Note

Habitat as a Potential Factor Limiting the Recovery of a Population of Nocturnal Seabirds

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ABSTRACT We asked whether the lack of a population response by ancient murrelets (*Synthliboramphus antiquus*) to eradication of rats (*Rattus* spp.) at Langara Island could be due to a change in vegetative cover. We quantified ancient murrelet habitat associations on 12 islands and assessed changes in vegetation at Langara Island between 1981 and 2007. We found that ancient murrelets exhibit a high degree of flexibility in their use of available breeding habitats, and we noted no changes over time. Thus, recovery of ancient murrelets at Langara Island is unlikely to be limited by habitat quality. We propose artificial social attraction as a method to speed recovery.

STUDY AREA

We conducted our study on 13 islands in Haida Gwaii, British Columbia (Fig. 1) ranging in size from 7.3 ha to 3,105.0 ha. All islands were forested; the dominant tree antipredator bene“ts of increasing canopy cover against the increased danger in having more obstacles (i.e., branches and trunks) to avoid when ”ying into colony sites (Heath 1915); 4) avoid dense shrub cover, as increasing shrub cover increases the risk of colliding with obstacles while ”ying through the area to attend the colony (Heath 1915); and 5) favor areas with mossy ground cover (Vermeer and Lemon 1986). Finally, as larger islands in Haida Gwaii support larger colonies (Gaston 1992), likely because of the amount of shoreline and subsequently breeding habitat close to shore, we predicted that ancient murrelets would 6) be more likely to breed on islands with greater shoreline perimeters.

Habitat on 12 islands in Haida Gwaii free of introduced predators was quanti“ed by the Canadian Wildlife Service (CWS) branch of Environment Canada using distance sampling with transects and quadrats between 1980 and 1986 (Fig. 1). Island area, number of transects, transect lengths, distance between transects, quadrat size, and distances between quadrats varied among islands (Table 1). Speci“c details of sampling methods are available elsewhere (Rodway et al. 1988, 1990, 1994). The survey design required transects to run through the extent of the colony and up to 2 quadrats beyond the colony boundary. On small islands this meant transects ran across the island and therefore sampled habitat throughout the island, whereas on larger islands transects ended before reaching the center of the island, meaning the interior habitat of the island was not sampled. Within each quadrat, measures of habitat (including slope, ground cover species, and shrub and canopy cover percent) were noted. For this analysis, we simpli“ed our habitat data to re”ect dominant ground cover species (i.e., species with > 50% cover and classi“ed them as moss, grass, or other), and percentage total shrub and canopy cover. We calculated distance to nearest shoreline using a map with plotted transect lines. We estimated shoreline perimeter using a Geographic Information System (GIS), and modeled shoreline using a Terrain Resource Information Management (TRIM„1:20,000) digital data set that delineated coastal island boundaries as ••the apparent high water mark,•• and was digitized from ortho-photographs.

We based presence of breeding birds within each quadrat on the presence of adults, eggs, hatched eggshells, eggshell membranes, and/or chicks in burrows. We searched all burrows within a quadrat by hand and noted the contents, including bird sign at the entrance (i.e., worn tunnels, feathers, and droppings). We controlled for differences in quadrat size by assigning each quadrat as either occupied by ancient murrelets or not, as opposed to using the number of occupied burrows within each quadrat.

At Langara Island, habitat surveys were conducted in 1981 by CWS personnel using the same methods (Rodway et al. 1994). We repeated these surveys and quanti“ed habitat models using Akaike•s Information Criterion for small sample sizes correcting for overdispersion ($QAIC_c$) by including an estimate of model deviance ($\hat{c}$ = model deviance/df) for the global model, and used $QAIC_c$ weights (w_i) to evaluate model likelihood (Burnham and Anderson 2002). We present models with a difference in $QAIC_c$ value, relative to the smallest value, $\Delta QAIC_c > 10$ and a w_i 0.

RESULTS

During 1980…1986, 1,118 quadrats were surveyed along 121 transects on 12 islands free of introduced predators. Quadrats ranged in size from 25…49 m^2 for a total of 45,854 m^2 surveyed, of which 18% (8,463 m^2) was occupied by ancient murrelets. Overall, we observed little difference in physical habitat feature use and availability (Fig. 2). Similarly, our analysis did not reveal selection for any of the habitat variables used in this analysis; the top-ranked model was the null model. This model received virtually all the support among the candidate models and over 5 times more support than the second best supported model (Table 2). Further, all of the habitat parameters included in the analysis had parameter estimates of 0.

Researchers surveyed 160 and 134 quadrats along 58 transects on Langara Island in 1981 and 2007, respectively. All quadrats were 25 m^2 in area for a total of 4,000 m^2 and 3,350 m^2 surveyed in 1981 and 2007. We noted no differ-

manner that other species use conspeci“c aggregations as a compass when searching for foraging patches (Weimerskirch et al. 2010). Furthermore, ancient murrelets in Haida Gwaii do not necessarily dig burrows but rather compact the ground and make use of natural openings or cavities (Gaston 1992). We did not have data on soil properties, but believe this could be an in”uential factor related to breeding site selection that