies have been surveyed at least once (although Corbin Island requires a thorough re-assessment) and are reasonably well known. On the other hand, most small colonies have only been visited once, have not had quantitative assessments of population size, and many more are likely to have gone unnoticed. The majority of the colonies occur in eastern Newfoundland, a distribution typical of most pelagic seabirds breeding in the province. This is likely a function of the proximity to appropriate foraging grounds near the continental shelf break. Labrador has a few known colonies, with numbers of pairs in the tens or hundreds, and represents the northern breeding limit of this species in the Northwest Atlantic. Québec has only a small population of Leach’s Storm-petrels, while Nova Scotia supports some larger colonies (tens of thousands) and may have over 100,000 breeding pairs (Huntingdon et al. 1996). New Brunswick and Maine support about 20,000 pairs, while Massachusetts represents the current southern breeding limit (Huntington et al. 1996).

Burrow occupancy rates did not vary greatly among colonies, ranging from 0.62-0.75, except for the sharply declining colony on Small Island (0.34). In contrast, excluding Baccalieu Island, burrow densities ranged from 0.22 to 1.87 burrows/m² across different islands; with Baccalieu Island itself showing an even greater range of 0.046-4.166 burrows/m². These ranges likely reflect habitat differences among islands, as burrow densities are related to habitat (Sklepkovych & Montevecchi 1989; Stenhouse & Montevecchi 2000). When used alone, the lack of range in occupancy rates, and the great range in burrow densities, make neither a suitable monitoring metric to assess population trends for this species in Newfoundland (except for crashing populations such as those on Small Island). Therefore, continued censuses to estimate island-wide breeding populations are recommended for future monitoring.

Both older and recent surveys used burrow grubbing to assess burrow contents. In other regions, the use of tape playbacks and/or video probes has
been recommended (Ambagis 2004; Mitchell et al. 2004). These two methods were attempted during recent surveys in Newfoundland, but reports from field workers suggested that they proved to be more difficult and less efficient than burrow grubbing. Playbacks proved difficult to interpret due to the high density of burrows. In Newfoundland, Leach’s Storm-petrel burrows tend to be relatively short and straight holes in peaty soils, making grubbing relatively easy (the contents could not be assessed for about 10% of burrows), especially in contrast to European Storm-petrels Hydrobates pelagicus which nest in crevices and in scree. However, further work will be conducted to investigate the value of these less invasive methods in assessing burrow occupancy.

Although the data on population trends for colonies in Newfoundland is somewhat sparse, a few patterns emerge from the available information. Firstly, between the 1970s-early 1980s to the late 1990s-early 2000s, there has been little change in the population size of the large colonies that have been monitored. On the other hand, the two smaller colonies that have been monitored have shown significant, and in the case of Small Island, precipitous, declines. Both these colonies share one feature; hundreds of pairs of Herring Gulls Larus argentatus and Great Black-backed Gulls L. marinus began nesting in the vicinity of these colonies since the 1970s (Robertson & Elliot 2002; Robertson et al. 2002).

It is not clear why these small colonies have declined in the face of gull predation, while the larger colonies appear stable. In the case of Green Island, light keepers are still present on the island, which keeps the island free of nesting gulls. Baccalieu Island is similarly gull free, due to the presence of red foxes Vulpes vulpes (Sklepkovych & Montevecchi 1989); although trend data for this island are not available. The large islands in Witless Bay support over 600,000 pairs of Leach’s Storm-petrels and harbour significant gull colonies, with approximately 2,900 pairs of large gulls on Gull Island and 1,700 pairs on Great Island (Robertson et al. 2001). Stenhouse et al. (2000) estimated that 49,000 Leach’s Storm-petrels were killed by gulls annually on Great Island alone, while Robertson et al. (2001) postulated that habitat-specific changes in gull nesting locations could lead to increasing predation pressure on Leach’s Storm-petrel. However, Leach’s Storm-petrel populations on Gull and Great Island appear to have been stable over the last 25 years. In general, breeding success of Leach’s Storm-petrel in Newfoundland is high and does not appear to vary greatly in response to ecosystem changes, as seen in other seabirds (Stenhouse & Montevecchi 2000; Regehr & Rodway 1999). Consistently high chick production, and the subsequent abundance of young pre-breeding cohorts, could explain how these mortality levels are maintained. Clearly, more work is needed to understand the degree to which Leach’s Storm-petrel populations are impacted by predation pressure from large gulls.
Additional threats to Leach’s Storm-petrel could include contaminants, as there are indications that Mercury (Hg) levels in the eggs of this species have risen from 1972-2000 in the Northwest Atlantic (Burgess & Braune 2001). Recent offshore oil and gas exploration and production on the Grand Banks and Scotian Shelf has increased the risk of Leach’s Storm-petrel colliding with offshore installations and being incinerated in gas flare booms (Wiese et al. 2001). Newfoundland has one of the largest chronic ship-source (bilge dumping) oil pollution problems in the world (Wiese & Ryan 2003). As surface feeders, storm-petrels consume hydrocarbons while foraging (Boersma 1986), which can impact chick survival and the reproduction of breeding adults (Trivelpiece et al. 1984). Unlike most major seabird colonies in the world, there is one significant threat that Leach’s Storm-petrel (and other seabirds) in Newfoundland are not currently facing, that is the introduction of predatory mammals or other invasive species (e.g. rats or rabbits). However, monitoring will be required to ensure that this remains the case.

Given the extent of the current potential threats, and uncertainties surrounding the impact of gull depredation, continued monitoring of Leach’s Storm-petrel in Newfoundland is clearly warranted. A survey of the large colony on Baccalieu Island is particularly critical for any future assessment of this population.

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dichtbij deze twee eilanden kan de populatie-afname op deze eilanden verklaren. Verschillen in habitatkwaliteit tussen de eilanden kan echter niet uitgesloten worden. Aan de andere kant leek massale predatie (een geschatte 49000 adulte vogels per jaar) van stormvogeltjes op Great Island, Witless Bay door grote meeuwen de broedpopulatie, die nu nog bestaat uit 270000 broedpaar niet gereduceerd te hebben. Hoewel het kolonies van Vaal Stormvogeltje in Newfoundland de laatste twee à drie decades voor de wind gaat, is een voortgaande monitoring aanbevolen gezien de potentiële bedreigingen door predatie (door meeuwen), gifstoffen, chronische olievervuiling en offshore olie- en gasproductie.

REFERENCES


