# Ideas for spatial management of skates and rays in the Irish Sea

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Ecological Modelling 312 (2015) 77–90

Contents lists available at ScienceDirect

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel

# Modelling abundance hotspots for data-poor Irish Sea rays

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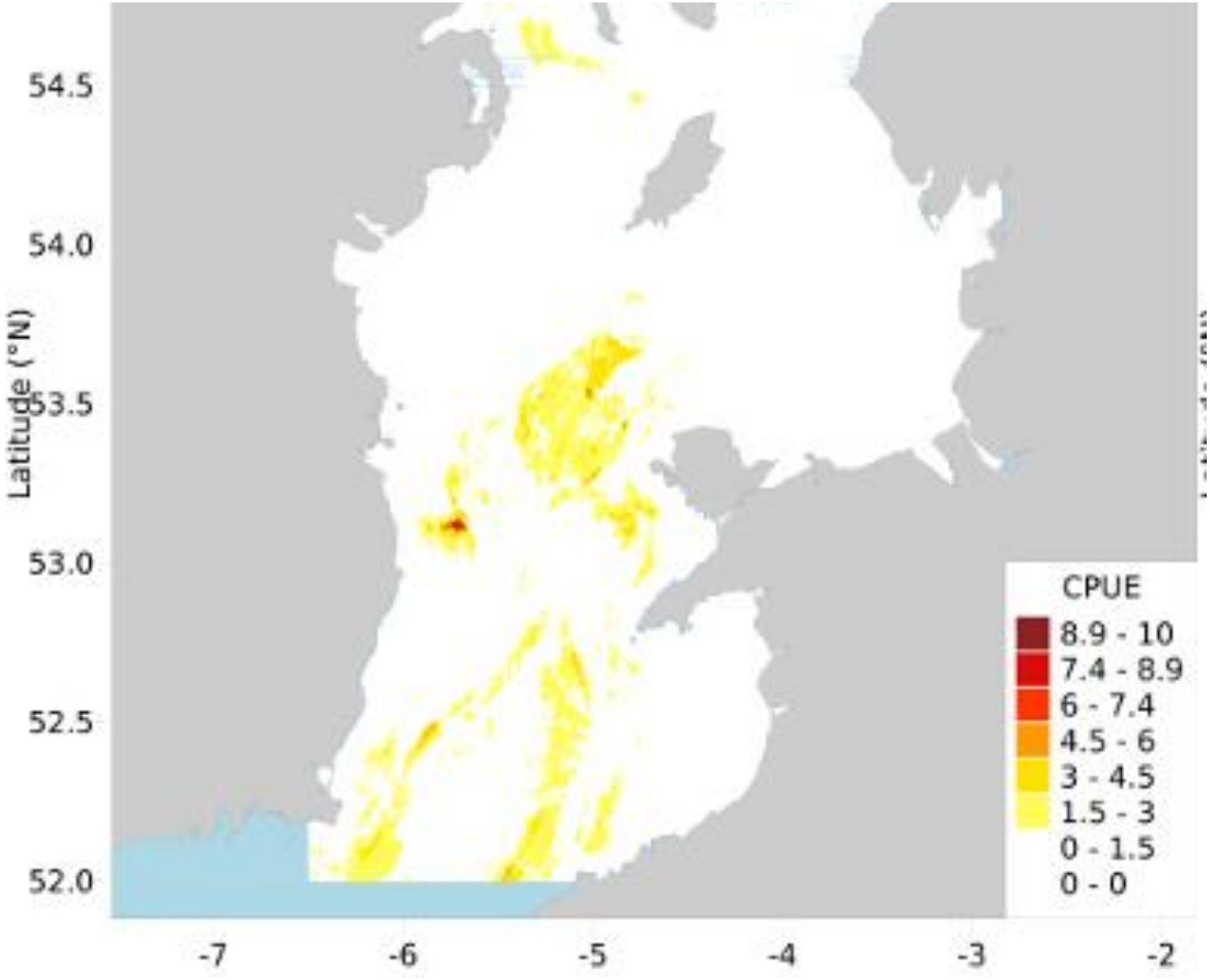
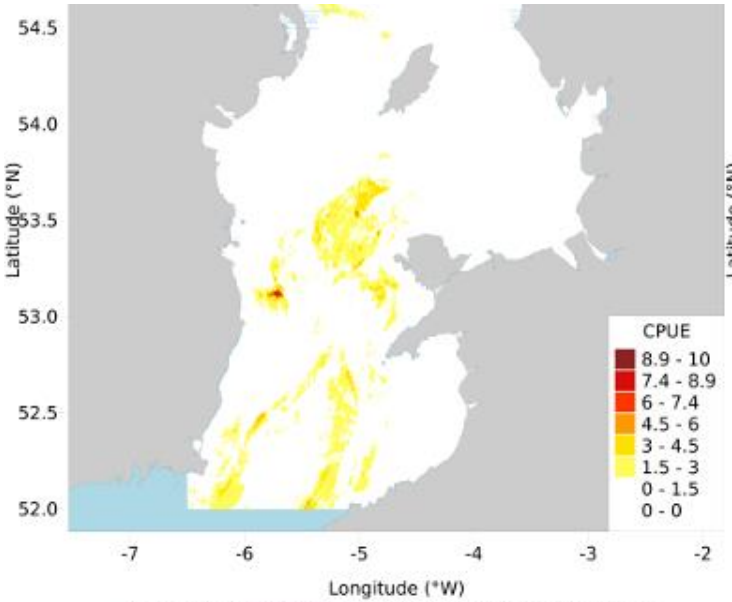
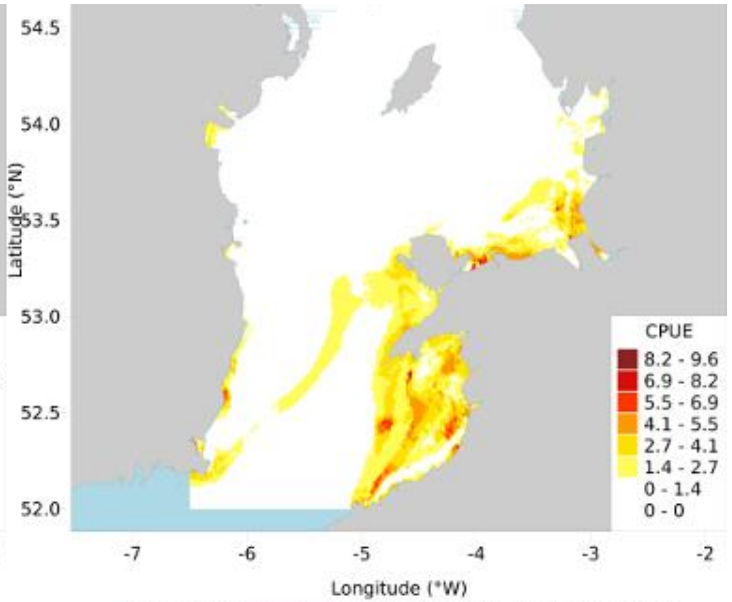
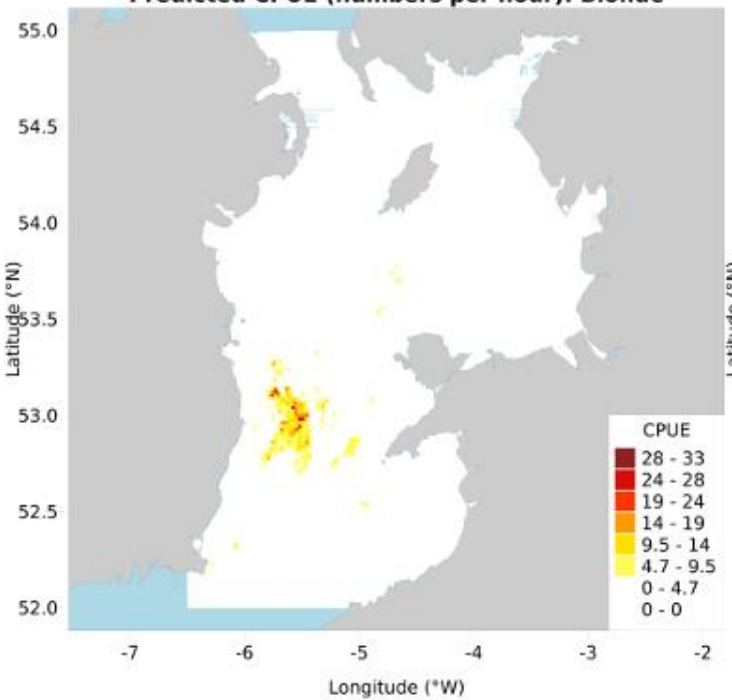
# Model the catch per unit effort from the surveys - For cuckoo ray

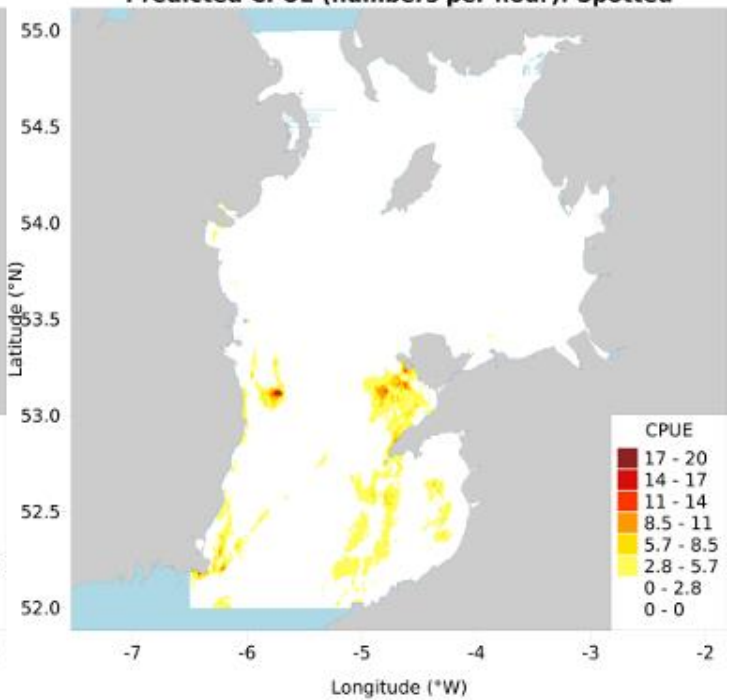


# - For cuckoo, thornback, blonde and spotted ray

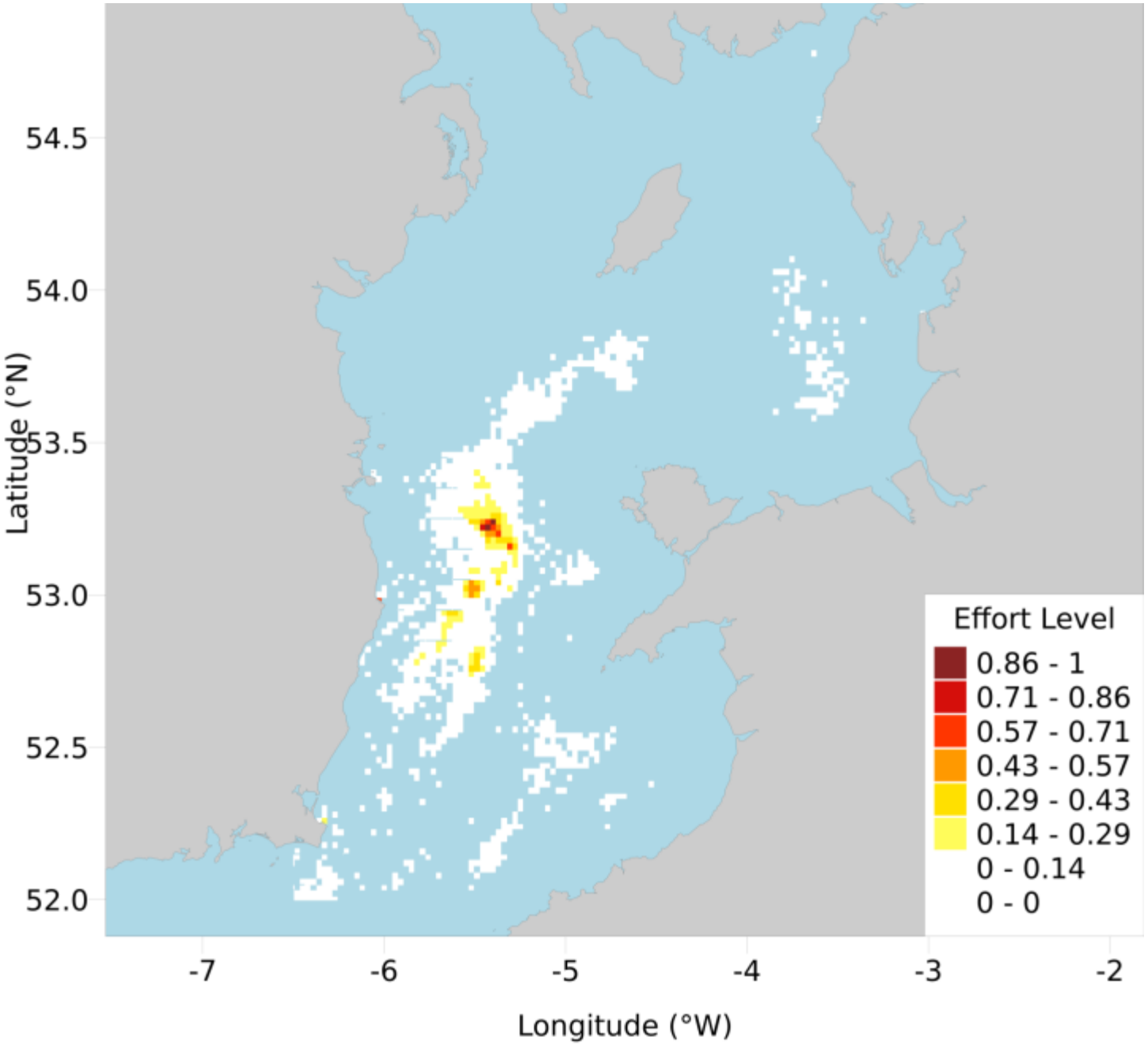


# Fishing effort



# Using maps to define candidate closures

# Estimate a CPUE that corresponds to an MSY Harvest rate

ICES Journal of Marine Science

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

ICES Journal of Marine Science; doi:10.1093/icesjms/fsu146

## Estimating biomass, fishing mortality, and "total allowable discards" for surveyed non-target fish

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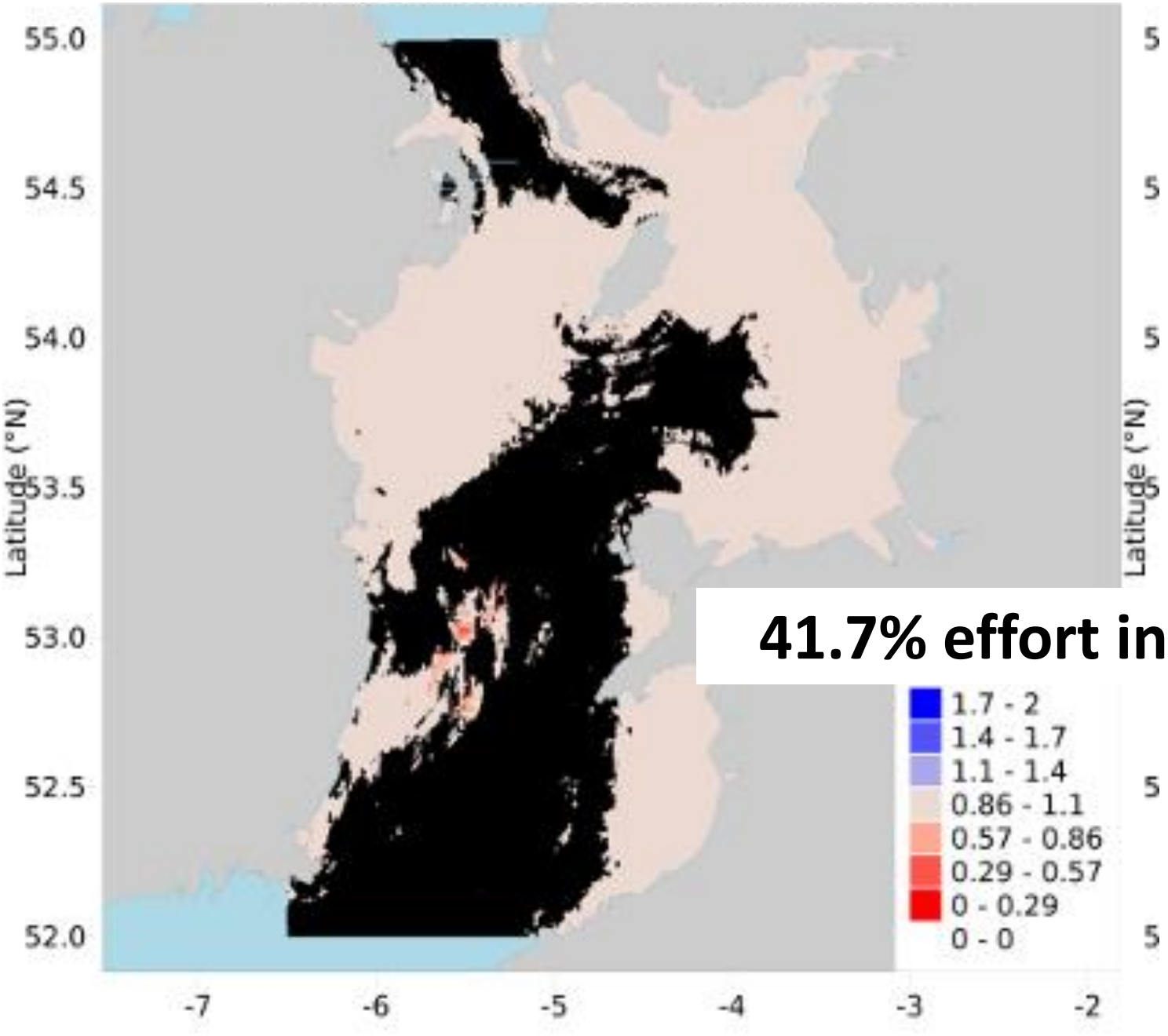
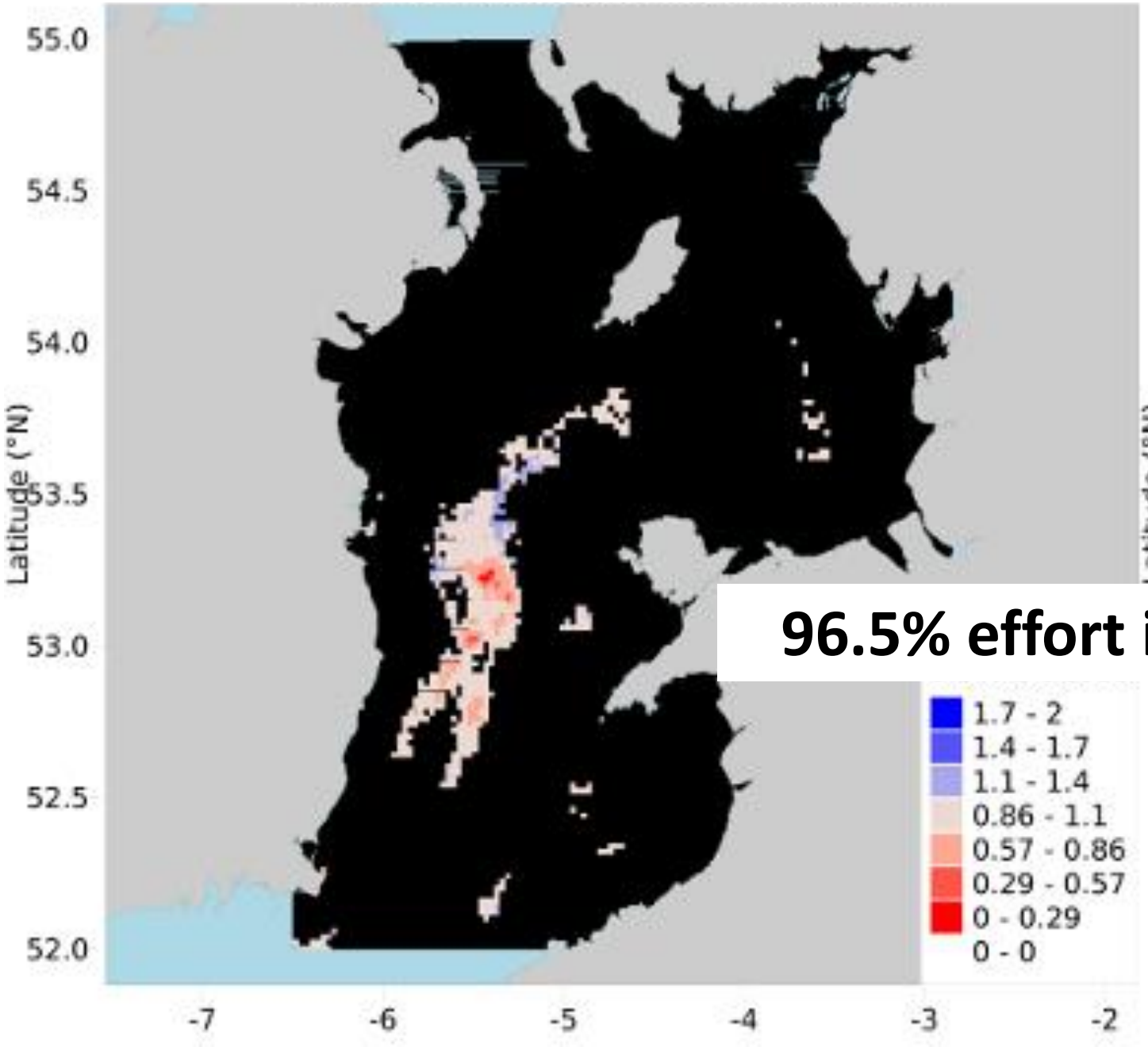
# Traditional closures (most biomass of ray)



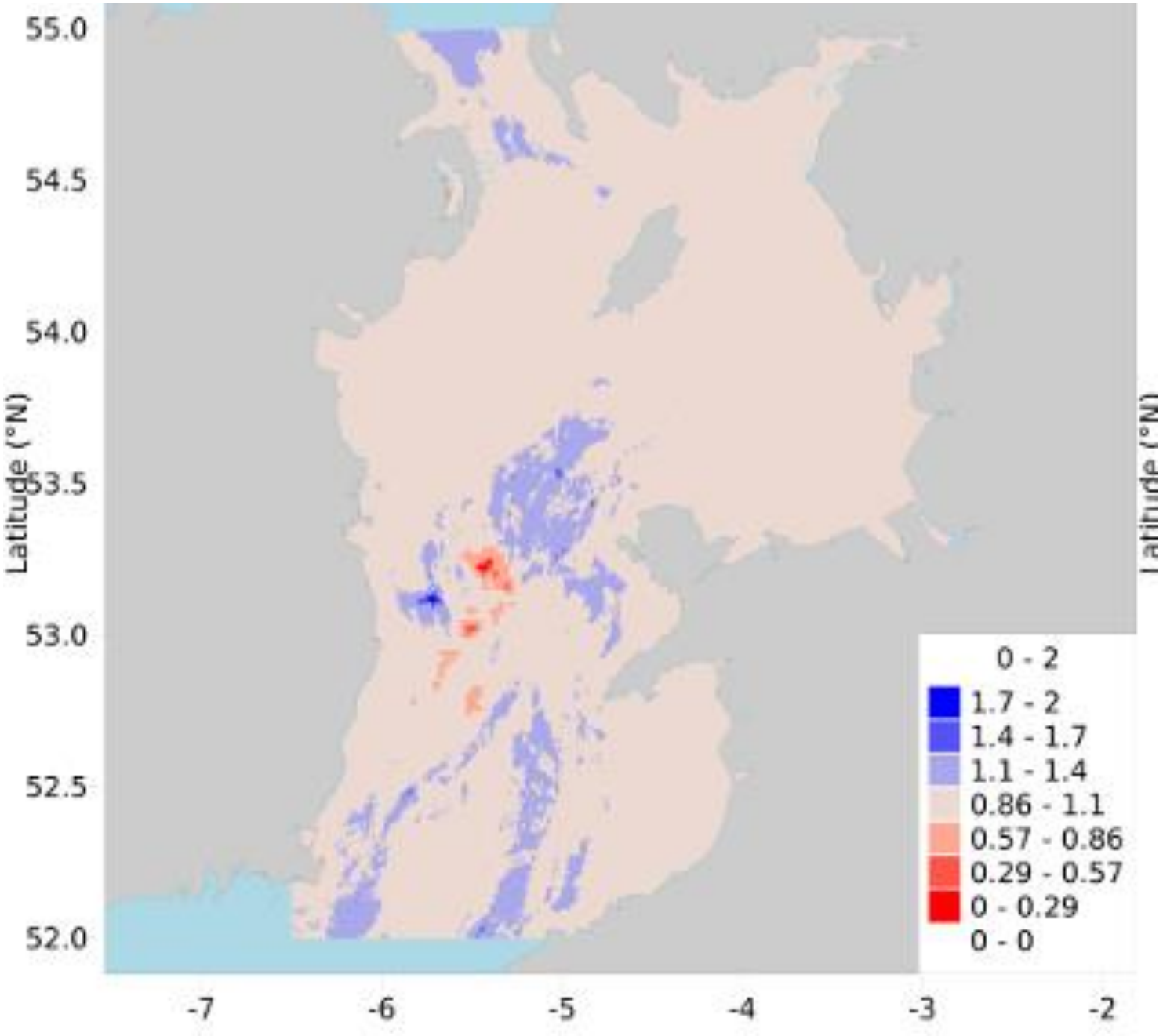

**41.7% effort intact**

# Effort based closure – least effort areas

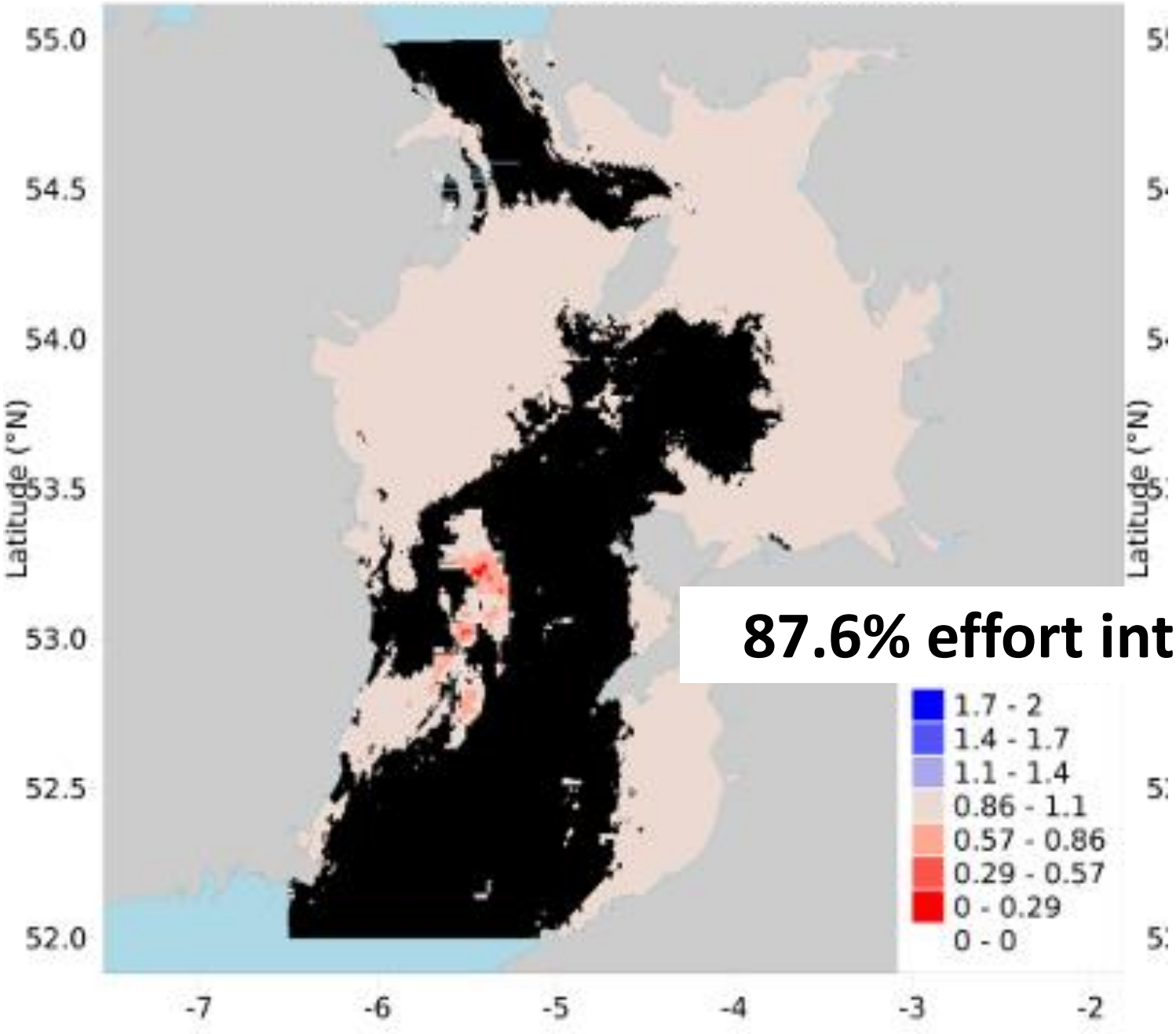



**96.5% effort intact**

# Cuckoo Survey CPUE and effort combined



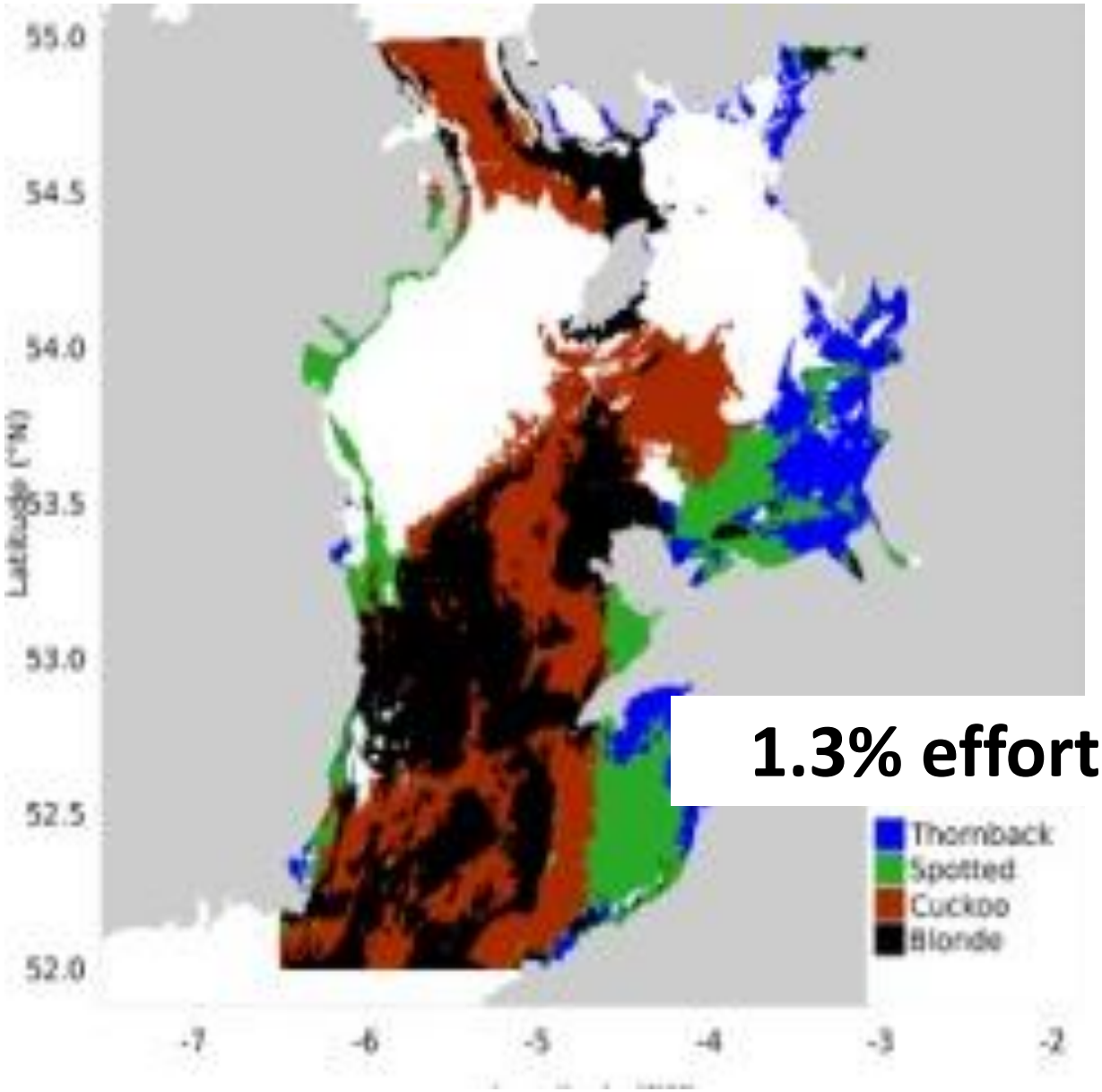
# Cuckoo Survey CPUE and effort combined closure




**87.6% effort intact**

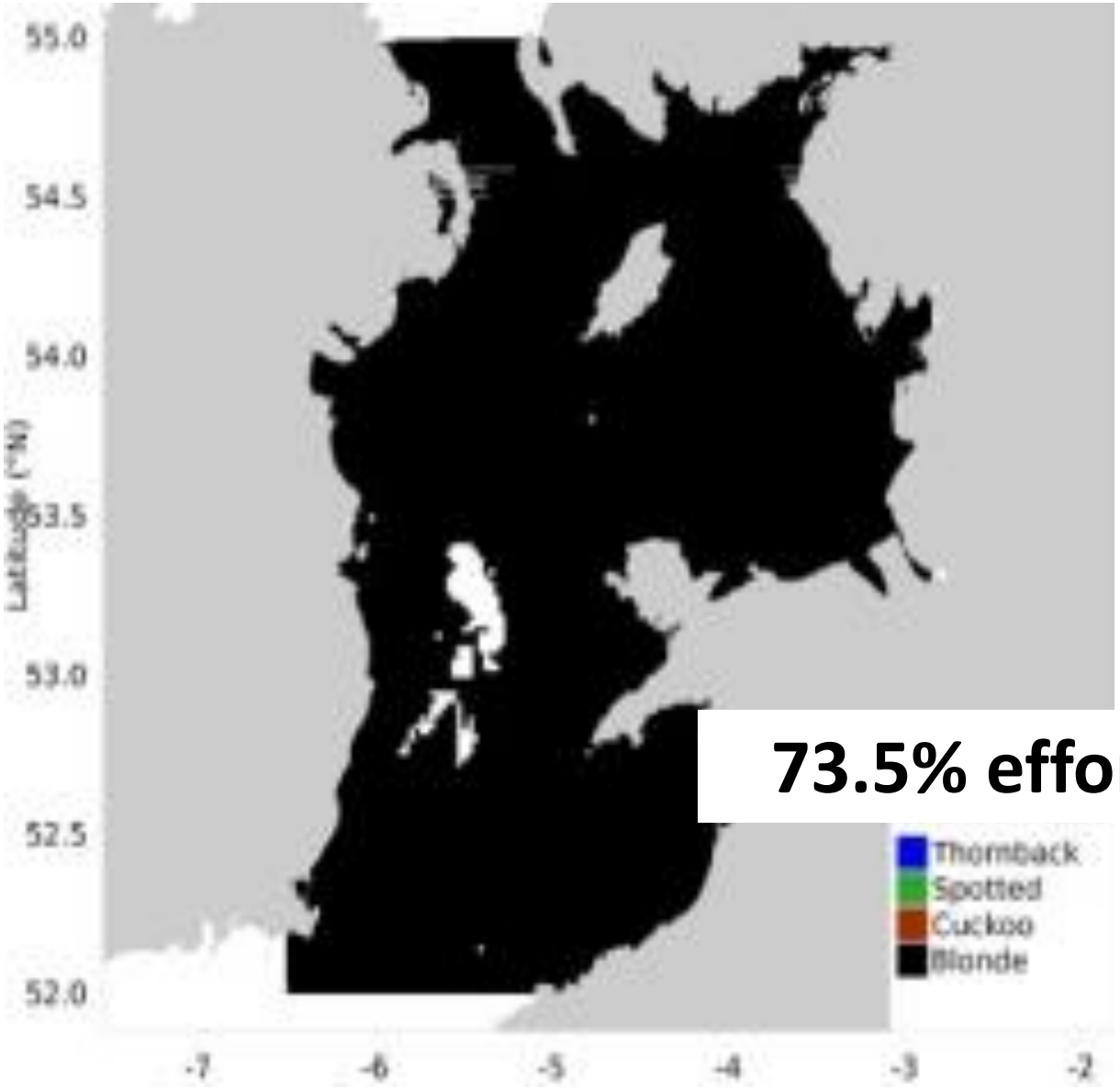
# Protection for all four species

# All species areas – biomass protection only



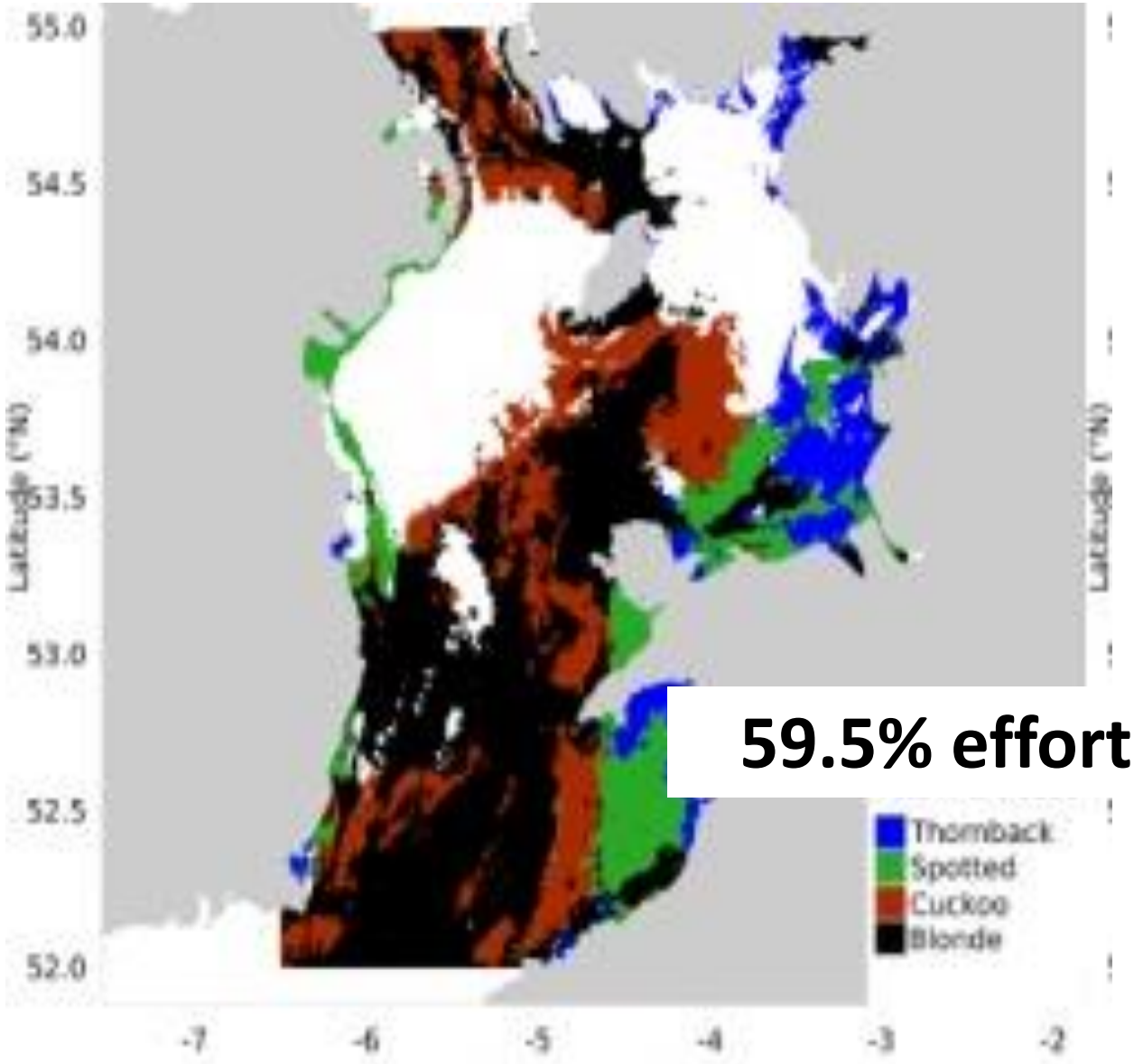

**1.3% effort intact!**

# All species areas combined – reverse effort




**73.5% effort intact**

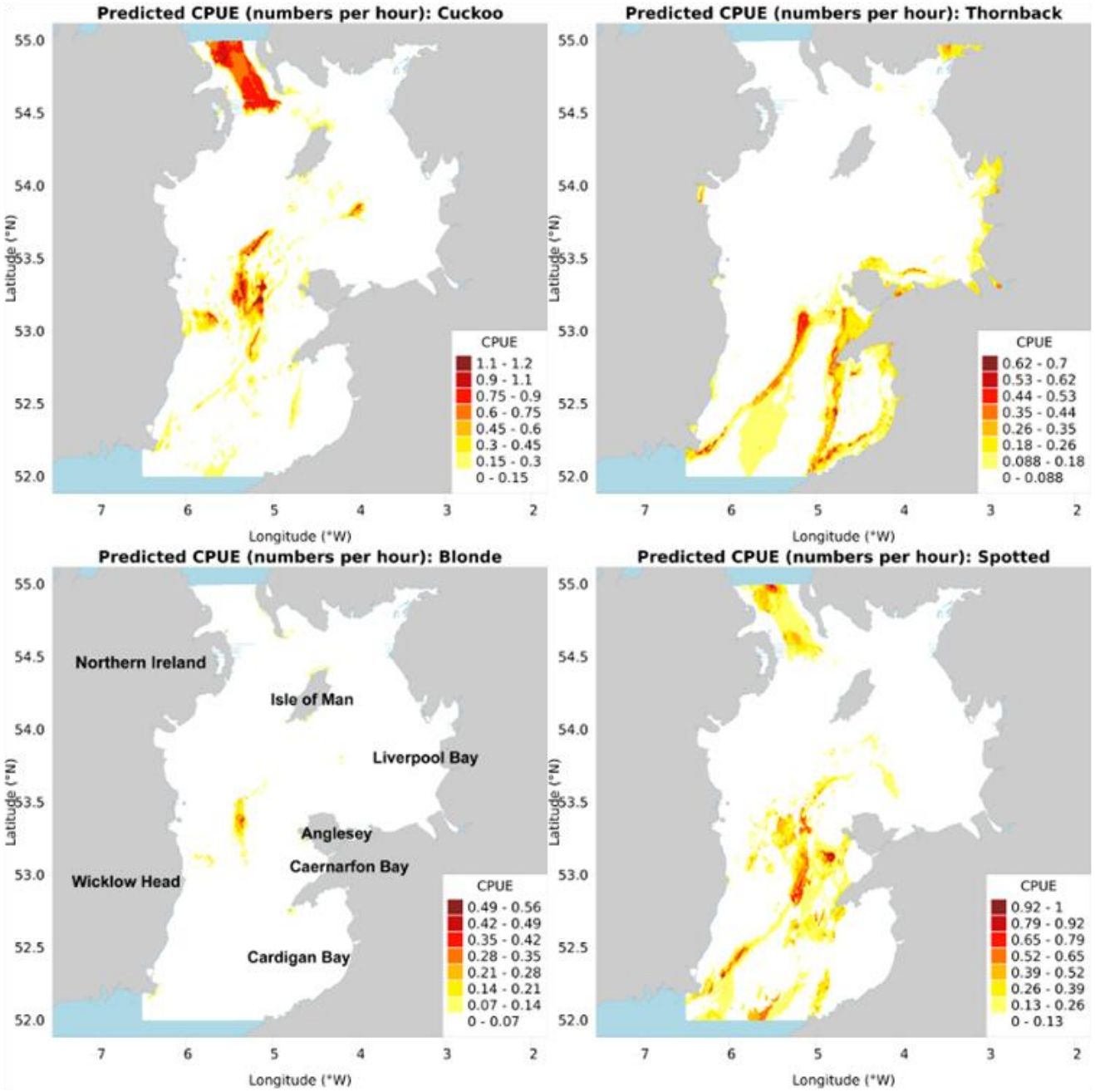
# Cuckoo Survey CPUE and effort combined closure



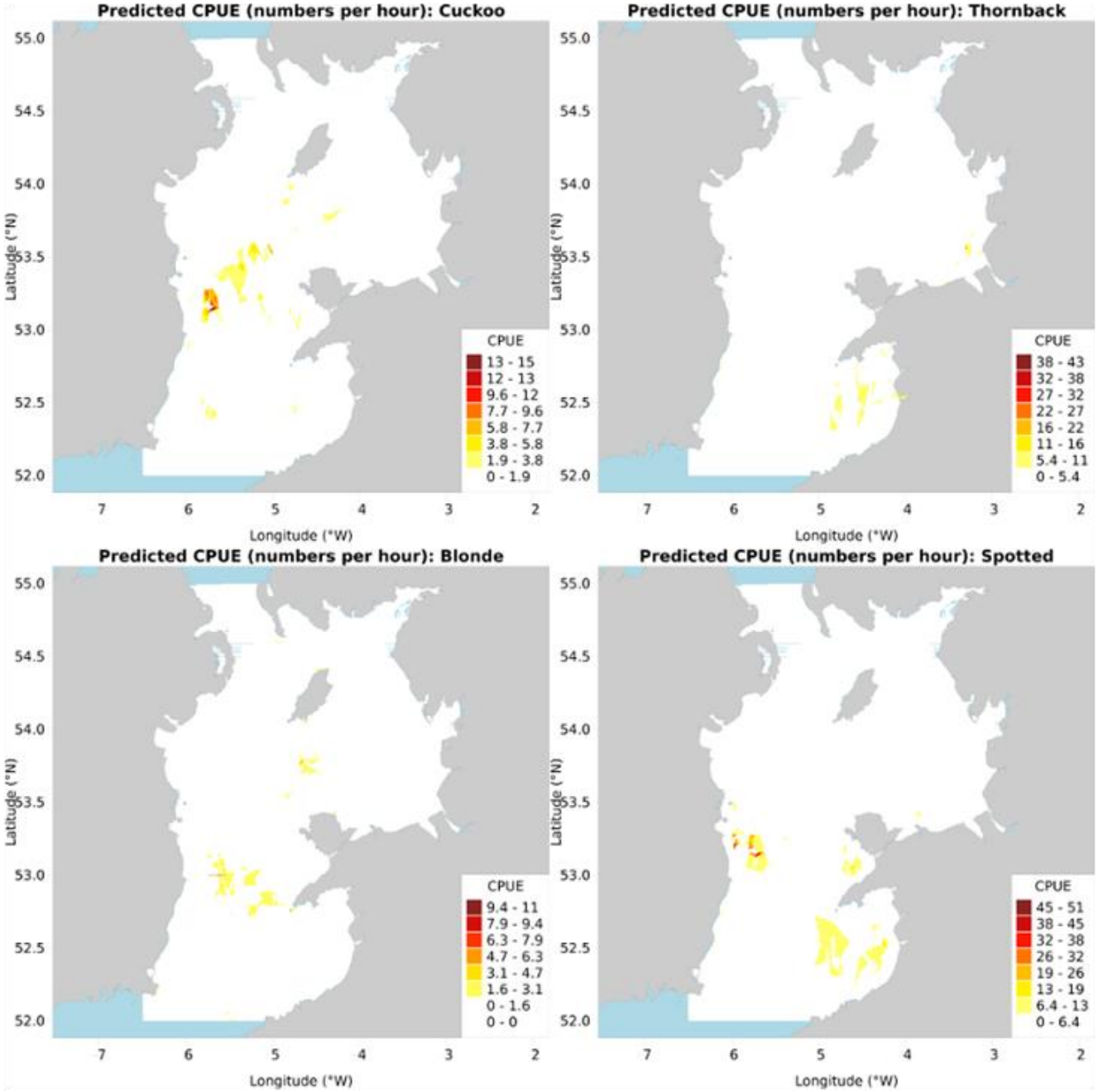

**59.5% effort intact**

# Protection for mature females and juveniles

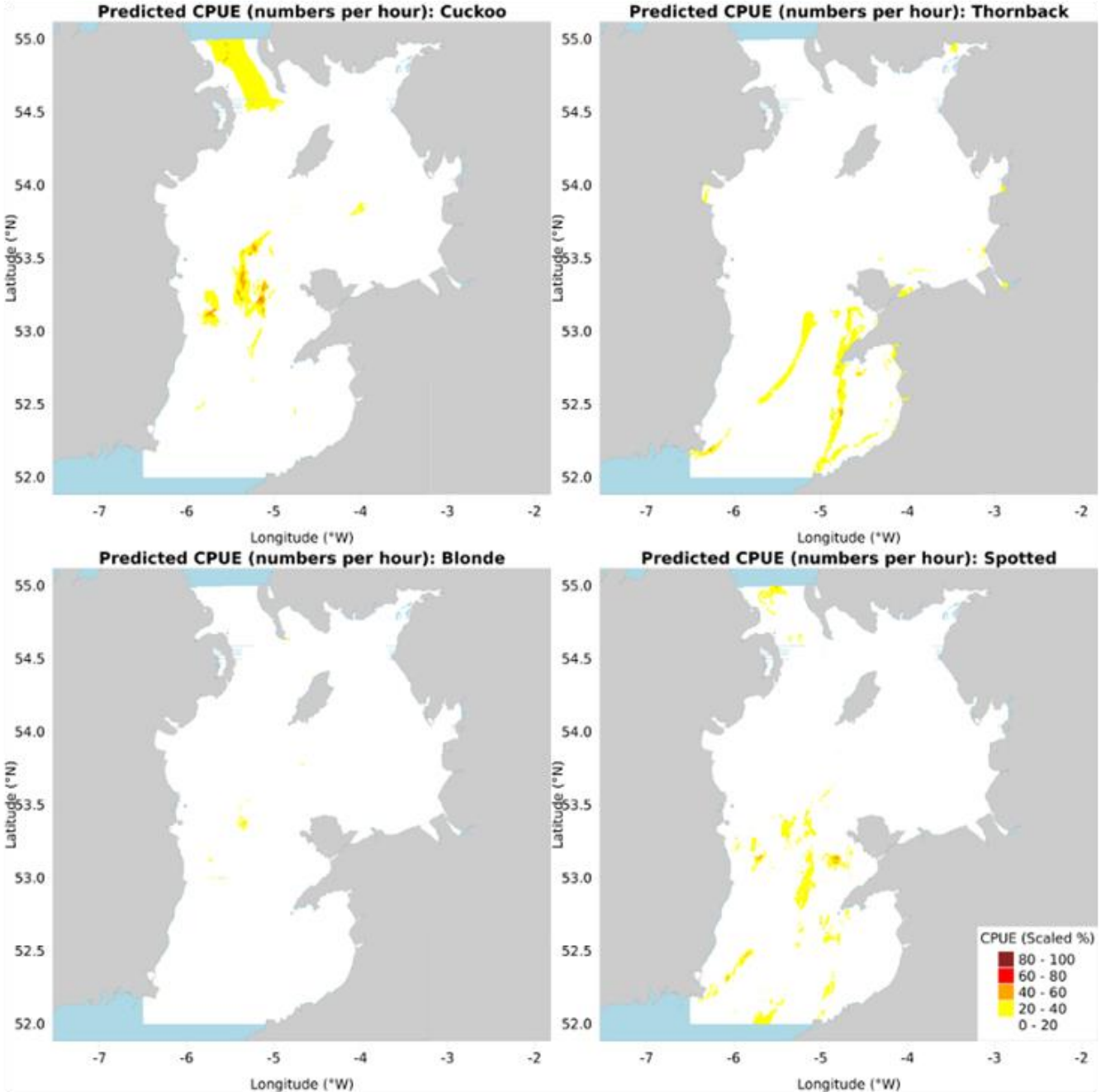
# Main areas of concentration for mature females



# Main areas of concentration for juveniles

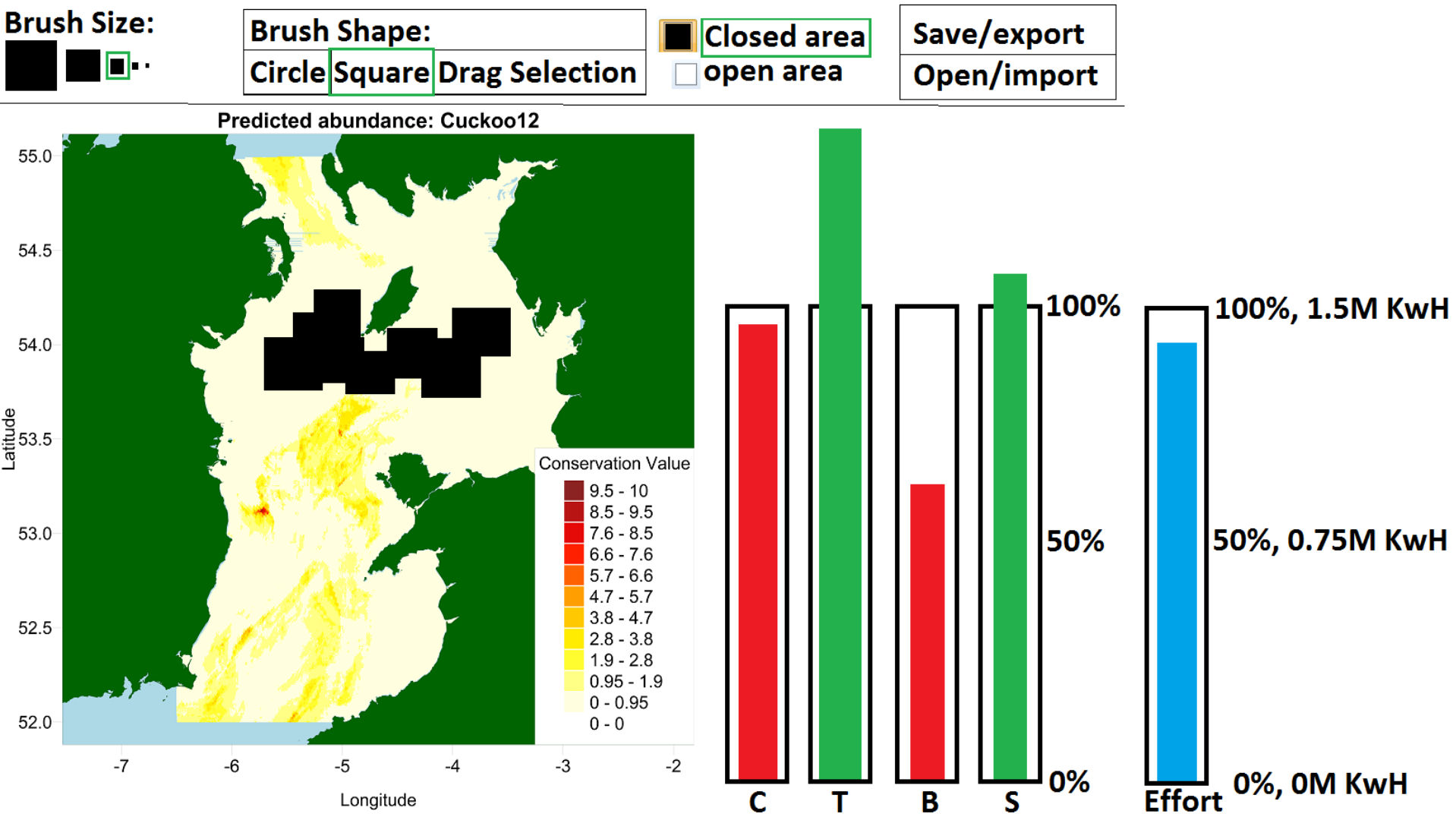


# Both mature females and juveniles



# A possible tool to help work it out

# An interactive tool to chose where to close to protect core biomass and minimize effort displacement ?



# Conclusions

- **Modeling allows the prediction of abundance hot spots as candidates for closure**
- **Allows balancing of protection with displacement of effort**
- **Can include spawning females and juveniles.**
- **So far based on TR1 fleet only**