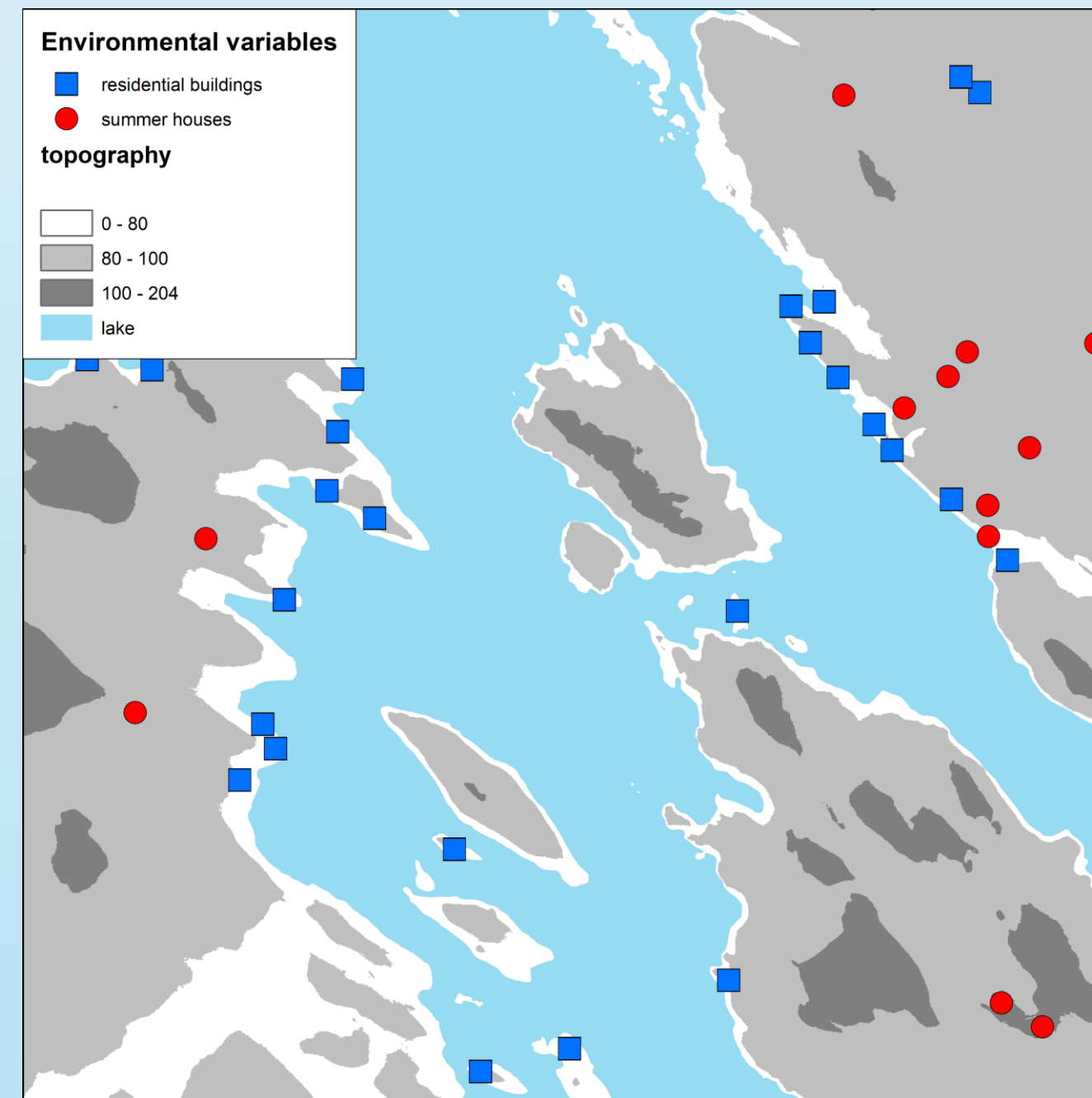
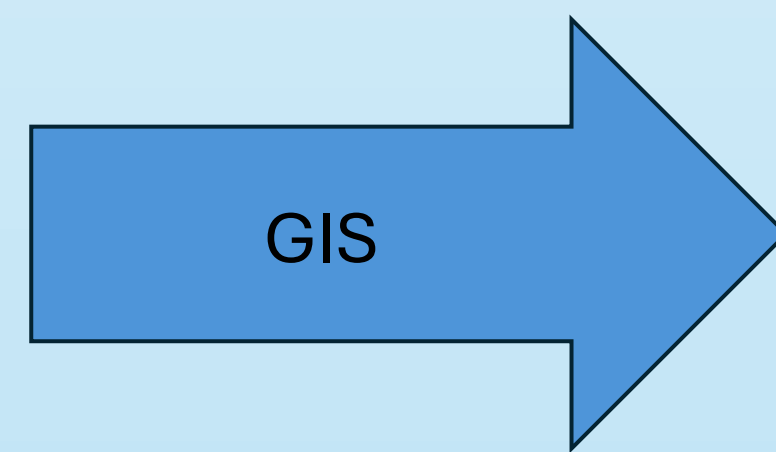


# Distribution models can help in planning the conservation of the Saimaa ringed seal

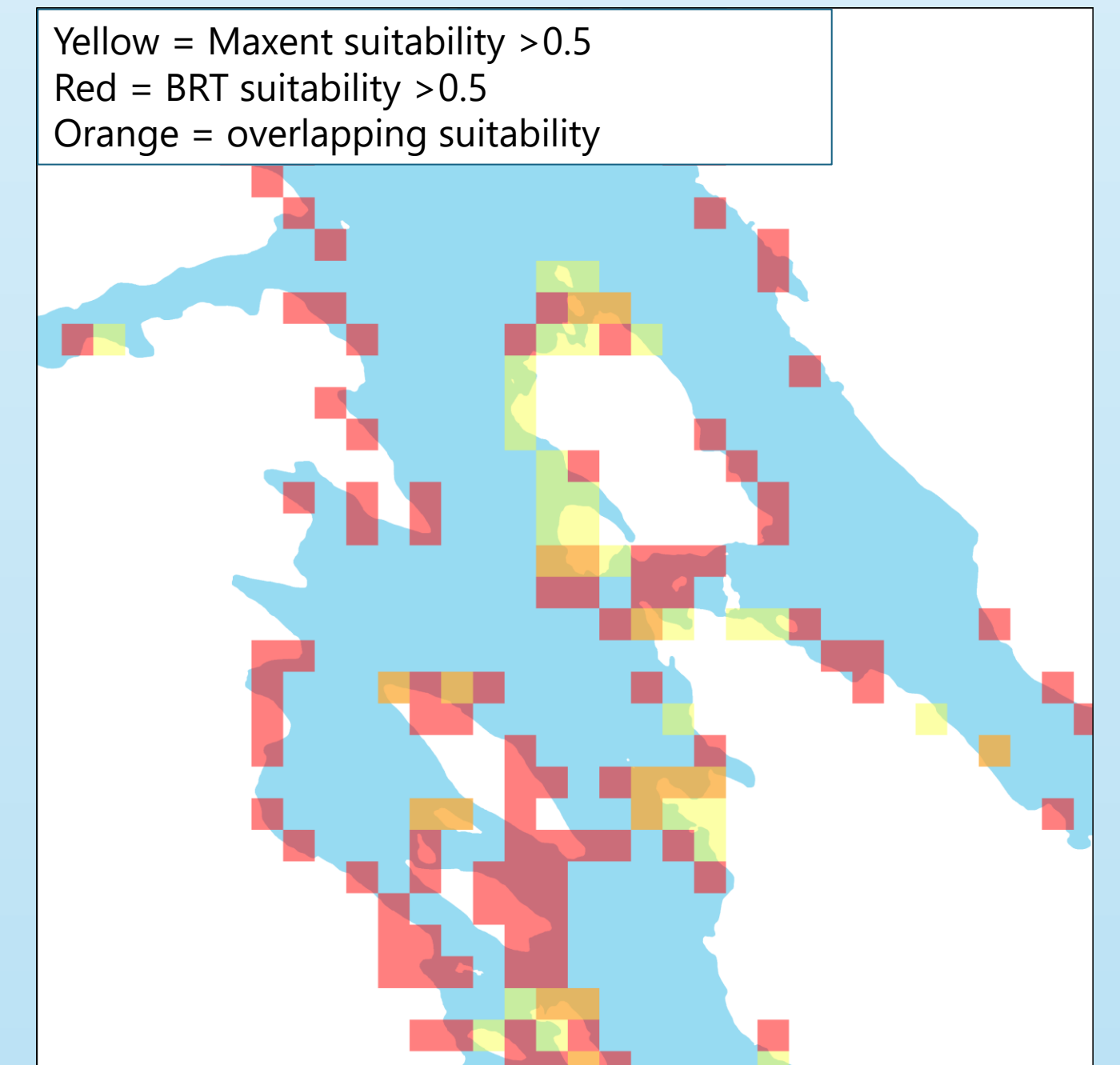
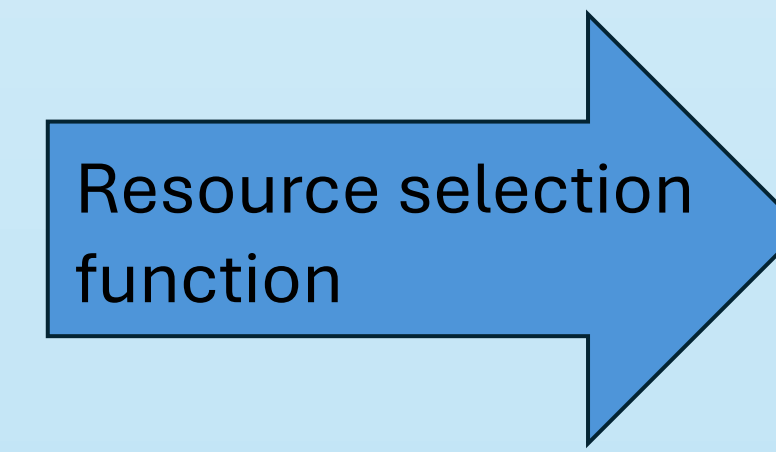
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Location of lair sites from censuses



Lair data and environmental variables



Maps of suitable areas for lairs

## Introduction

- The endangered Saimaa ringed seal (*Pusa hispida saimensis*) is endemic to Finland. It inhabits a freshwater Lake Saimaa that is greatly affected by human pressures, e.g., **shoreline development**.
- Seals dig subnivean lairs for breeding and hauling out into snowdrifts on shoreline ice.
- Observed lair sites of the ringed seal are considered in **land use planning** but information on potentially suitable areas is lacking.
- Maps of suitable areas are needed to make results transferable to conservation managers.

## Materials and methods

- Species distribution modelling software Maxent and boosted regression tree modelling in R: comparison of results.
- Breeding and haul-out lair data** from 2022 (N=437) including lairs both in natural and man-made snowdrifts. Comparison to available habitat (~5000 random points on shoreline).
- Environmental data** on 1. slope of shore, 2. open water area, and Euclidean distances to 3. residential buildings and 4. summer houses.
- Percentage of lairs from 1987 to 2023 overlaying the habitat suitability classes and the cardinal point location of the lair site shores were computed.

## Results

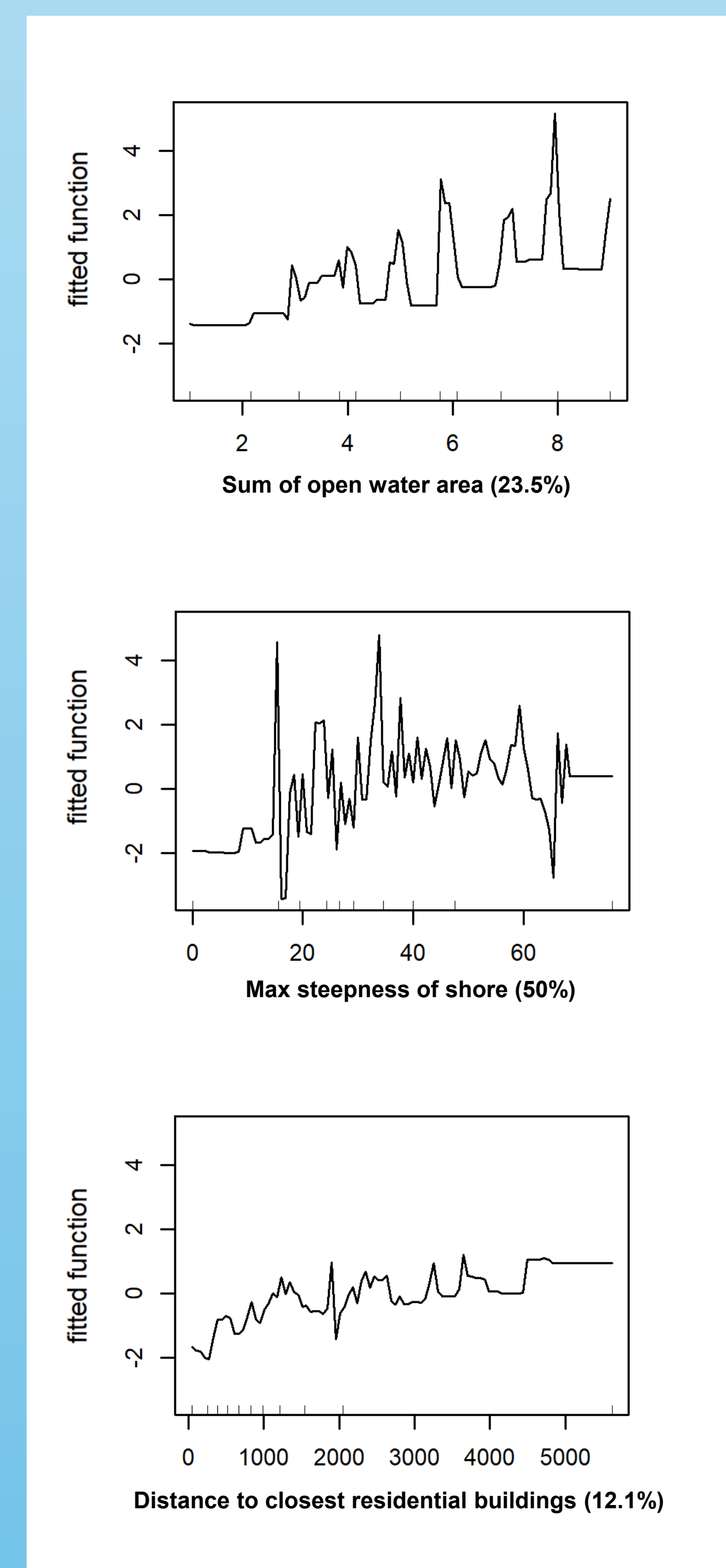
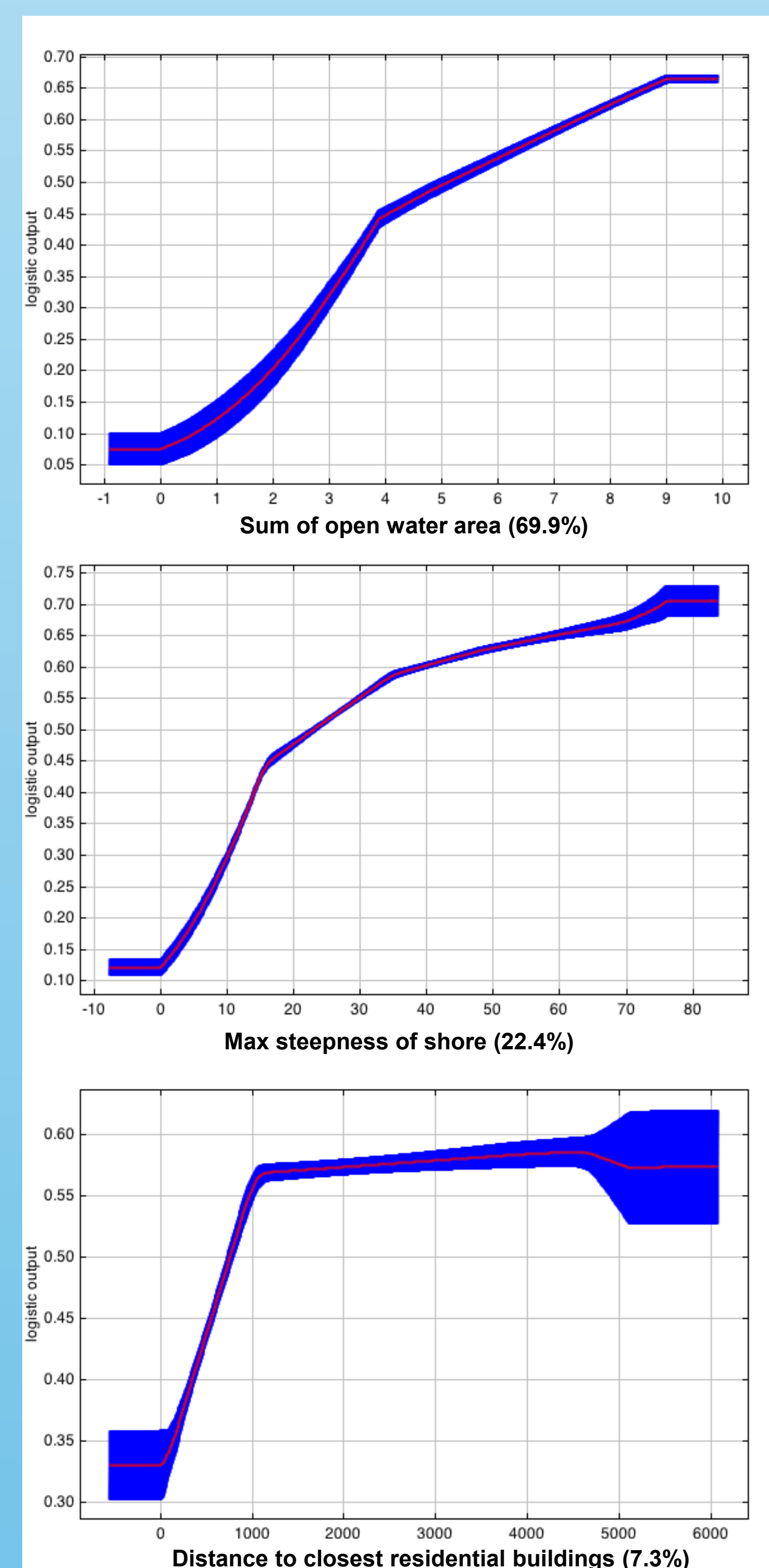
- Increasing amount of open water area and steepness of the shore** largely explain the occurrence of lairs in both Maxent and BRT models (Fig. 1). Distance of **>1 km from residential buildings** indicates highest suitability.
- Based on the maps, most of the good habitat consists of the **shores of islands and islets** rather than mainland shore. 47% of the lairs located on north-eastern and northern shores where snow typically lasts longer.
- Based on the Maxent and BRT models, only **12% or 26% (Maxent / BRT) of the available habitat is moderately or highly suitable** (>0.5 on a scale of 0-1) for the seals and 73% / 58% (Maxent / BRT) of observed lairs from 1987-2023 occurred in these habitats.

## Conclusions

- Information on suitable habitat and potential distribution should be utilized when coordinating conservation of the ringed seal and land use in the Saimaa area.
- The remaining suitable shoreline and the surrounding area should be left unbuilt** to conserve lair sites of this endangered seal. Unbuilt areas especially on northern or north-eastern shores should be conserved.
- Different distribution models may be applicable, but in this case Maxent performed slightly better. BRT projected more suitable habitats, but Maxent projected the most suitable habitats more accurately based on historical and present occurrence of the lairs.

## Main results

**Larger amount of surrounding open water area and increasing steepness of the shore contribute most to the location of Saimaa ringed seal lairs. In addition, sites that are over 1 km from the closest residential buildings are most suitable, emphasizing that the remaining suitable shoreline should be left unbuilt to ensure successful breeding and haul-out for the seals.**



**Fig. 1.** Amount of open water area, steepness of shore and distance to residential buildings increase the suitability of shore as lair habitat. Results from models in Maxent on the left (mean response of 15 model runs in red and mean SD in blue) and BRT on the right. The relative contribution/influence of predictors in the Maxent and BRT models is given in parentheses on the x-axis labels.



**METSÄHALLITUS  
 FORSTSTYRELSEN  
 MEHCIRÁÐDEHUS**

