

Ecology

The marbled murrelet (*Brachyramphus mar-moratus*) is an auk found along the Pacific coast of North America. They are listed as a Species at Risk in Canada.

Nests are on large branches in trees > 20 m tall and are very hard to find.

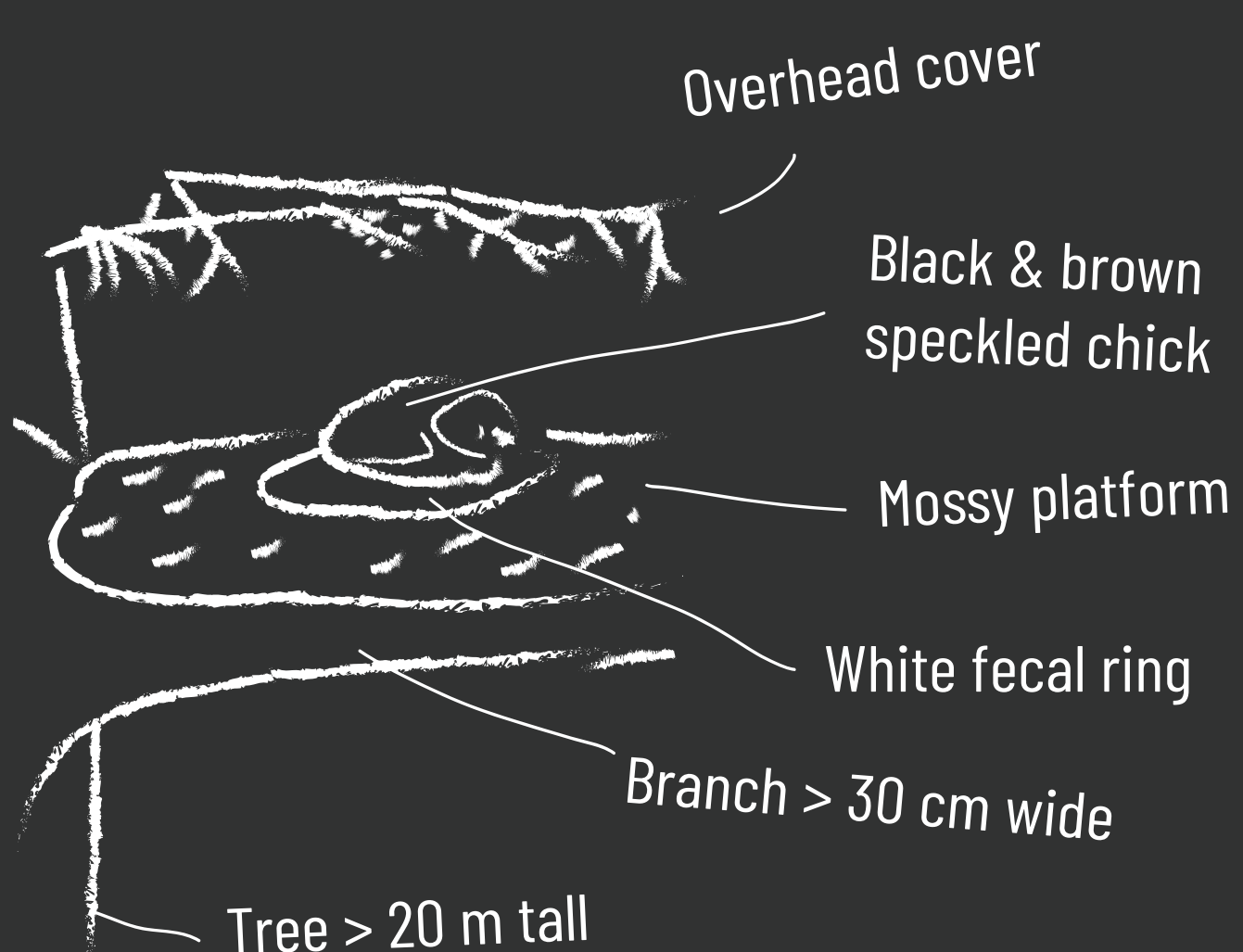
Nest platforms usually contain epiphytes for nest substrate and overhead vegetative cover for protection.

They feed in the ocean daily, flying up to 80 km back to the nest.

Loss of nesting habitat is the primary cause of population decline.

In BC, recovery efforts aim to retain >70% of suitable nesting habitat compared to a 2002 baseline.

Nest sketch



More info



Modeling Marbled Murrelet Nesting Habitat Using Airborne Laser Scanning (ALS) Data in BC, Canada

Authors: C. Cosgrove¹, N. Coops¹, F.L. Waterhouse²

¹Faculty of Forestry, UBC, Vancouver, Canada ²BC Ministry of Forests, Nanaimo, Canada



Cameron Cosgrove
cosgrOve@mail.ubc.ca

Aims

Accurate **maps of nesting habitat are essential for forest management** in British Columbia (BC). Existing habitat maps are qualitative and coarse scale. Therefore, we aimed to:

- Produce a **quantitative fine scale habitat model** of murrelet nesting habitat using ecologically relevant predictors.
- Assess what modeling approach performs best with a low sample size.
- Explore how ALS model predictions compare with existing qualitative habitat mapping.

Data & Methods

Nest data: 58 nests for training (area A) 21 nests for testing (area B). Location error of ± 50 m.

ALS data: Covers two study sites: A (198,325 ha) and B (130,009 ha). Average point density 35 points m^{-2} .

Model predictors: All designed to capture key nesting features at 100 m^2 (Figure 1).

Modeling: Ensembles of Small Models (ESM) and MaxEnt were tested. Both are suitable for modeling rare species with low sample sizes (Table 1).

Model Comparisons: For area A the best model was compared to existing low level aerial surveys of murrelet habitat (Figure 4)

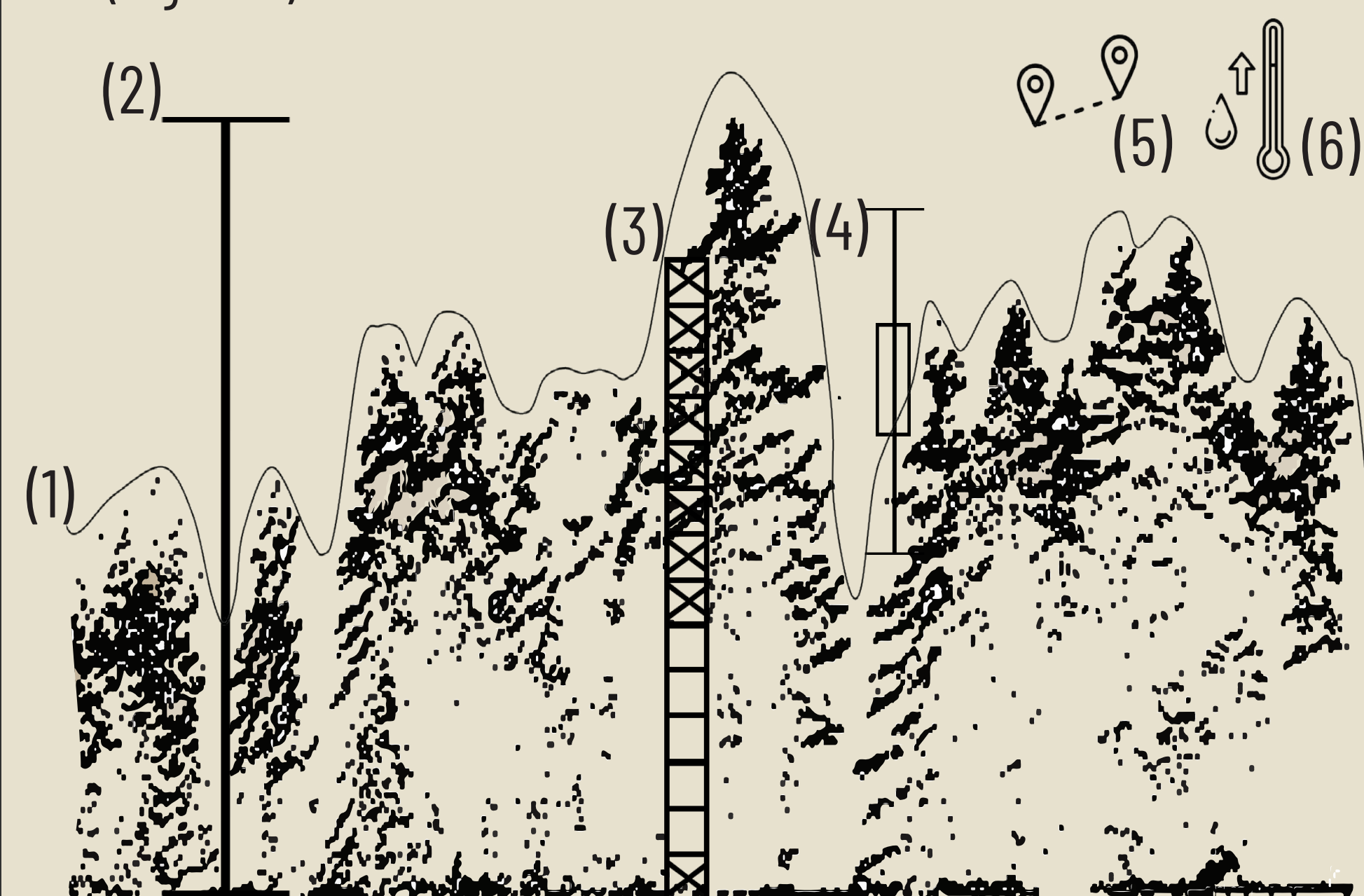


Figure 1: A 1 m cross section of ALS data showing representations of the model predictors. 1: Canopy Surface Area. 2: Forest Height. 3: A count of the number of empty 1 m^3 voxels found below the canopy (X = vegetated voxel). 4: Standard deviation of point heights. 5: Distance to coast. 6: Climate Moisture Index.

Results

Table 1: Modeling results showing the approach, variable set, and model performance for the training area (A) and transfer area (B). The best performing model is highlighted in the table.

Approach	Variables	AUC A	Boyce A	AUC B	Boyce B
ESM	p95, csa, cmi, zsd, vox_canopy, dist_coast	0.685	0.906	0.631	0.355
ESM	p95, csa, zsd, vox_canopy	0.680	0.988	0.612	0.240
MaxEnt	p95, csa, cmi, zsd, vox_canopy, dist_coast	0.824	0.997	0.465	0.869
MaxEnt	p95, csa, zsd, vox_canopy	0.771	0.997	0.604	0.744
MaxEnt	q95, csa	0.651	0.801	0.49	-0.300
MaxEnt	q95, zsd	0.717	0.966	0.608	0.315
MaxEnt	q95, vox_canopy	0.771	0.992	0.604	0.457
MaxEnt	vox_canopy, csa	0.621	0.843	0.617	0.716
MaxEnt	vox_canopy, zsd	0.767	0.989	0.631	0.666
MaxEnt	csa, zsd	0.732	0.982	0.494	0.123

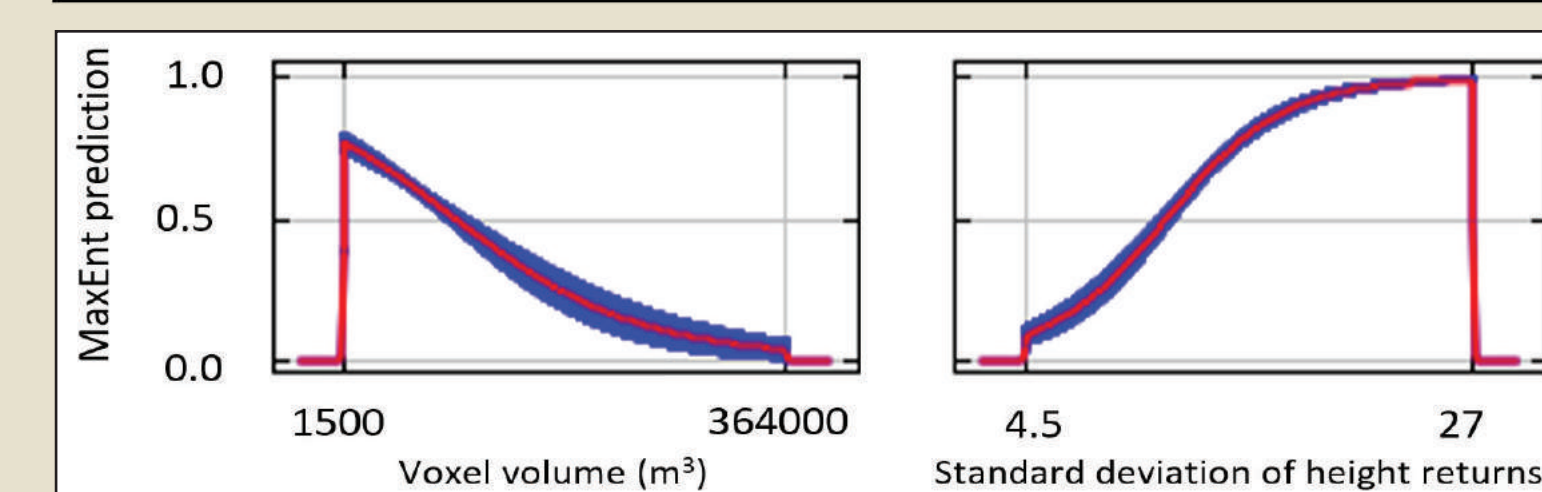


Figure 3: Predictor response plots for the best performing model.

Management use

Discrepancies between our model and existing habitat mapping (Figure 4) can be used to reassess potentially misclassified habitat, improving the reserve network for murrelets in BC.

Our model can be applied to new areas with no existing habitat information.

Key findings

- Ecologically relevant ALS models can predict murrelet nesting habitat in BC.
- A MaxEnt model with only two variables emerged as the best performing model.
- Our habitat predictions broadly align with existing mapping, but we found additional unmapped areas of high-quality habitat.
- Our model is useful for management. We recommend it is used in conjunction with existing habitat mapping to inform conservation and forest management decisions for marbled murrelets in BC.

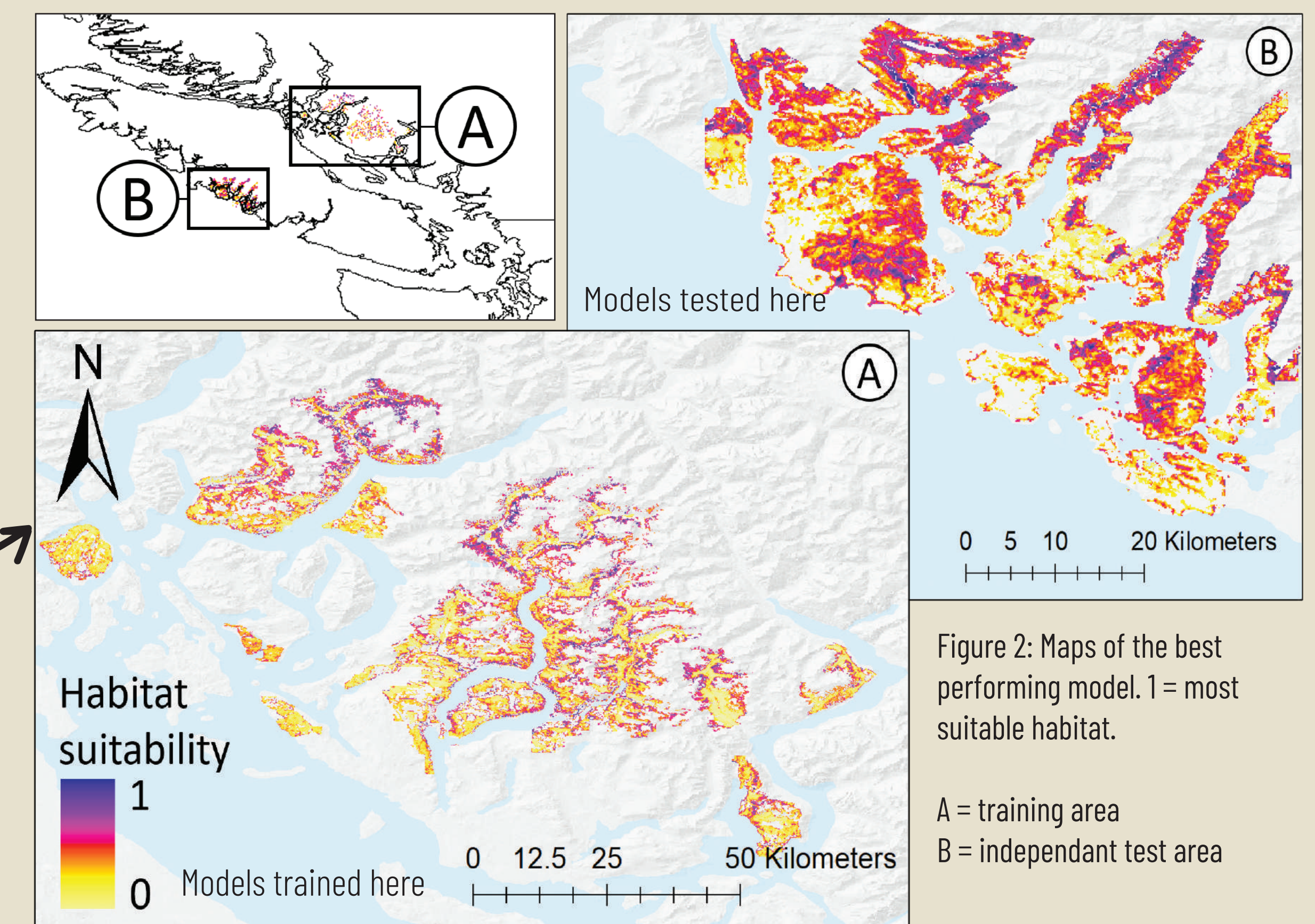


Figure 2: Maps of the best performing model. 1 = most suitable habitat.

A = training area
B = independent test area

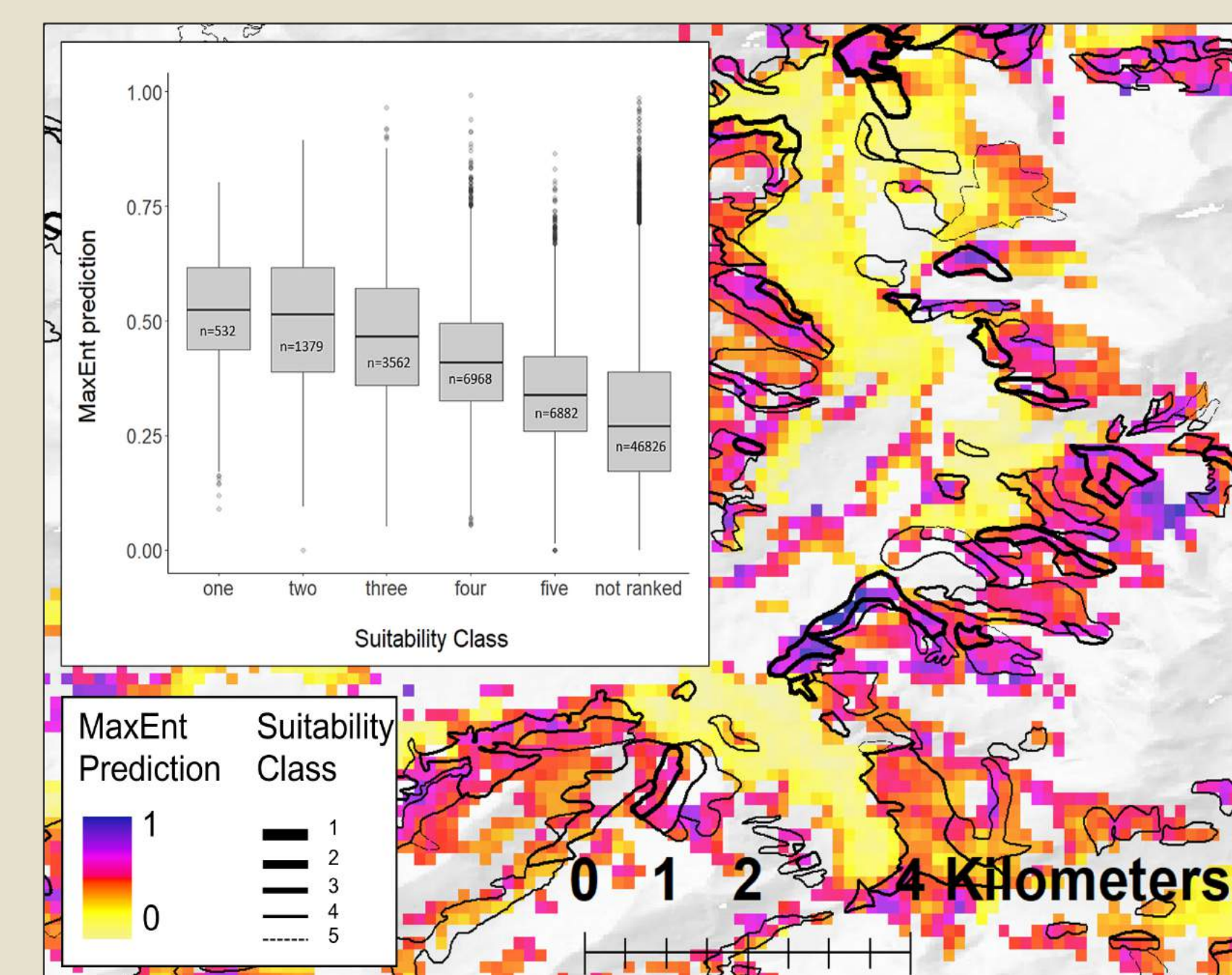


Figure 4: Box plots and a map overlay showing the distribution of MaxEnt habitat predictions within the low level aerial survey mapped habitat classes. Class one represents the most suitable habitat.

