Northern shortfin squid fishery footprint on the Northeast US continental shelf [9]

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Overview

- **Short Term Task:** Conduct analyses that describe the proportion of *Illex* habitat fished in any given year and consider related implications for potential overfishing (or lack thereof).
- **Approach:**
  - Estimate the area accessed by the fishery each year based on presence/absence of fishing vessels by 5 minute squares.
  - Estimate the geographic range of shortfin squid in US waters each year based on spatial models (VAST).
  - Calculate the proportion of habitat overlapped by fishing effort as an order of magnitude estimate for a proxy for fishing mortality (F).

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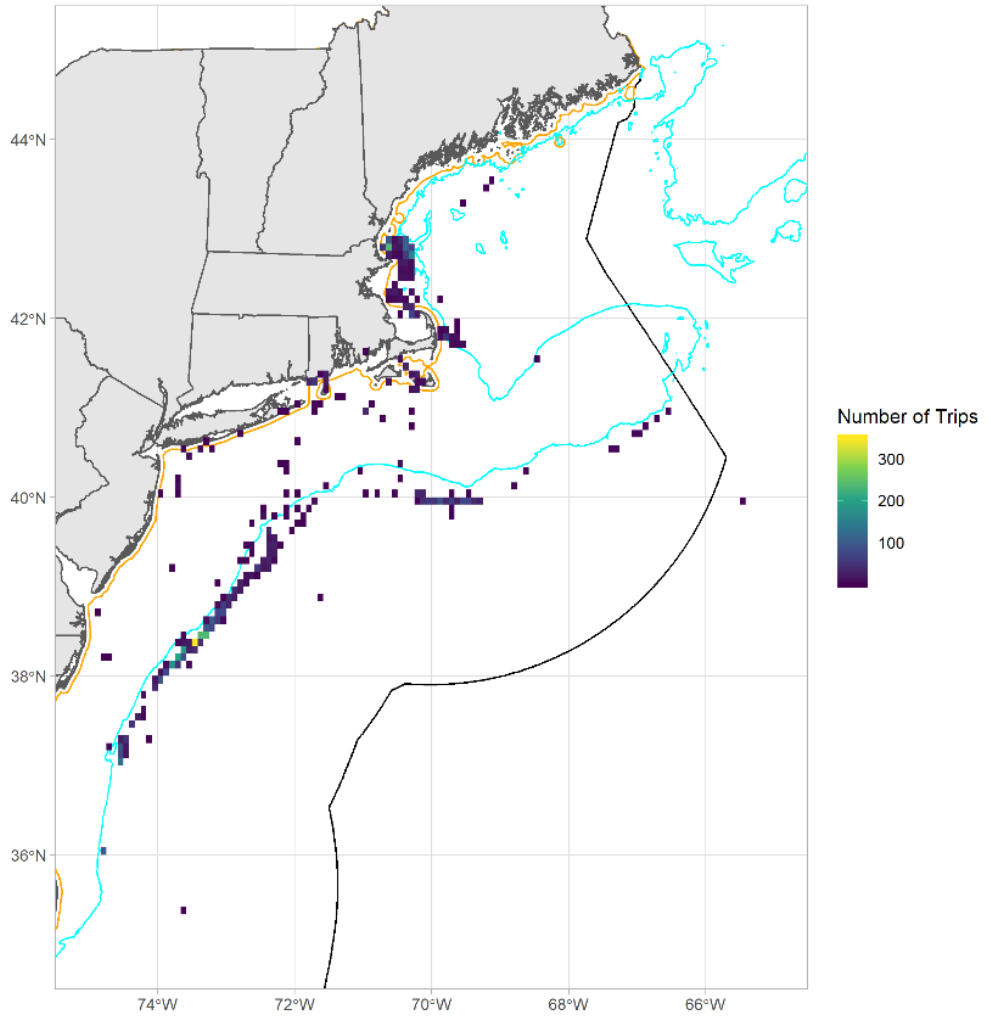
Data

- Presence/absence of *Illex*
  - Fall surveys
    - NEFSC 2000 - 2018
    - NEAMAP 2007 - 2019
    - ME/NH 2000 - 2019
  - Filtered for daytime tows
    - Defined as 06:00 – 18:59 EST
- Presence of fishing effort
  - Vessel Trip Reports 2000-2019
  - Aggregated to 5 min square



map: Ben Galuardi

Methods

- VAST – Vector Autoregressive Spatio-Temporal model (Thorson 2019)
  - GLMM specifically designed for fishery applications
    - Combining multiple surveys
    - Integrating across space for abundance indices
    - Distinguishes between density and catchability covariates
  - Configuration
    - 100 knots
    - 25km prediction grid
    - Year effect – fixed
    - Spatio-temporal effects – random
    - Vessel effect – random
    - Binomial distribution with logit link

Photo credit: Calvin Alexander

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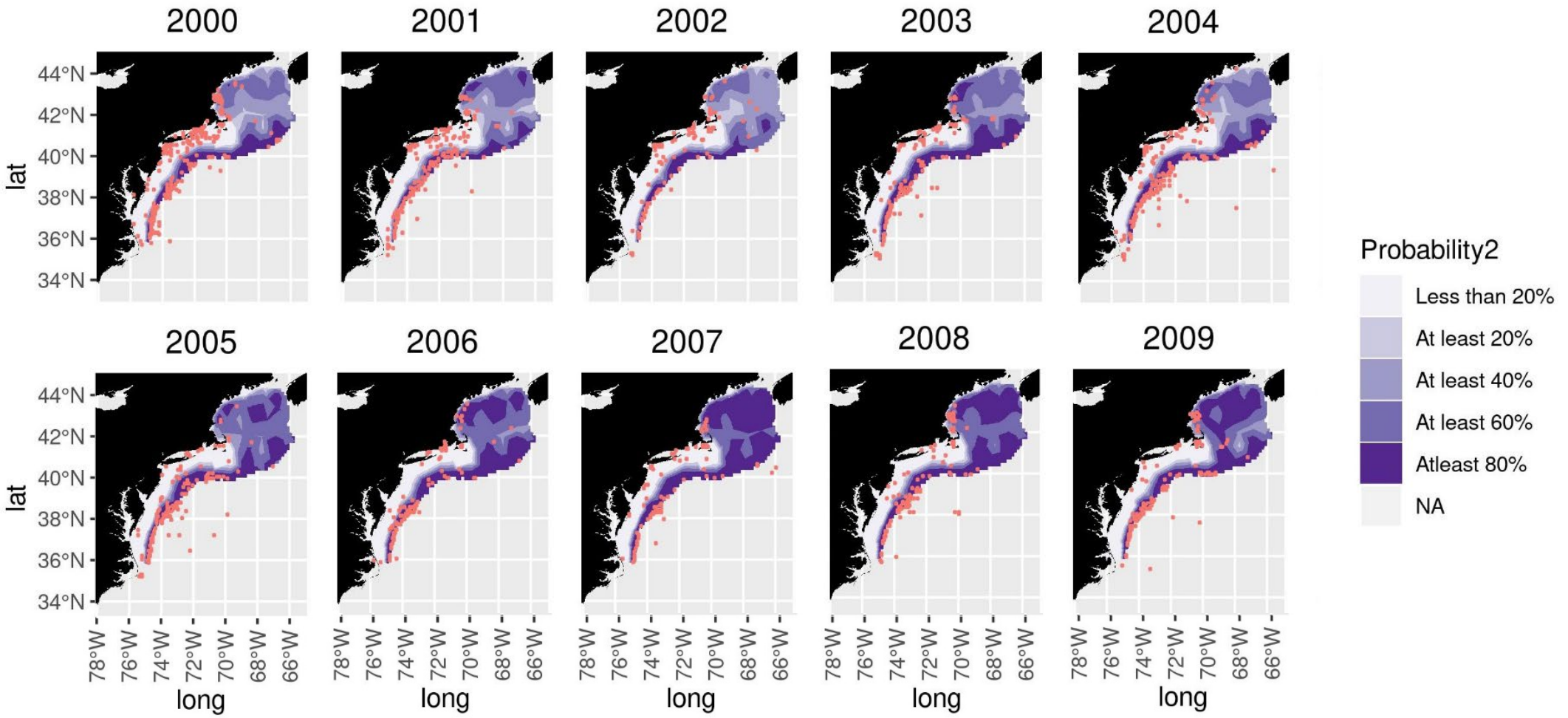
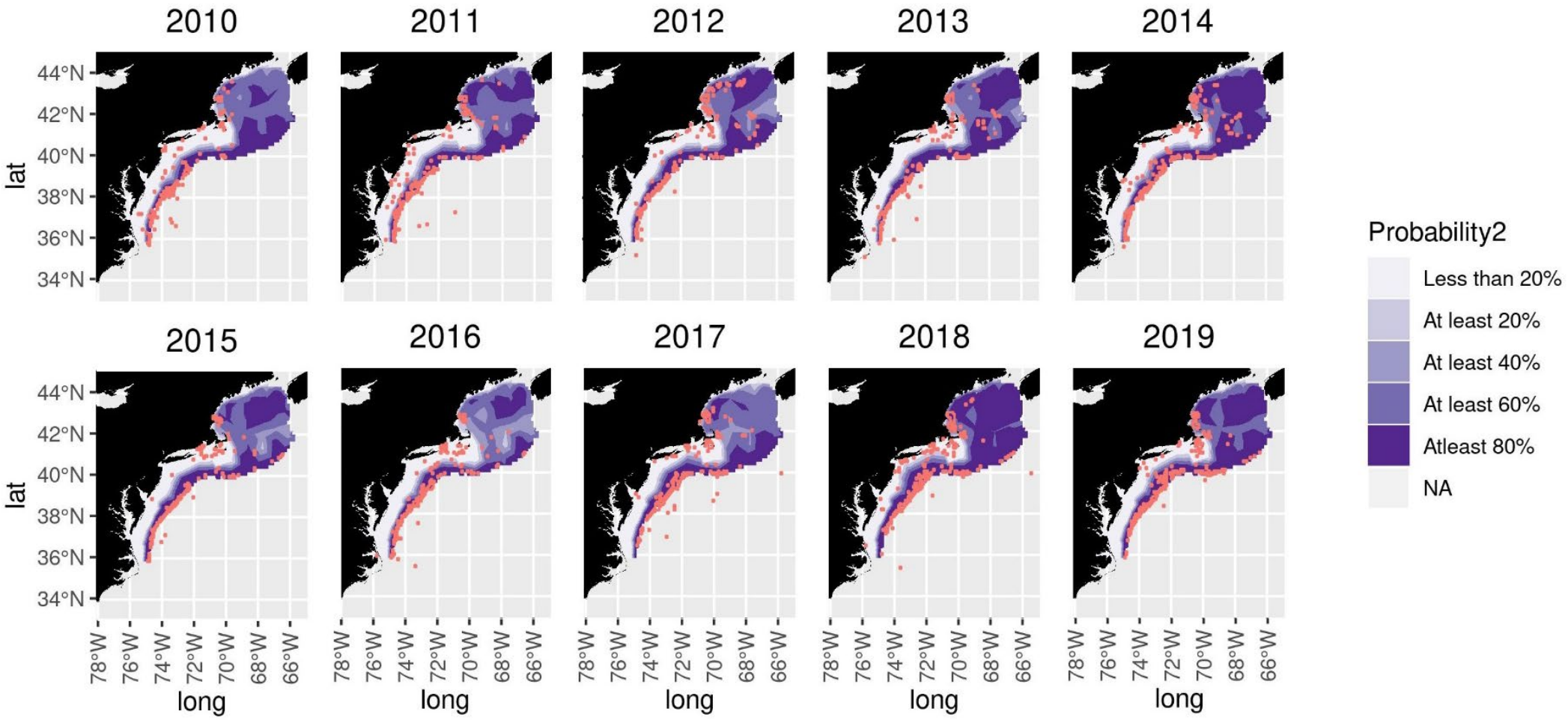
Methods

- Convert prediction points to polygons of probability of occurrence bins
  - Less than 20% probability of *Illex*
  - 20 – 39%
  - 40 – 59%
  - 60 – 79%
  - 80% or greater
- Convert fishing effort raster files to polygons
- Intersect effort polygons with habitat polygons (based on at least 40, 60, or 80% probability of occurrence).

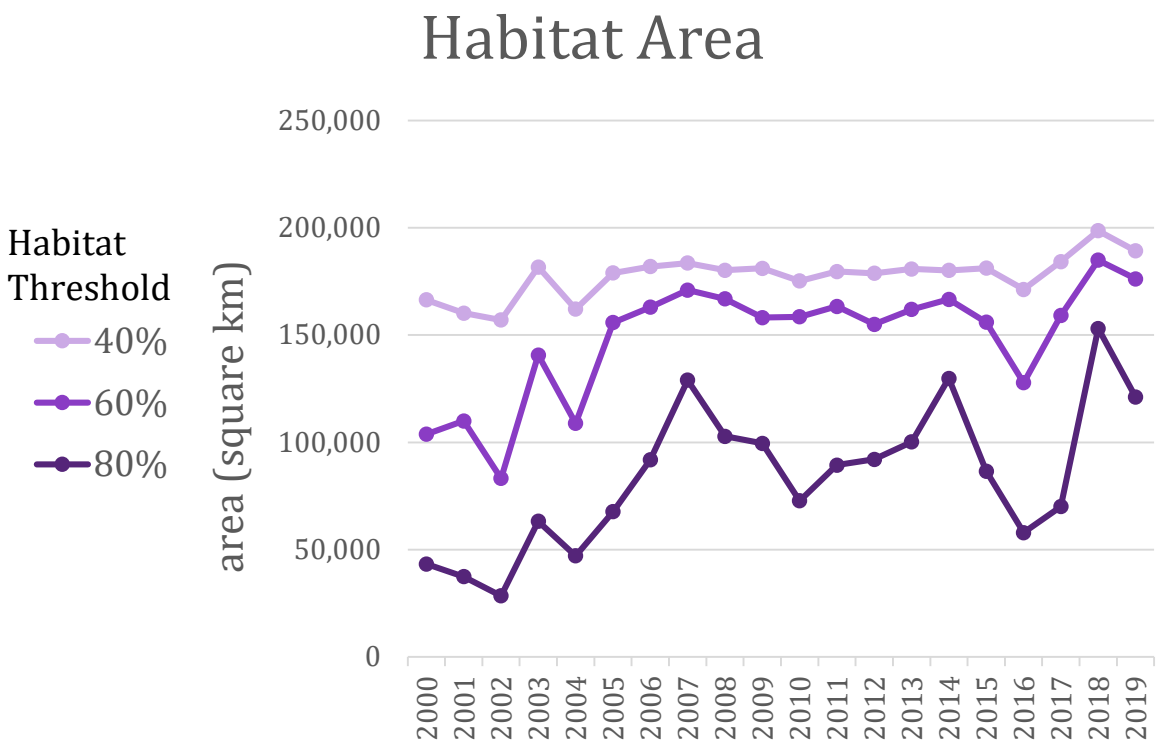
Results (2000-2009)

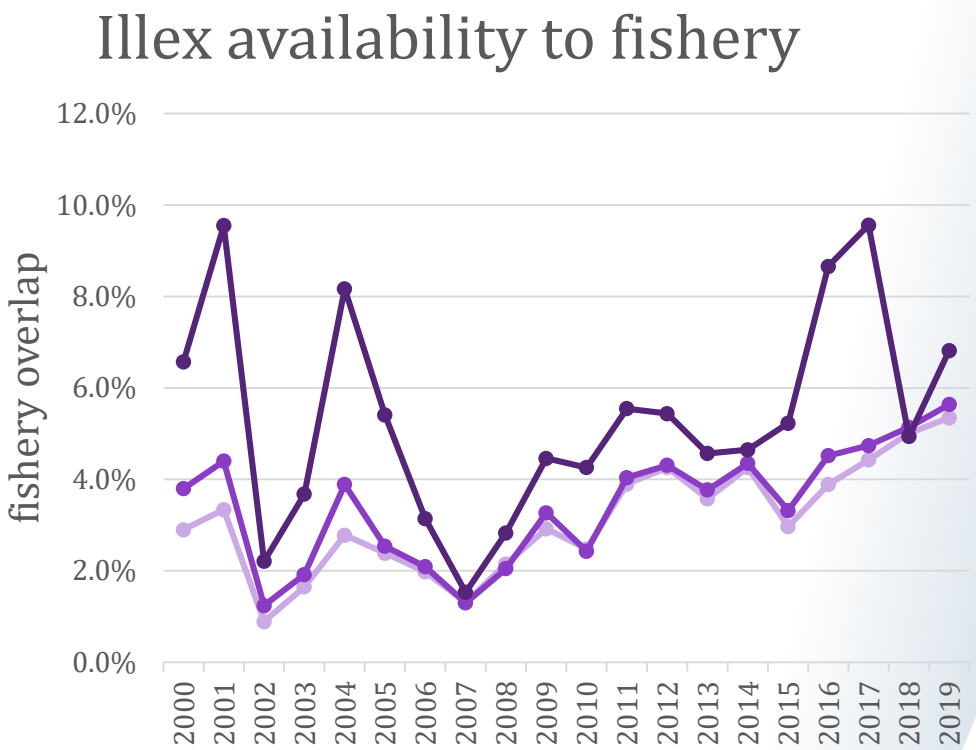


Results (2010-2019)



Results


Habitat Area
Habitat Threshold
40%
60%
80%
area (square km)
250,000
200,000
150,000
100,000
50,000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Illex availability to fishery
fishery overlap
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

Results Summary

- *Illex* habitat area ranged from 28,515 km^2 to 153,117 km^2 across years using the 80% probability threshold.
- Proportion of habitat available to the fishery (Table 3)
  - minimum of 0.9% in 2002 (based on the lowest threshold for habitat)
  - maximum of 9.6% in 2001 and 2017 (based on the highest threshold for habitat)

Discussion

- Habitat is consistent with expectations despite the model being uninformed by environmental variables.
- The actual proportion of habitat exposed to fishing is likely substantially smaller than our conservative estimate (~1 to 10%).
  - Fishing effort is aggregated to coarse scale
  - Illex occupy deeper waters than are available to the surveys and areas to the north and south of the area we considered.
- Our findings support the MAFMC SSC's conclusion that the northern shortfin squid has been lightly exploited because a small portion of the species range falls within the area where the US fishery operates.