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Title

Diving Behavior and Identification of Sex of Breeding Atlantic Puffins (*Fratercula arctica*), and Nest-Site Characteristics of Alcids on Petit Manan Island, Maine

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Document Type

Open Access

Degree Program

Wildlife & Fisheries Conservation

Degree Type

Master of Science (M.S.)

Year Degree Awarded

2012

Month Degree Awarded

May

Keywords

seabird, foraging, nest characteristics, Atlantic puffin, Gulf of Maine, diving

Abstract

During 2008 – 2009, we quantified foraging behavior of adult Atlantic puffins (*Fratercula arctica*) by deploying time-depth recorders (TDRs) on 18 adults and collected morphological measurements from 40 adults nesting on Petit Manan Island, Maine. Dive data were successfully retrieved from 5 birds foraging for 14 days in 2008, and 8 birds foraging for 18 days in 2009. Pooling across all birds, a total of 8,097 dives were recorded, with peaks in activity during 0400-0800 and 1600-2000, and no diving between 2100 and 0400. Mean (\pm SD) dives/bird/day was 276.4 (\pm 84.7), with dives grouped into bouts lasting 17.8 (\pm 31.5) minutes, consisting of 8.9 (\pm 3.4) dives. Dive depth was less than 15 m for 86% of the dives. Mean maximum dive depth across birds was 9.7 (\pm 1.7) m, with the deepest dive being 40.7 m. Females made fewer deep dives (27-41 m), had more midday dives (1000 - 1559), and their dives were spread across a greater number of bouts per day than males. Given a mean foraging trip length of 60.1 (\pm 38.3) minutes for 26 birds observed in 2009, we estimate that adult puffins foraged, on average, within 31 km of the colony. Morphological measures were recorded by a single observer and included body mass, wing chord, bill depth, bill length, culmen, and head-bill length, and represented 19 males and 21 females, based on blood sample analysis. Data were analyzed using classification trees, and our final tree used culmen length and bill depth to correctly classify 34 of 40 (85%) birds ($\kappa = 0.695$, $P < 0.01$). Use of our model can greatly improve the ability of biologists to identify sex of puffins in the field at this colony site, but variability in morphological data we collected at addition colonies indicates that future work is needed to determine its applicability throughout the Gulf of Maine. During 2009, we measured burrow characteristics of alcids and empty burrows. Breeding success and burrow characteristics were measured for nests of 104 puffins, 58 guillemots and 4 razorbills, with burrow characteristics measured for an additional 12 guillemot and 56 empty burrows. Mean diameter of burrow openings of puffins, guillemots, razorbills and empty burrows were significantly different, and artificial puffin burrows had significantly smaller openings than natural while artificial and natural guillemot burrows had similar opening diameters. Hatch, chick, and nest success of puffins was similar among burrow types, but guillemots had higher hatch and nest success in artificial burrows. The variables we used to create models for predicting hatch and nest success for puffins and guillemots had inadequate discriminatory power to predict success.

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