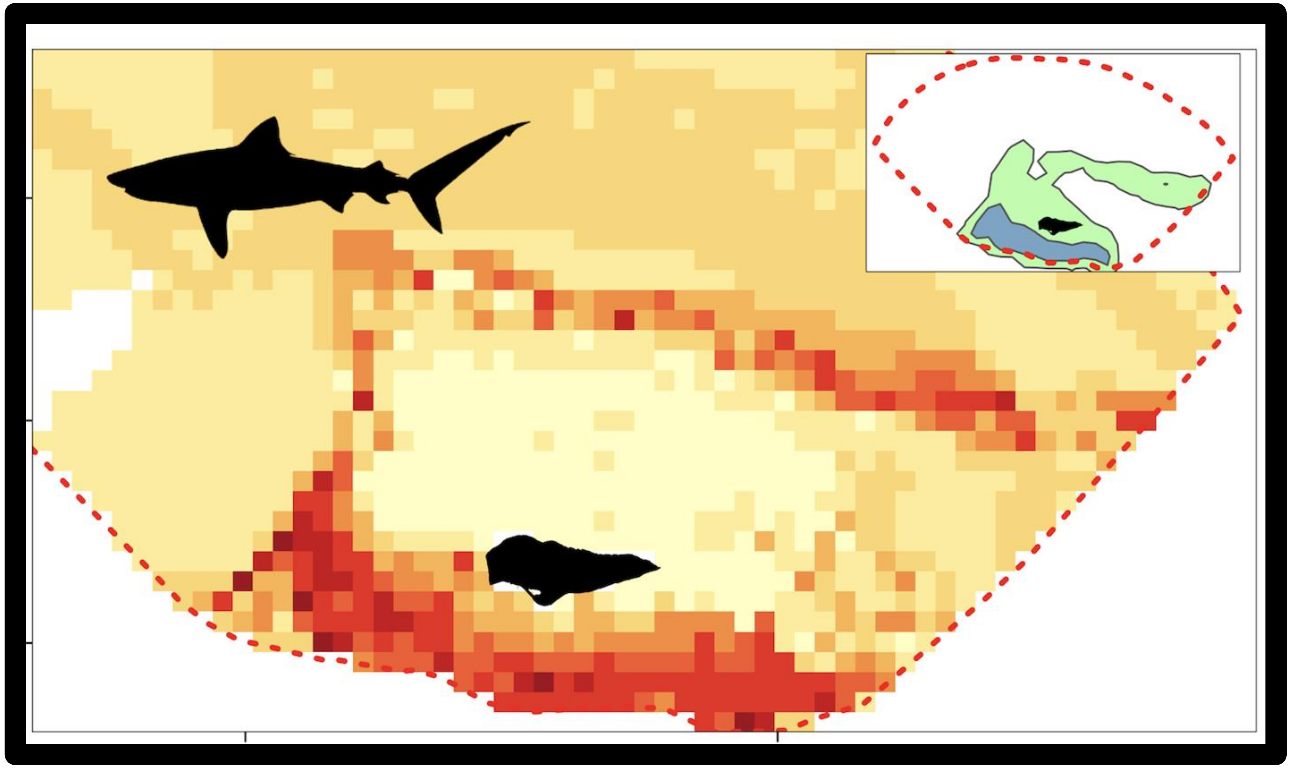
Relative Habitat Selection and Resource Selection Functions in Aquatic Acoustic Telemetry

Theory, Application, and Process



Lucas Griffin
Assistant Professor
University of South Florida

Jonathan Rodemann
Postdoctoral Associate
Florida International University

Roadmap for today

1. Modeling Habitat Selection

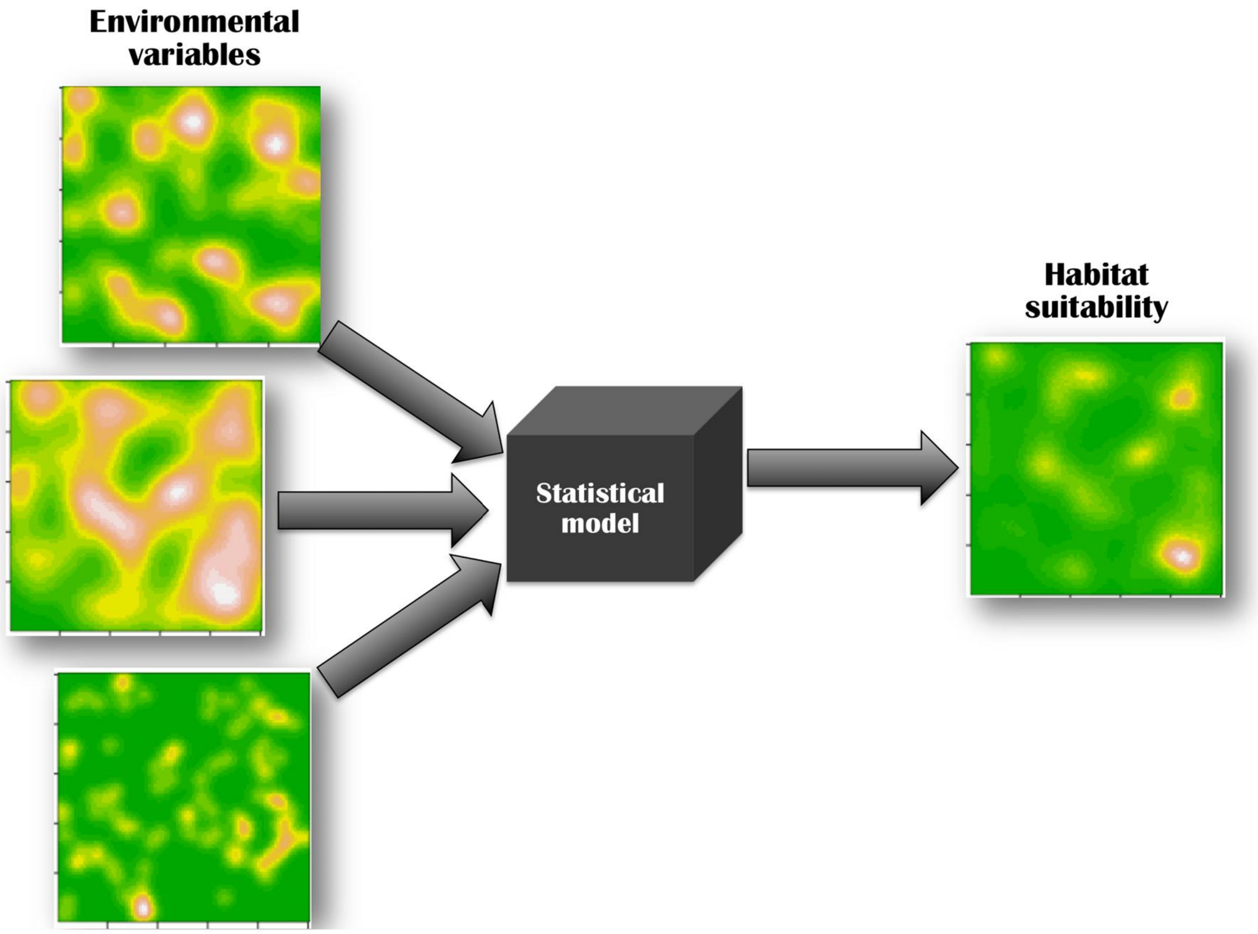
1. Terrestrial vs. Aquatic

1. Approach with Acoustic Telemetry

1. Considerations and Next Steps

1. Hands-on Code with Seatrout Example

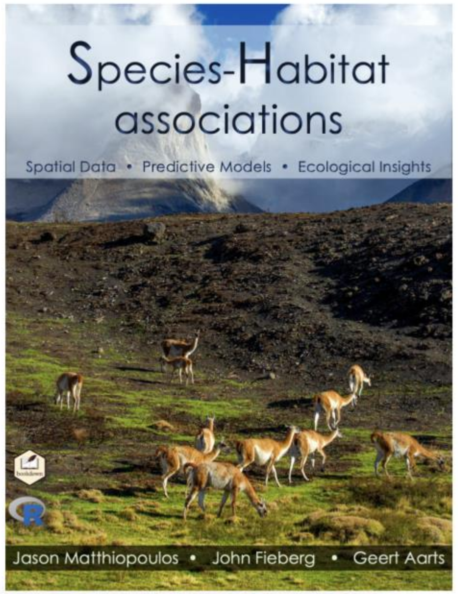
What habitats do animals like or avoid?



Species-Habitat Associations: Spatial data, predictive models, and ecological insights

Jason Matthiopoulos, John Fieberg, Geert Aarts

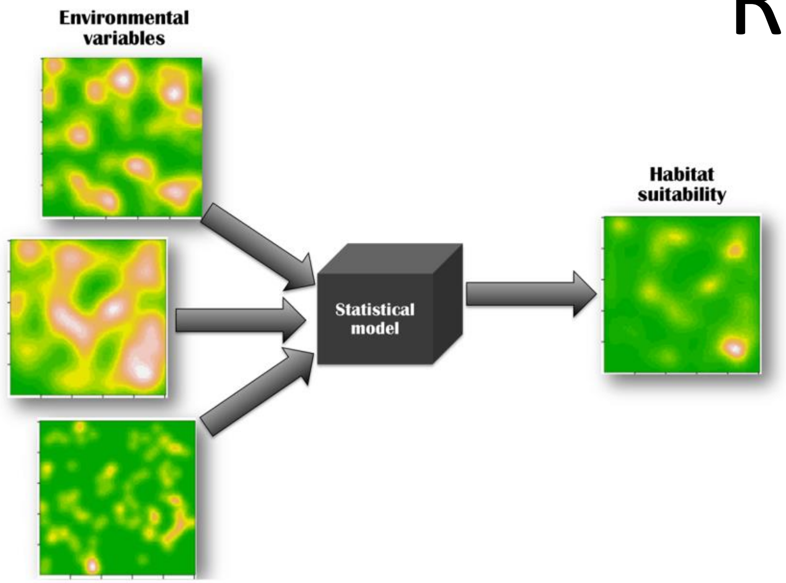
2023-01-03



Matthiopoulos et al. 2023

What habitats do animals like or avoid?

Species Distribution Models & Resource Selection Functions



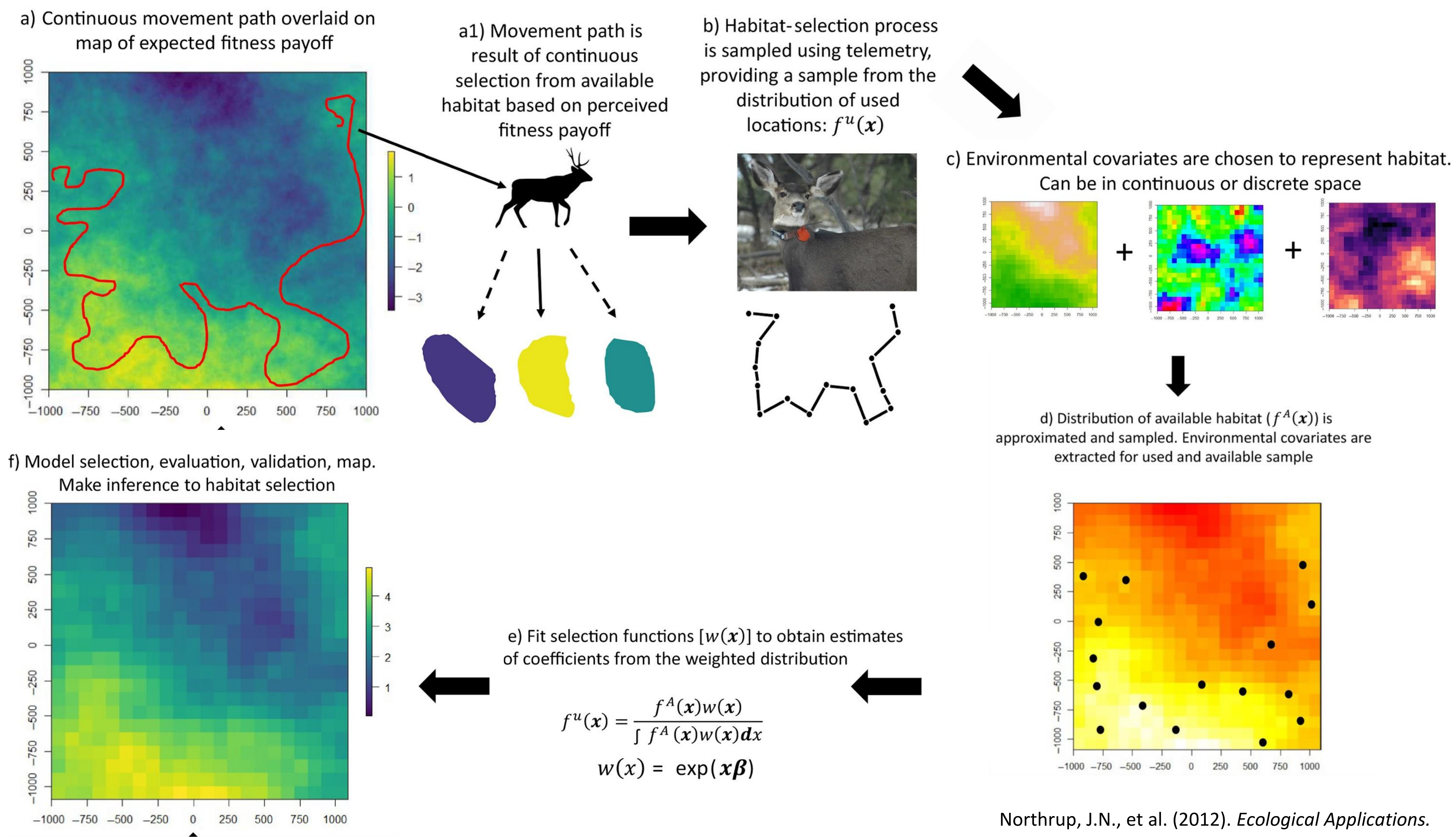
Input

Locations of individuals

Random assignment of locations, also known as pseudo-absences

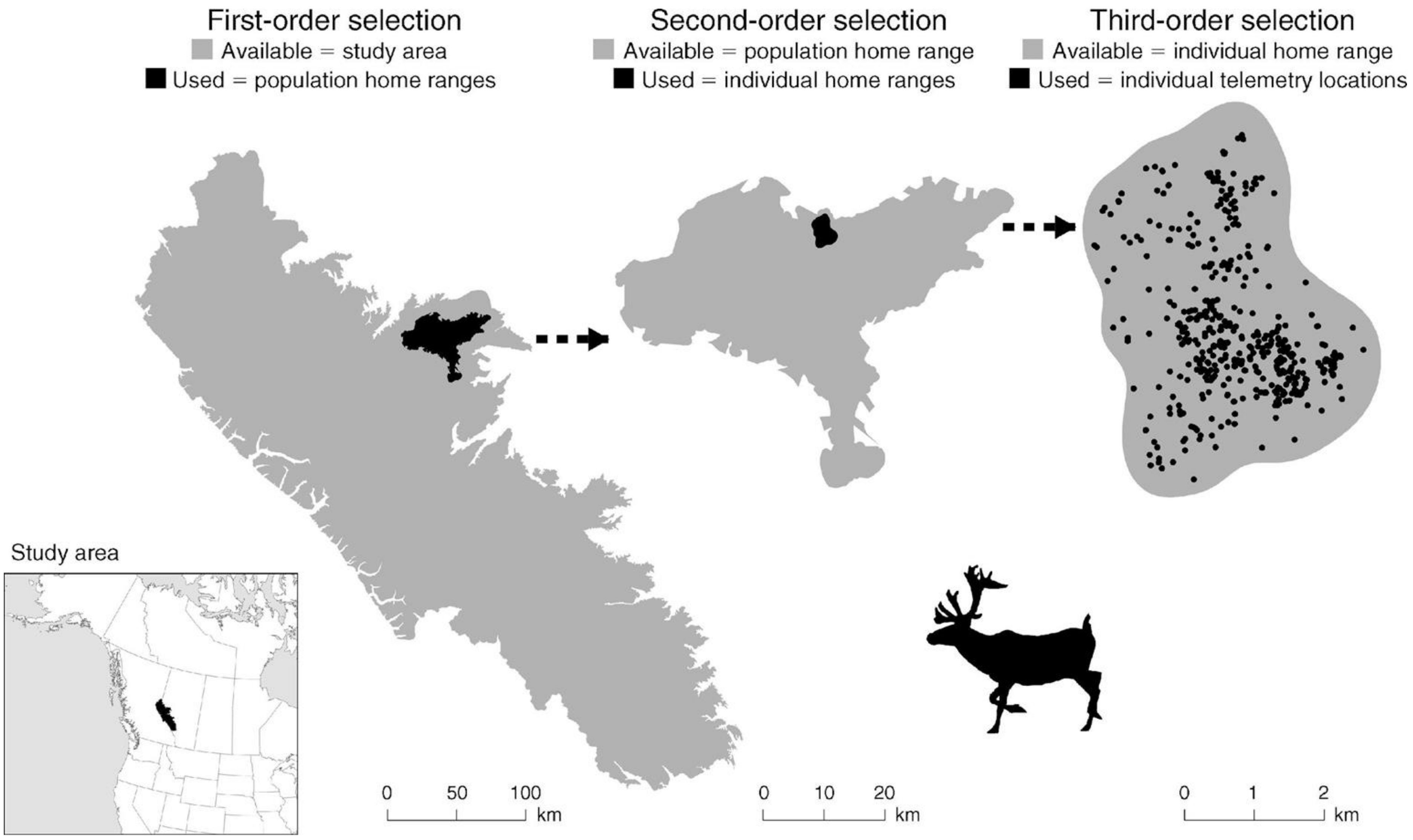
Output

Distribution as a function of resources, risks, conditions

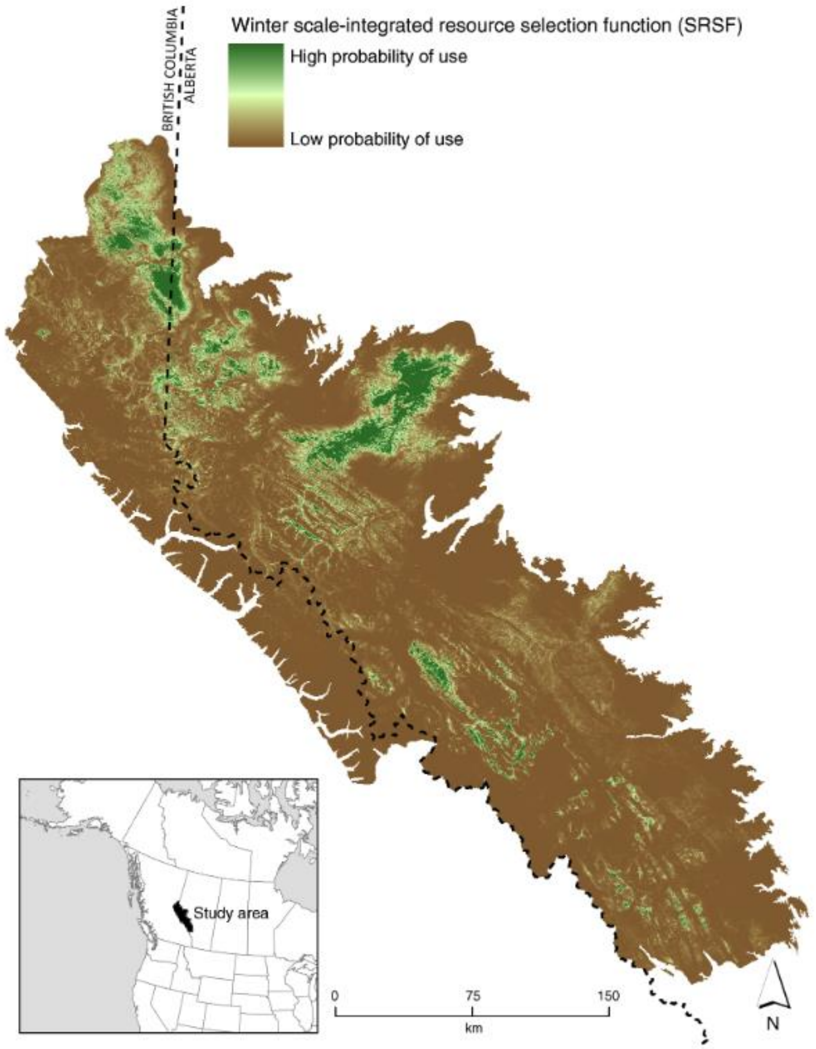


Northrup, J.N., et al. (2012). *Ecological Applications.*

What habitats do animals like or avoid?



DeCesare, N. J., Hebblewhite, M., Schmiegelow, F., Hervieux, D., McDermid, G. J., Neufeld, L., ... & Musiani, M. (2012). Transcending scale dependence in identifying habitat with resource selection functions. *Ecological Applications*, *22*(4), 1068-1083.



DeCesare, N. J et al. (2012). *Ecological Applications.*

ELSEVIER
Ecological Modelling
Volume 157, Issues 2–3, 30 November 2002, Pages 281-300

Evaluating resource selection functions

Mark S Boyce [a], Pierre R Vernier [b], Scott E Nielsen [a], Fiona K.A Schmiegelow [c]

Journal of Animal Ecology
BRITISH ECOLOGICAL SOCIETY
Standard Paper | Free Access

Multi-trophic resource selection function enlightens the behavioural game between wolves and their prey

Nicolas Courbin, Daniel Fortin, Christian Dussault, Viviane Fargeot, Réhaume Courtois

ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA
Report | Free Access

Practical guidance on characterizing availability in resource selection functions under a use–availability design

Joseph M. Northrup, Mevin B. Hooten, Charles R. Anderson Jr., George Wittemyer

Journal of Applied Ecology
BRITISH ECOLOGICAL SOCIETY
Free Access

Use of resource selection functions to identify conservation corridors

Cheryl-Lesley B. Chetkiewicz, Mark S. Boyce

ELSEVIER
Rangeland Ecology & Management
Volume 66, Issue 4, July 2013, Pages 419-427
Research Articles

Winter Resource Selection by Mule Deer on the Wyoming–Colorado Border Prior to Wind Energy Development

Stephen L. Webb [1], Matthew R. Dzialak [2], Karl L. Kosciuch [3], Jeffrey B. Winstead [4]

Trends in Ecology & Evolution
Volume 14, Issue 7, 1 July 1999, Pages 268-272
CellPress
Review

Relating populations to habitats using resource selection functions

Mark S. Boyce [a], Lyman L. McDonald [b]

Go to Trends in Ecology & Evolution on ScienceDirect

Diversity and Distributions
Open Access
A Journal of Conservation Biogeography
BIODIVERSITY RESEARCH | Open Access

Humans alter habitat selection of birds on ocean-exposed sandy beaches

Justin J. Meager, Thomas A. Schlacher, Tara Nielsen

ECOSPHERE
AN ESA OPEN ACCESS JOURNAL
Article | Open Access

Identifying polar bear resource selection patterns to inform offshore development in a dynamic and changing Arctic

Ryan R. Wilson, Jon S. Horne, Karyn D. Rode, Eric V. Regehr, George M. Durner

Animal Conservation
ZSL LET'S WORK FOR WILDLIFE
Open Access

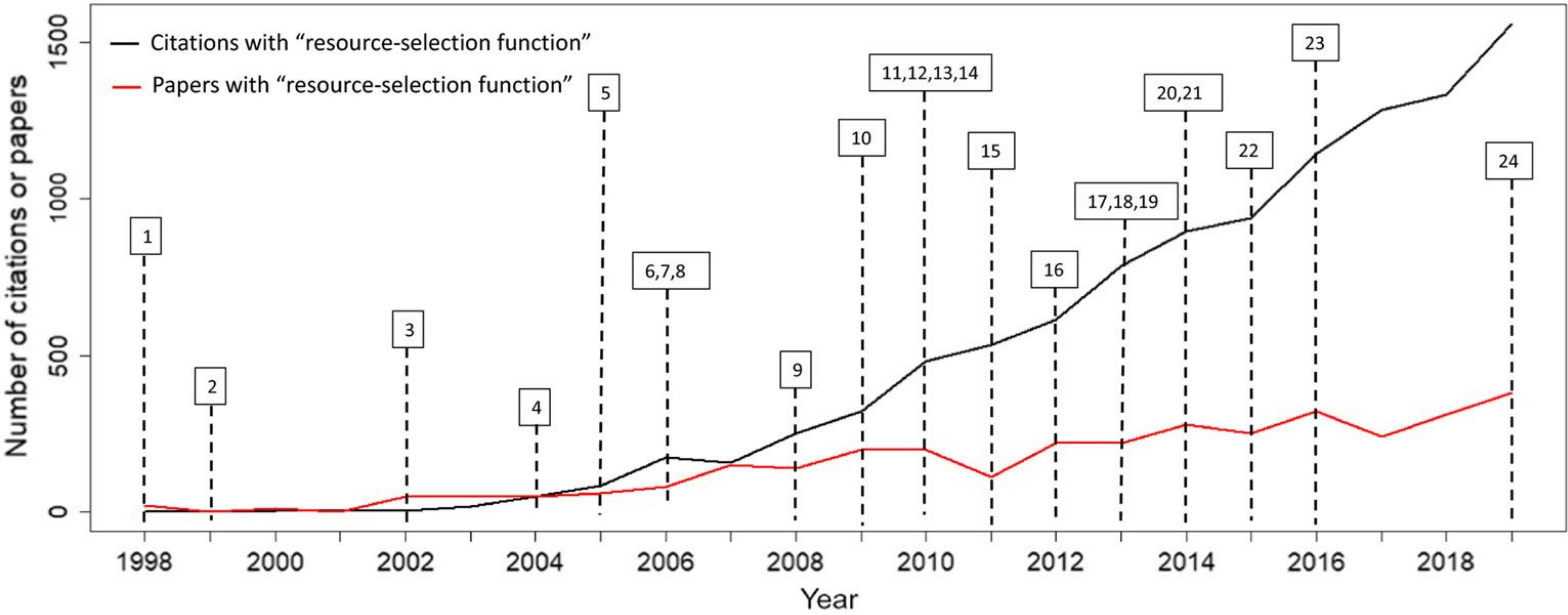
Conservation planning using resource selection models: altered selection in the presence of human activity changes spatial prediction of resource use

S. M. Harju, M. R. Dzialak, R. G. Osborn, L. D. Hayden-Wing, J. B. Winstead

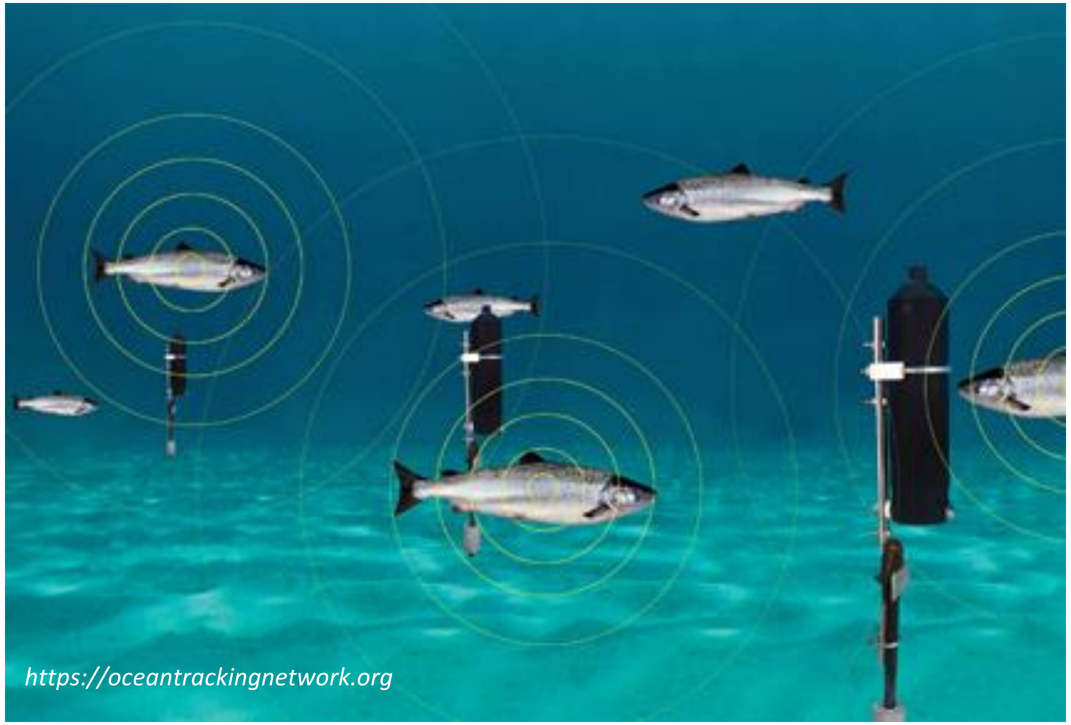
ELSEVIER
Ecological Modelling
Volume 359, 10 September 2017, Pages 449-459

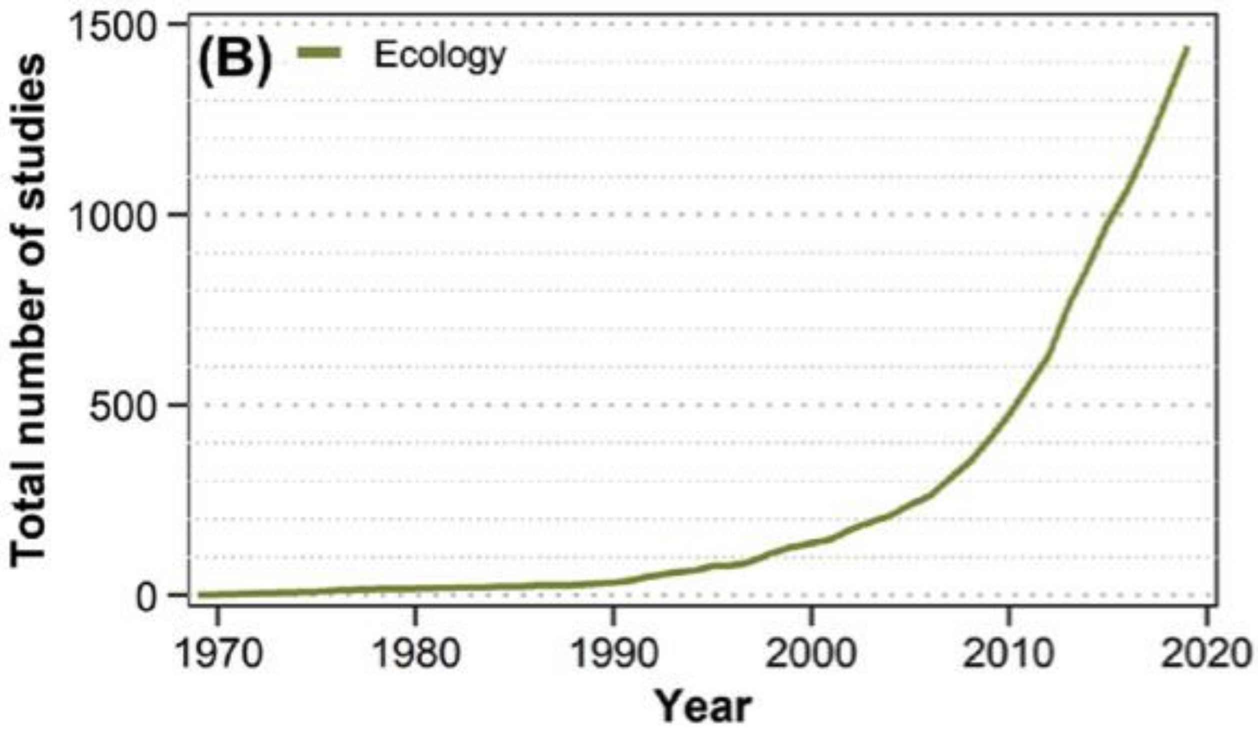
Using dynamic population simulations to extend resource selection analyses and prioritize habitats for conservation

Julie A. Heinrichs [a, b], Cameron L. Aldridge [a], Michael S. O'Donnell [c], Nathan H. Schumaker [d]



Northrup, J.N., et al. (2012). *Ecological Applications.*





Matley, J. K., et al. (2021). Global trends in aquatic animal tracking with acoustic telemetry. *Trends in Ecology & Evolution*.

Vol. 40: 53–64, 2019
https://doi.org/10.3354/esr00975

ENDANGERED SPECIES RESEARCH
Endang Species Res

Published October 2

Juvenile hawksbill residency and habitat use within a Caribbean marine protected area

Thomas H. Selby[1,*], Kristen M. Hart[2], Brian J. Smith[1], Clayton G. Pollock[3], Zandy Hillis-Starr[3], Madan K. Oli[4]

RESEARCH Open Access

Space use and relative habitat selection for immature green turtles within a Caribbean marine protected area

Lucas P. Griffin[1*], Brian J. Smith[2], Michael S. Cherkiss[3], Andrew G. Crowder[3], Clayton G. Pollock[4], Zandy Hillis-Starr[4], Andy J. Danylchuk[1] and Kristen M. Hart[3]

frontiers in Marine Science

ORIGINAL RESEARCH
published: 29 April 2021
doi: 10.3389/fmars.2021.631262

A Novel Framework to Predict Relative Habitat Selection in Aquatic Systems: Applying Machine Learning and Resource Selection Functions to Acoustic Telemetry Data From Multiple Shark Species

OPEN ACCESS

Edited by:
Mark J. Henderson,

Lucas P. Griffin[1*], Grace A. Casselberry[1], Kristen M. Hart[2], Adrian Jordaan[1], Sarah L. Becker[1], Ashleigh J. Novak[1], Bryan M. DeAngelis[3], Clayton G. Pollock[4], Ian Lundgren[5], Zandy Hillis-Starr[6], Andy J. Danylchuk[1†] and Gregory B. Skomal[7†]

Movement Ecology

RESEARCH Open Access

Habitat and movement selection processes of American lobster/jakej within a restricted bay in the Bras d'Or Lake/Pitu'paq, Nova Scotia, Canada

Shannon Landovskis[2*], Megan Bailey[1], Sara Iverson[1,2], Skyler Jeddore[3], Robert J. Lennox[1,2,4], Caelin Murray[1] and Fred Whoriskey[2]

1347

Canadian Science Publishing

PERSPECTIVE

Applications of telemetry to fish habitat science and management

Jacob W. Brownscombe, Lucas P. Griffin, Jill L. Brooks, Andy J. Danylchuk, Steven J. Cooke, and Jonathan D. Midwood

ORIGINAL RESEARCH article

Front. Mar. Sci., 25 July 2022
Sec. Marine Conservation and Sustainability
Volume 9 - 2022 | https://doi.org/10.3389/fmars.2022.851757

This article is part of the Research Topic
Novel Technologies for Assessing the Environmental and Ecological Impacts of Marine Renewable Energy Systems
View all 8 articles >

Modeling the Probability of Overlap Between Marine Fish Distributions and Marine Renewable Energy Infrastructure Using Acoustic Telemetry Data

Charles W. Bangley[1*] Daniel J. Hasselman[2] Joanna Mills Flemming[1]
Fredrick G. Whoriskey[3] Joel Culina[2] Lilli Enders[4] Rod G. Bradford[5]

Contents lists available at ScienceDirect

Ecological Indicators

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

ELSEVIER

Original Articles

Habitat selection and spatial behaviour of vulnerable juvenile lemon sharks: Implications for conservation

Molly M Kressler[a,b,*], Evan E Byrnes[c,d], Alice M Trevail[a], Clemency E White[e], Vital Heim[f], Matthew Smukall[b], Adrian C Gleiss[c,g], Richard B Sherley[a,h]

Received: 21 July 2023 | Accepted: 14 April 2024
DOI: 10.1111/1365-2656.14108

Journal of Animal Ecology BRITISH ECOLOGICAL SOCIETY

RESEARCH ARTICLE

Intraguild processes drive space-use patterns in a large-bodied marine predator community

Maurits P. M. van Zinnicq Bergmann[1,2] | Lucas P. Griffin[3] | Thomas W. Bodey[4] | Tristan L. Guttridge[2,5] | Geert Aarts[6,7] | Michael R. Heithaus[1] | Matthew J. Smukall[2,8] | Yannis P. Papastamatiou[1]

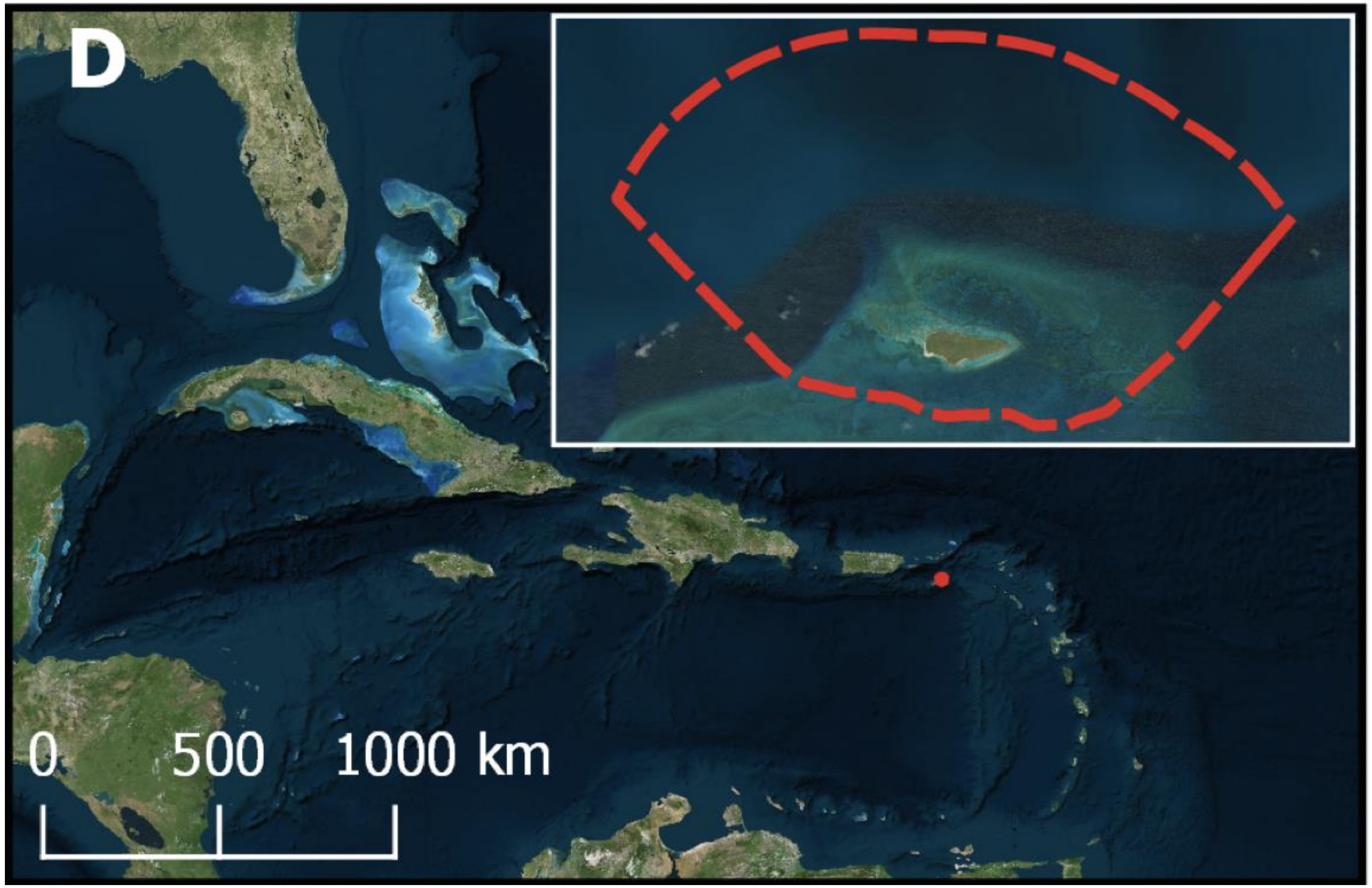
Vol. 40: 53–64, 2019
https://doi.org/10.3354/esr00975

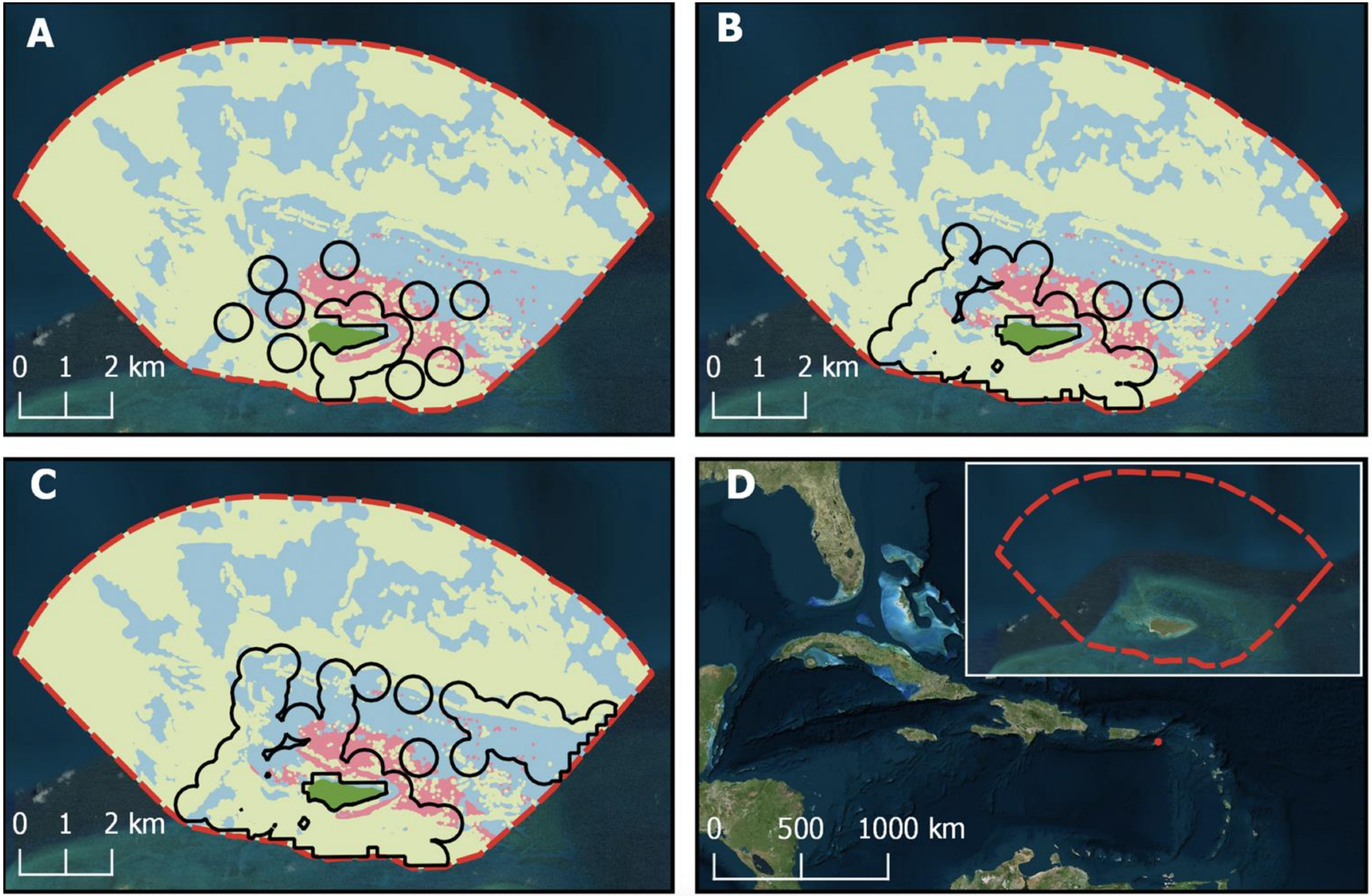
ENDANGERED SPECIES RESEARCH
Endang Species Res

Published October 2

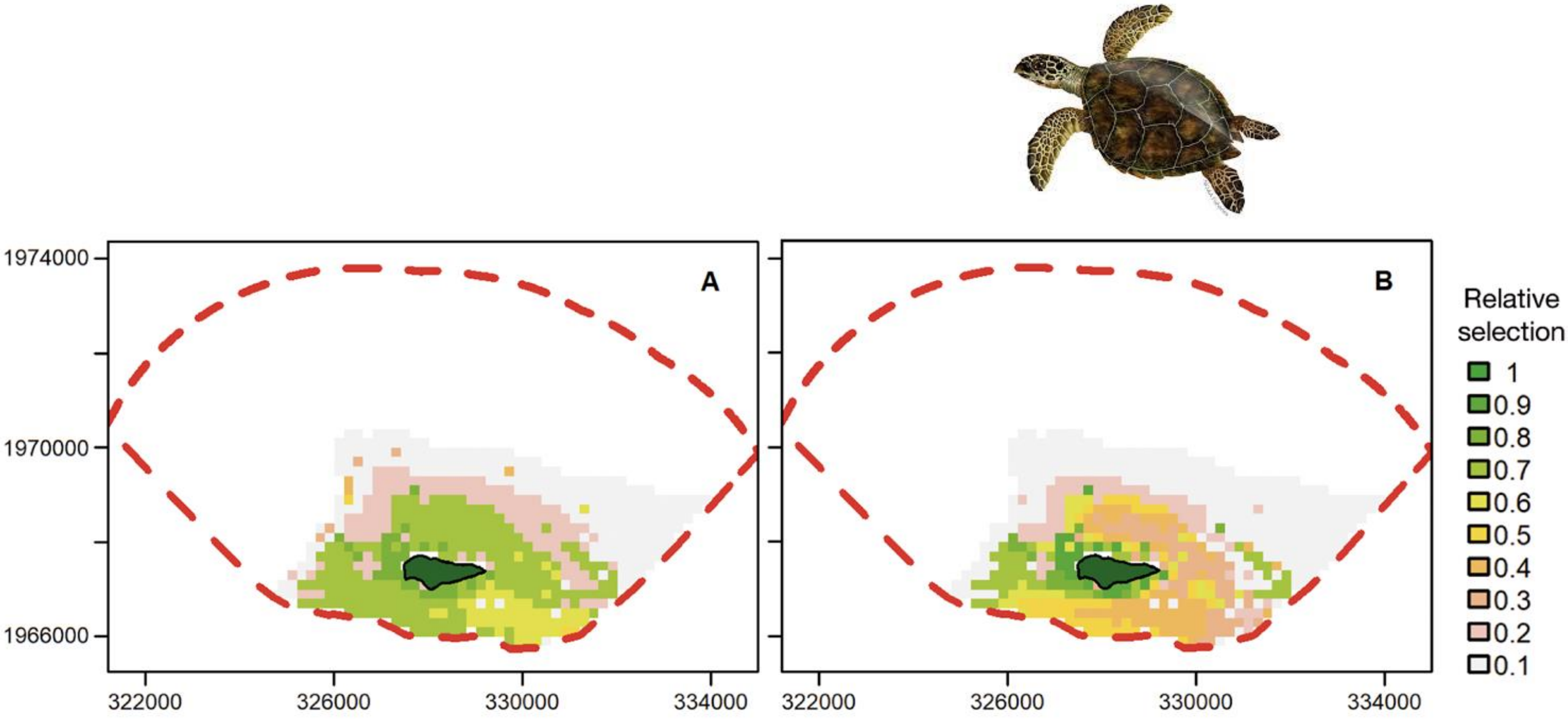
Juvenile hawksbill residency and habitat use within a Caribbean marine protected area

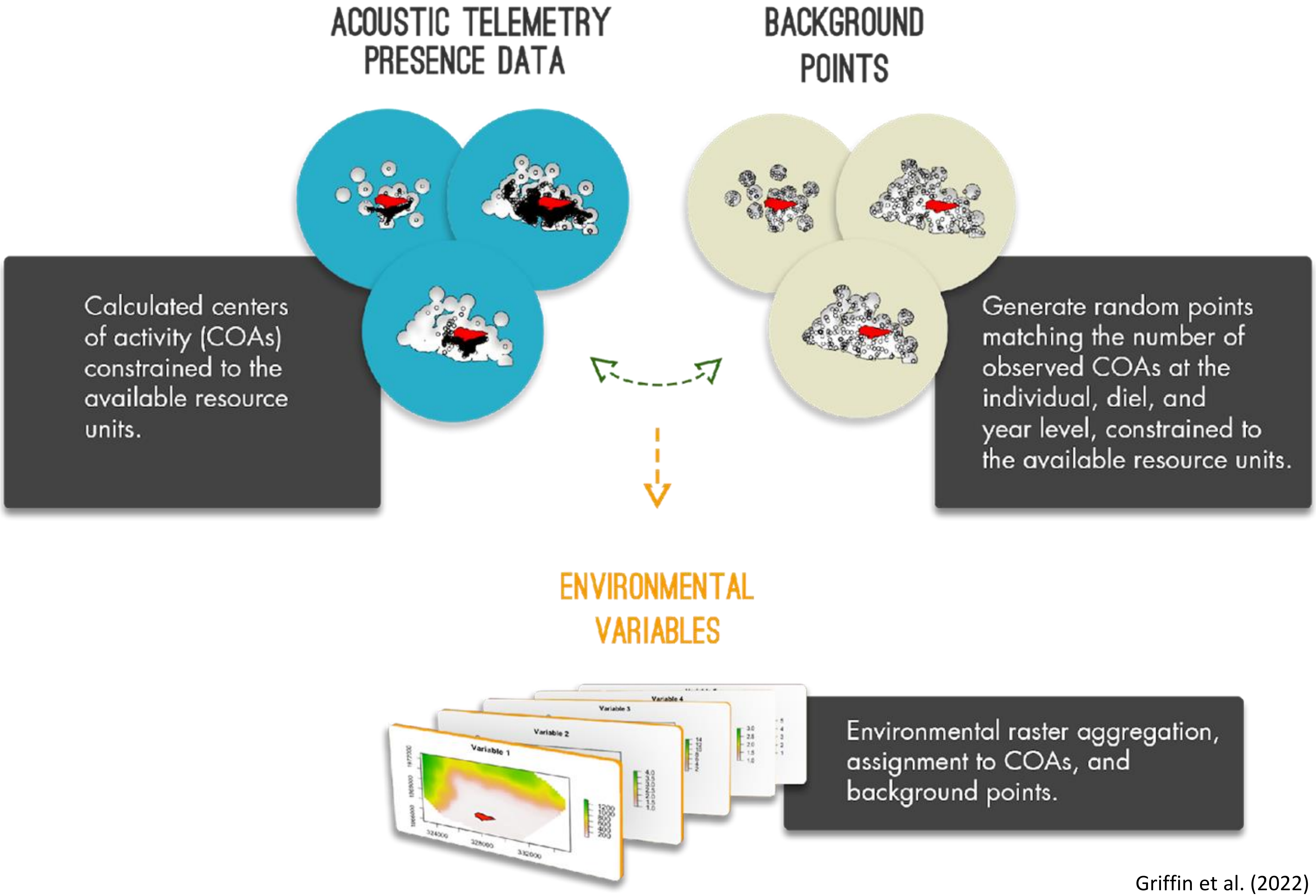
Thomas H. Selby[1,*], Kristen M. Hart[2], Brian J. Smith[1], Clayton G. Pollock[3], Zandy Hillis-Starr[3], Madan K. Oli[4]



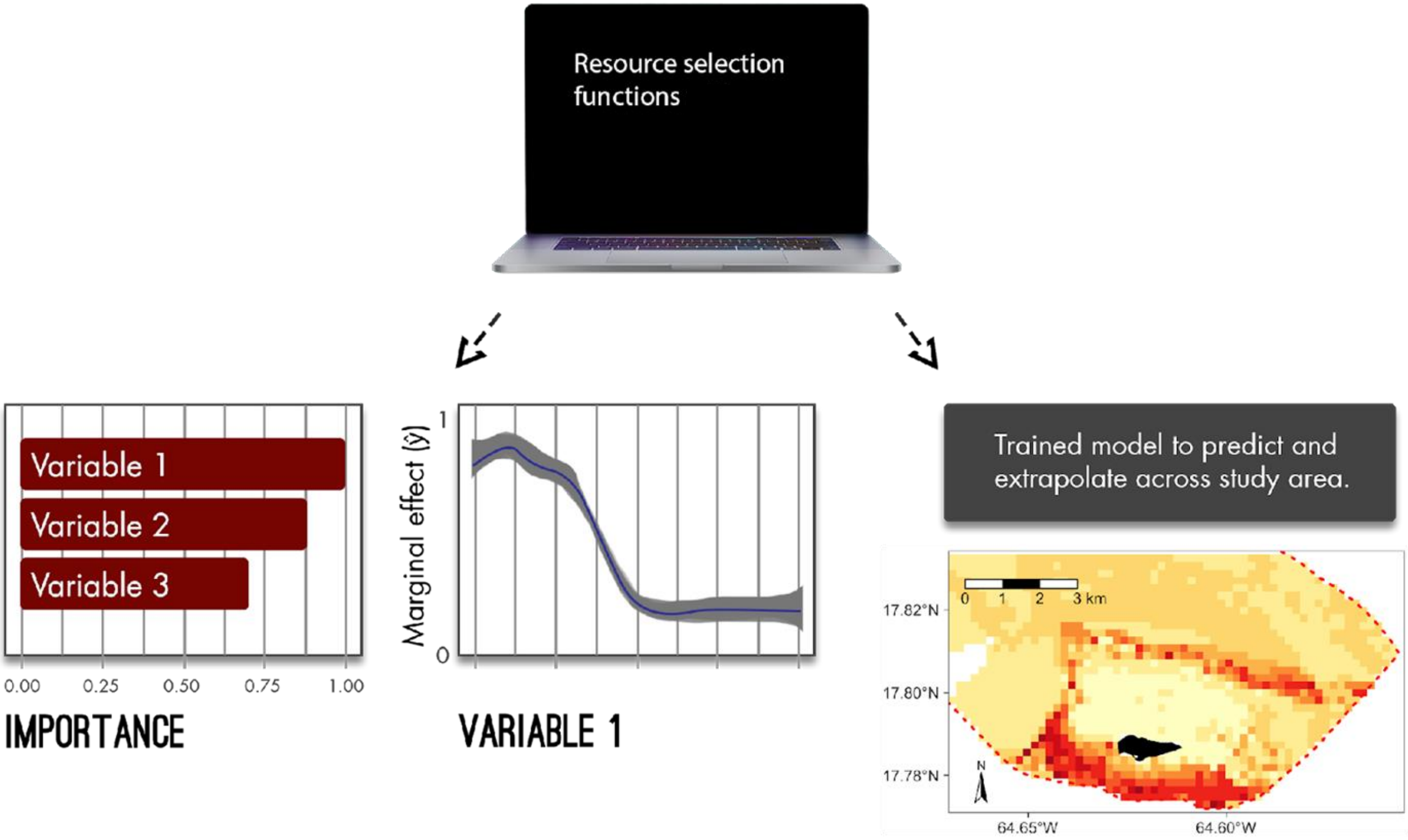


Selby et al. (2019). *End. Spec. Res.*


A
B
1974000
1970000
1966000
322000
326000
330000
334000
Relative selection
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1



Griffin et al. (2022) *Front. Mar. Sci.*


Resource selection functions
Variable 1
Variable 2
Variable 3
0.00
0.25
0.50
0.75
1.00
IMPORTANCE
Marginal effect (ŷ)
1
0
VARIABLE 1
Trained model to predict and extrapolate across study area.
0
1
2
3 km
17.82°N
17.80°N
17.78°N
N
64.65°W
64.60°W

Considerations with RSFs and Acoustic Telemetry

Array Design

- Does it cover all representative habitats? Home range of animal?
- How does detection efficiency get incorporated?
- What's your available habitat delineation?

Deriving location data

- Centers of activity, correlated random walks, etc. (see *patter* package)

Location to pseudo-absence points ratio

Spatial and temporal autocorrelation

- Modeling approach
- Thinning the data

Habitat variables

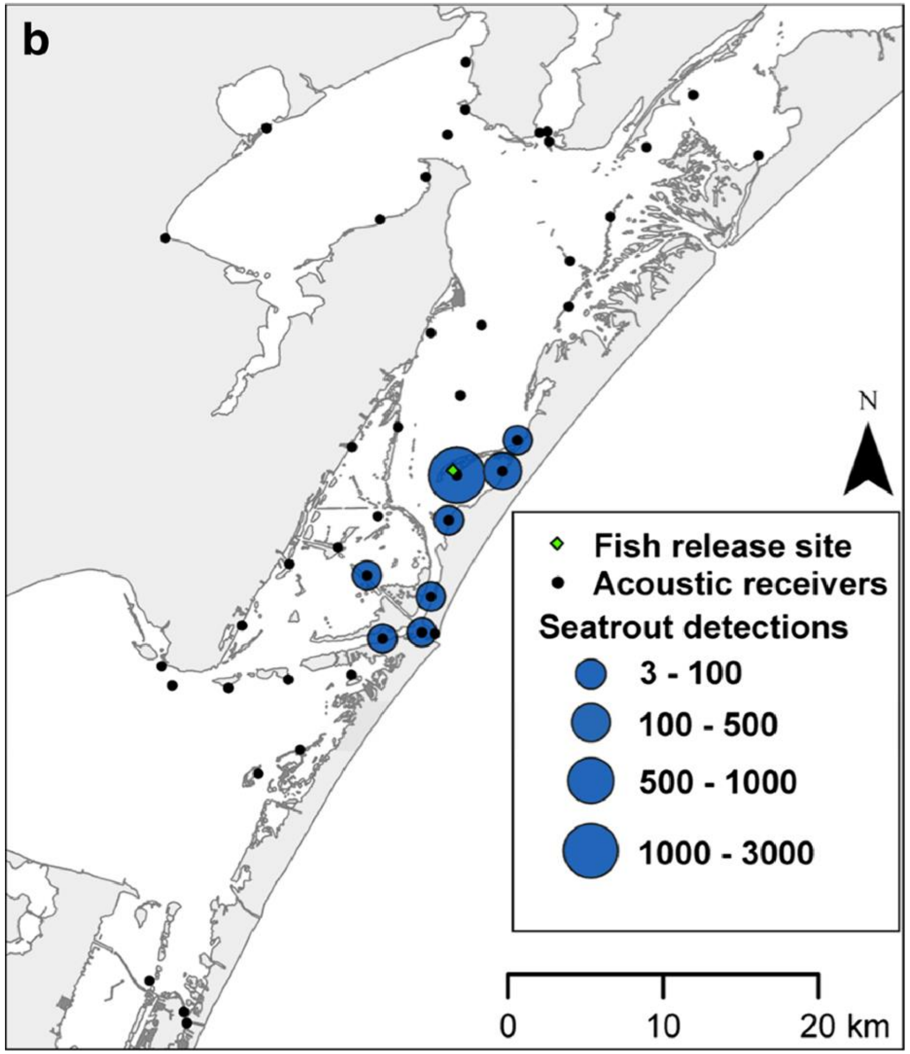
- Static vs dynamic
- Scales

Extrapolations:

- How robust are predictions into new systems (see *dsmextra package)*

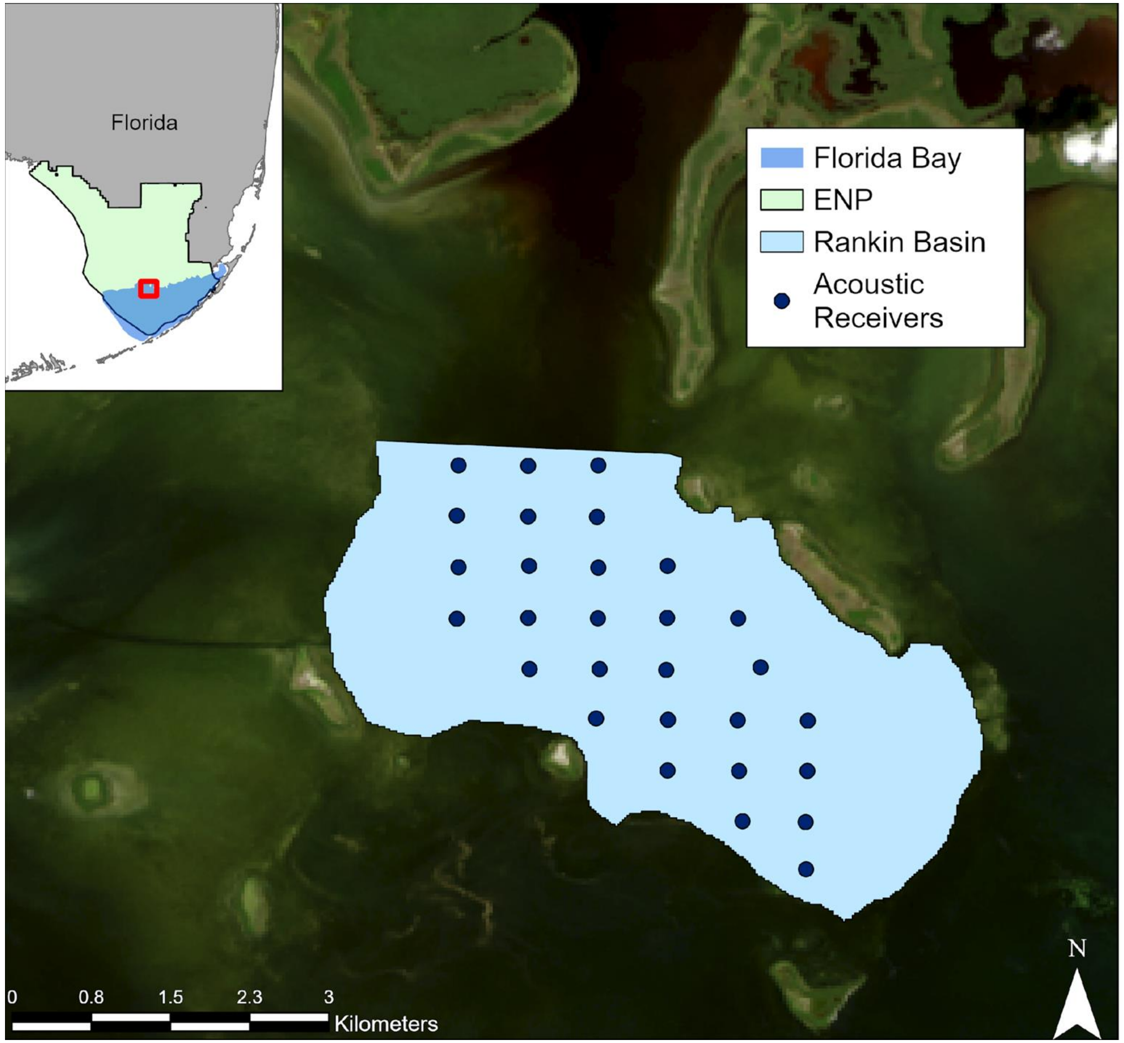
Seatrout Example

Spotted Seatrout (*Cynoscion nebulosus*)



Moulton et al., 2017 *Estuar Coasts*

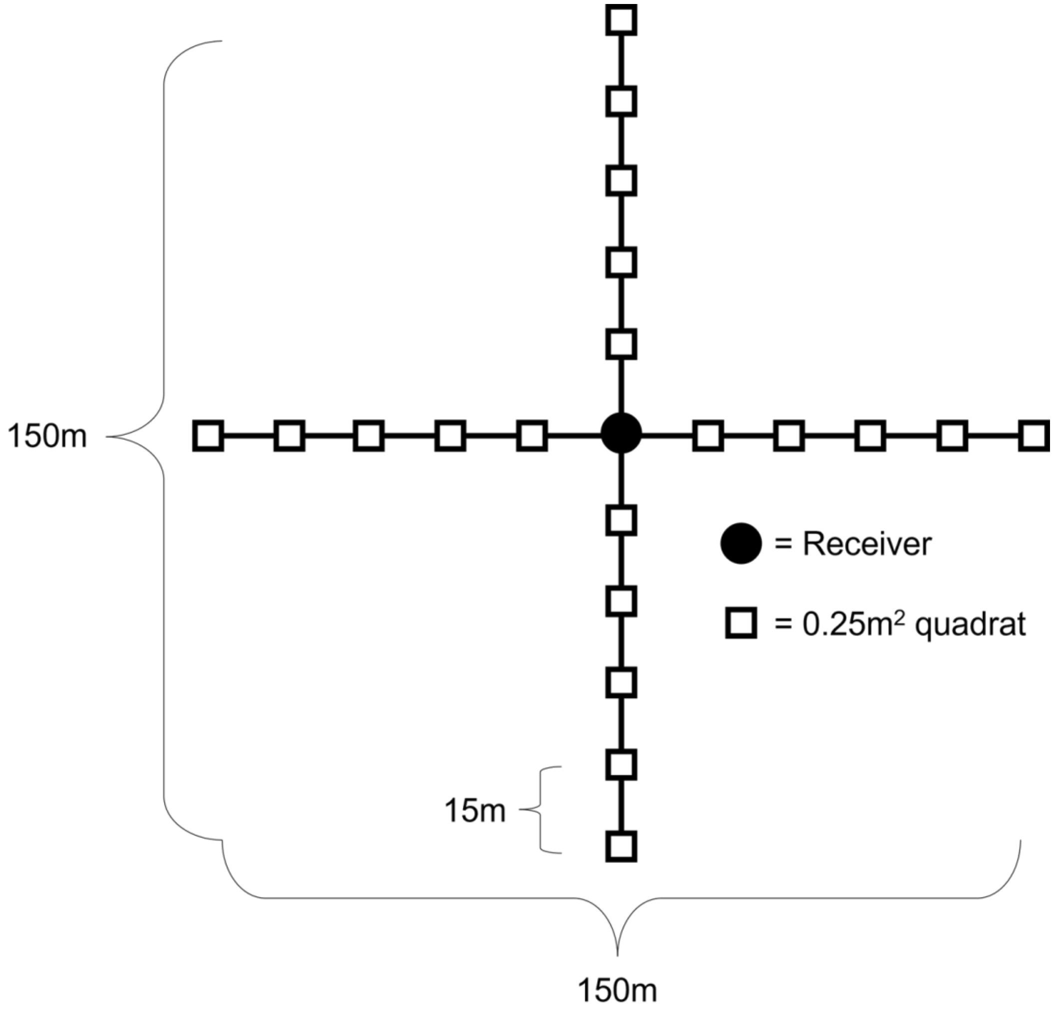
Methods



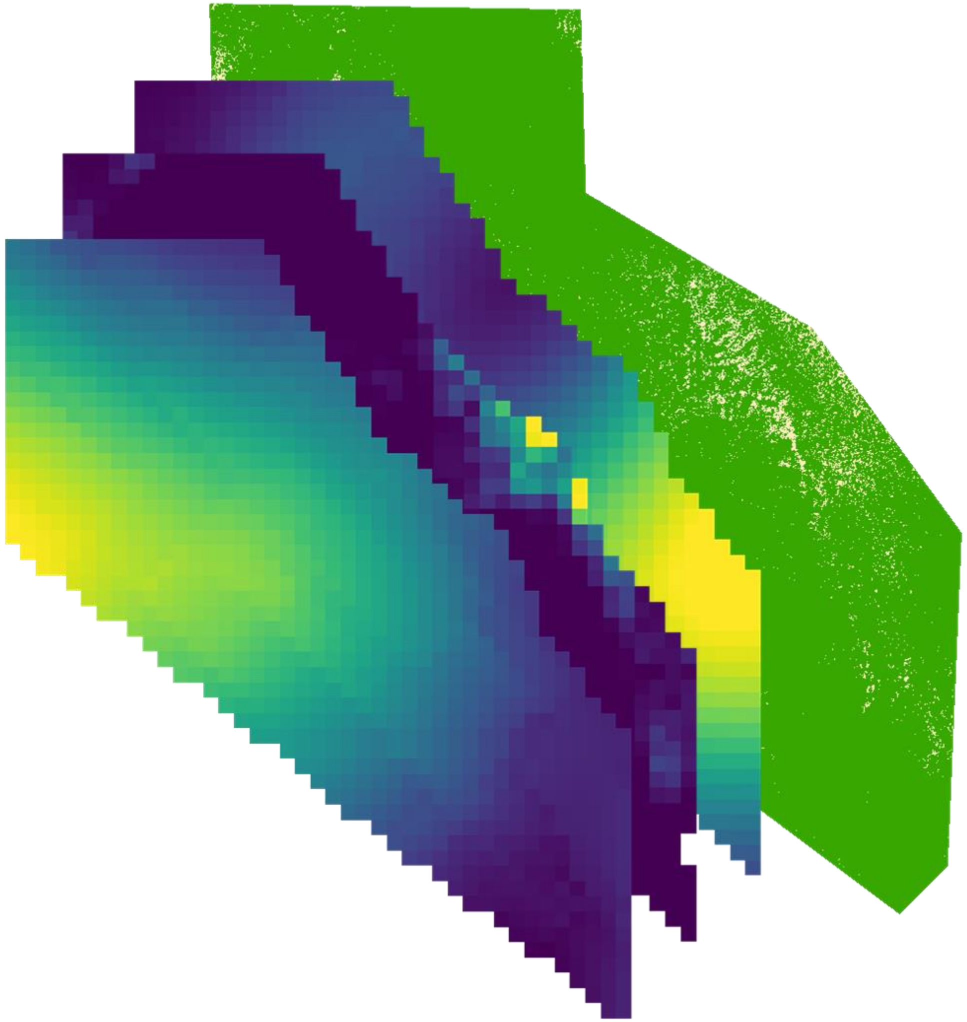
- ❖ 29 receivers
- ❖ 151 tagged seatrout
    - ❖ Using a subset of 8 individuals

Heupel et al., 2006 *Mar Fresh Res*, Brownscombe et al., 2019 *Rev Fish Bio Fisheries*

Methods



Methods



Receiver SAV surveys
FHAP SAV surveys
Aerial imagery

Methods

Acoustic data

Take out false detections, include only trout, calculate center-of-activity in 1 hour time bins

Random pseudo-absence points

1 across array for every presence

Extract habitat data

Extracted at each point

Random Forest Models

Training and testing datasets, model validation