NOAA FISHERIES

Northwest Fisheries Science Center

Inclusion of ecosystem information in US fish stock assessments: progress toward ecosystem-based fisheries management?

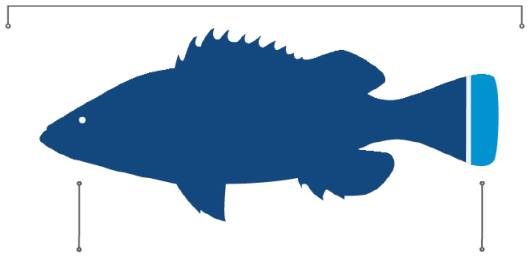
Kristin Marshall

7th National Meeting of the Scientific Coordination Subcommittee

15 August 2022

US fisheries management successes

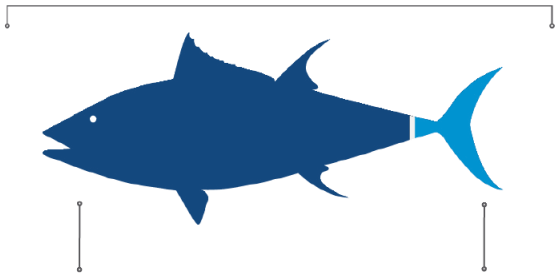
322 Stocks with Known Overfishing Status



92% not subject to overfishing (296 stocks)

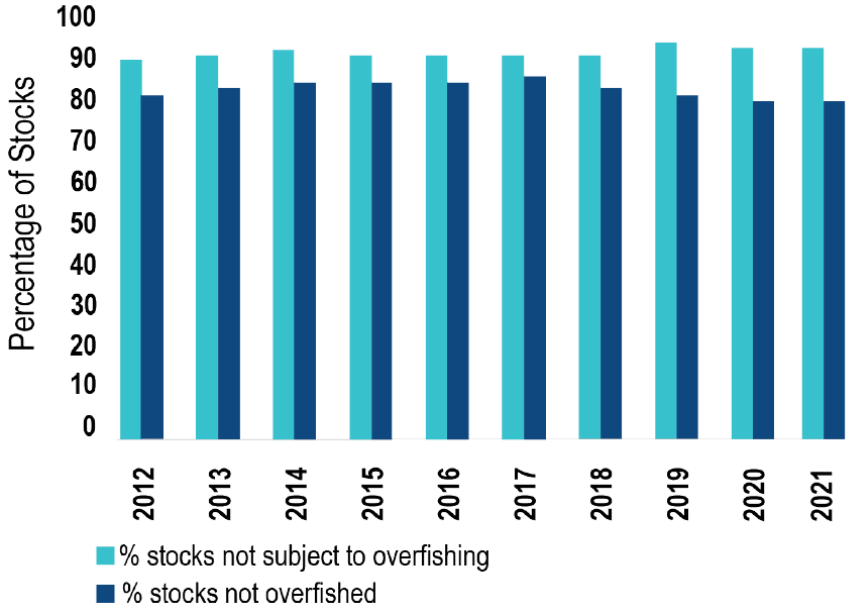
8% subject to overfishing (26 stocks)

252 Stocks with Known Overfished Status



80% not overfished (201 stocks)

20% overfished (51 stocks)



Status of the Stocks 2021. Annual Report to Congress on the Status of U.S. Fisheries. May 2022.

Ecosystem changes challenge fishery systems

The Atlantic

SCIENCE

A Coveted Fish Is Now a 'Climate Loser'

When is it time to give up on Rhode Island's winter flounder?

By Ben Goldfarb

How and when do stock assessments incorporate ecosystem information?

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 (2019), 76(1), 1–9. doi:10.1093/icesjms/fsy152

Review Article

Inclusion of ecosystem information in US fish stock assessments suggests progress toward ecosystem-based fisheries management

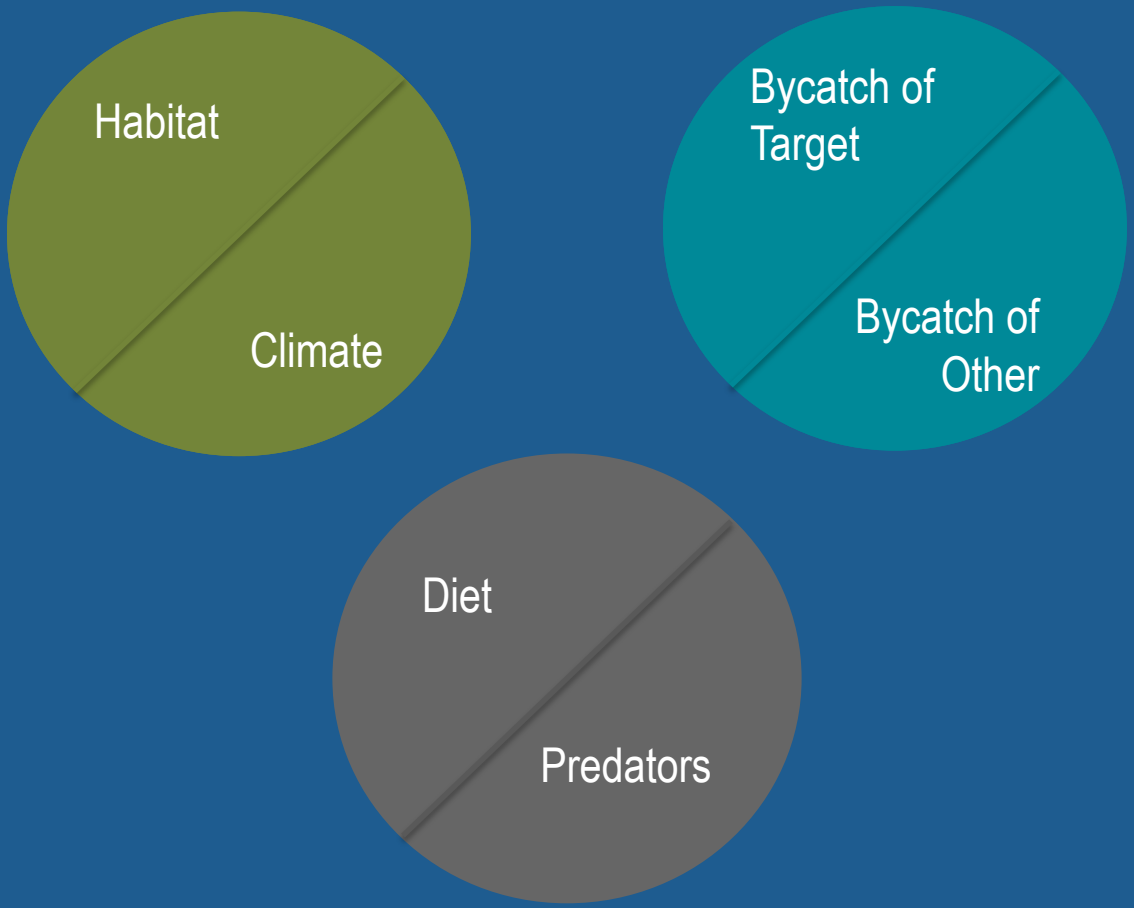
Kristin N. Marshall [1]*, Laura E. Koehn[2], Phillip S. Levin[3,4], Timothy E. Essington[2], and Olaf P. Jensen[5]

Goals

- Gauge the status of the use of ecosystem considerations in stock assessments
- Provide examples than can serve as a reference
- Consider how ecosystem information can be used in the institutional context in which assessments occur

Are U.S. assessments using ecosystem information?

- Census of recent stock assessment reports (through 2015)
- US federally managed stocks
- NOAA Species Information System (SIS) database (n=206)

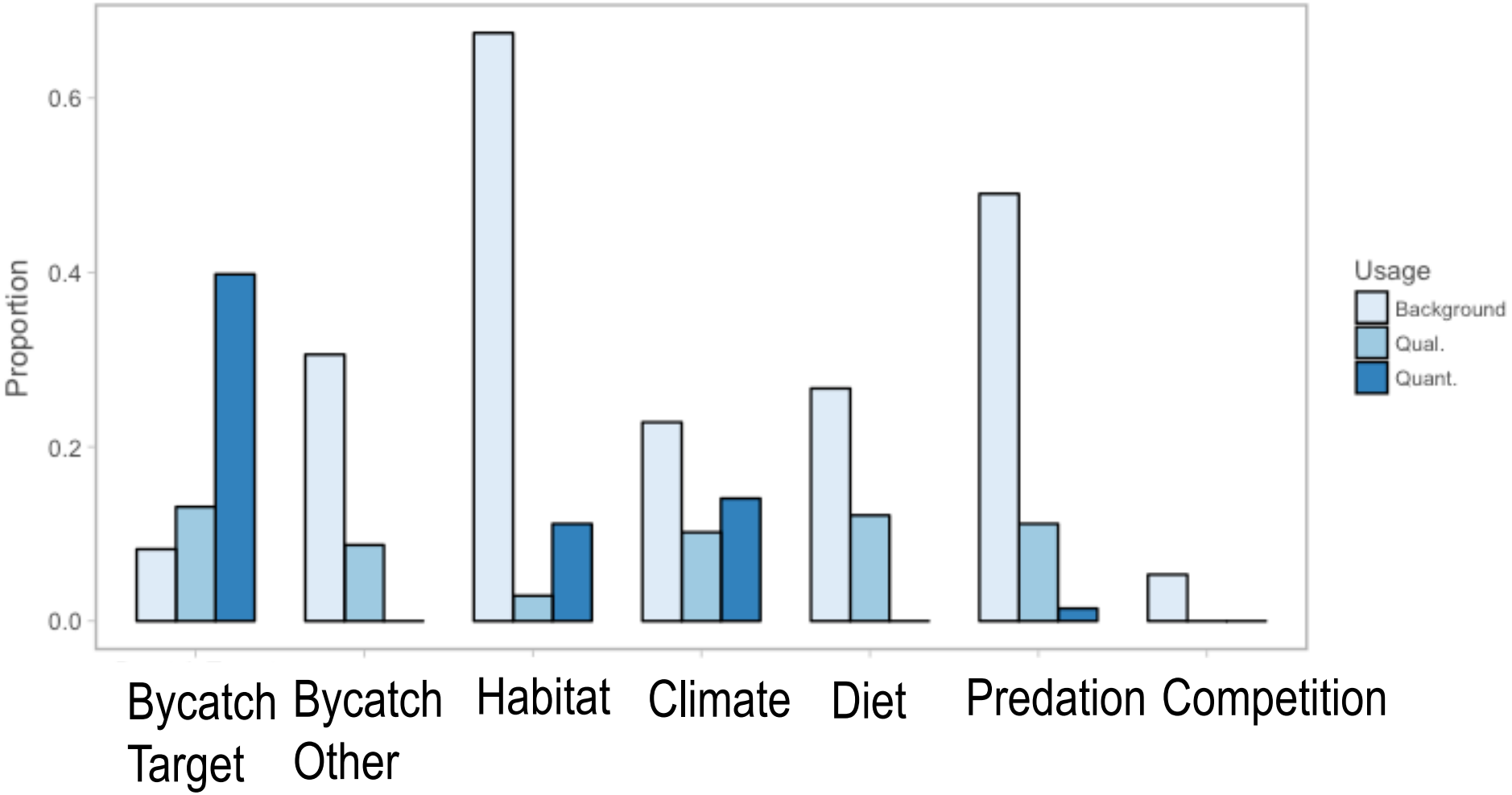

Habitat
Climate
Bycatch of Target
Bycatch of Other
Diet
Predators

Scoring

1	Does not appear
2	Referenced as background information
3	Includes quantitative data and/or explicit link made between topic and assessment parameters or output Eg: diet compositions and population trends in prey species
4	Included explicitly in the stock assessment model thru data inputs or parameter estimation Eg: temperature-dependent catchability

Higher scores do not necessarily indicate higher quality assessments

24% included ≥ 1 ecosystem factors quantitatively



Environmental Interactions: Climate

Model term	Factors	Example Species
Catchability	Temperature-dependent	
Catch	Temperature-dependent assignment	
Productivity/ Recruitment	Environmental indicators	
Growth	Time-varying with PDO regime	
Mortality	Harmful algal bloom indicator	

Environmental Interactions: Habitat

Approaches for survey-habitat mismatch:

- Survey catchability informed by bottom type
- Biomass is a product of area of bottom type
- Tows/trips only used if in appropriate bottom type

Total habitat area as estimated parameter

Habitat based spatial assessment model

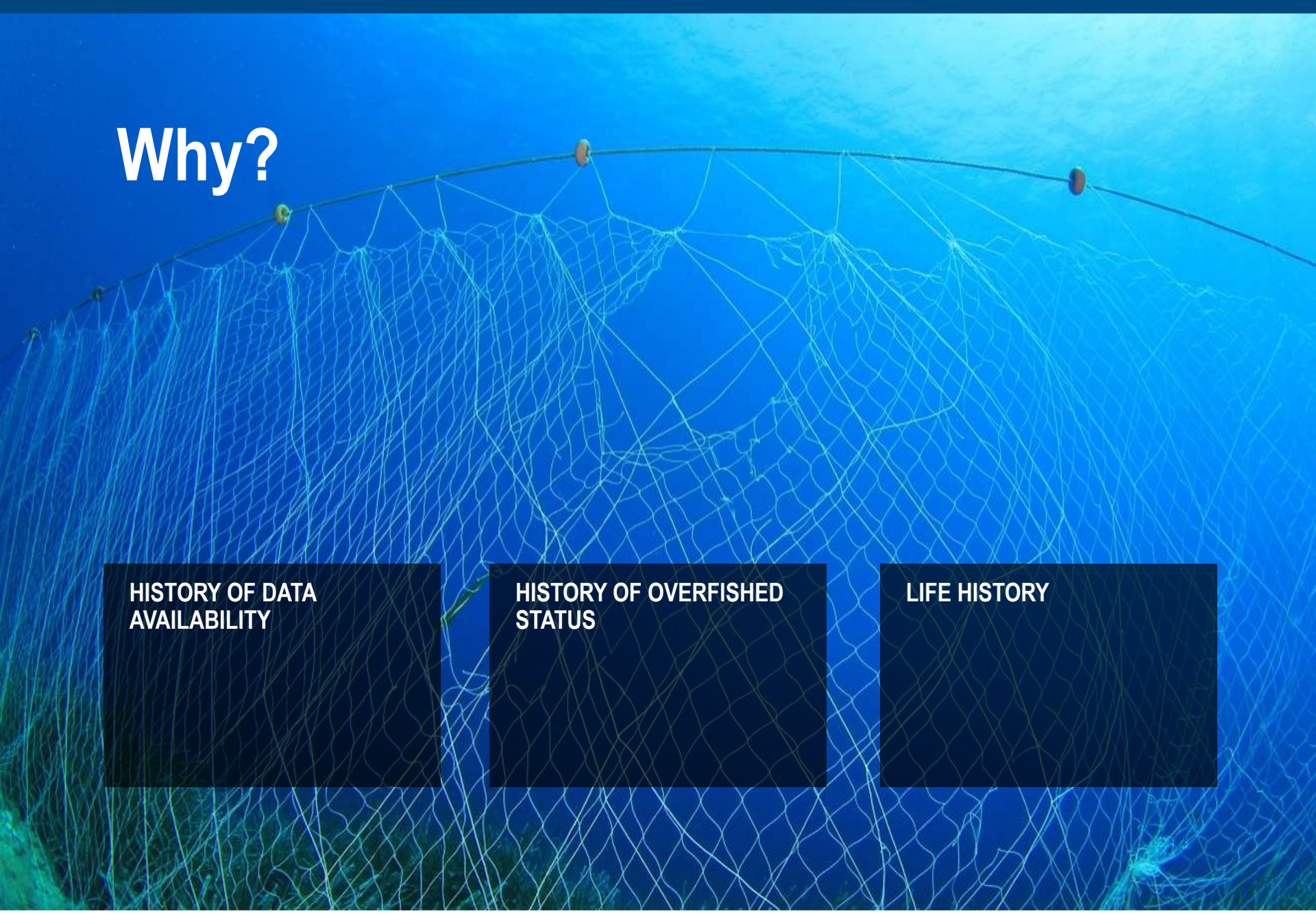
Species Interactions: Predation

Mortality:

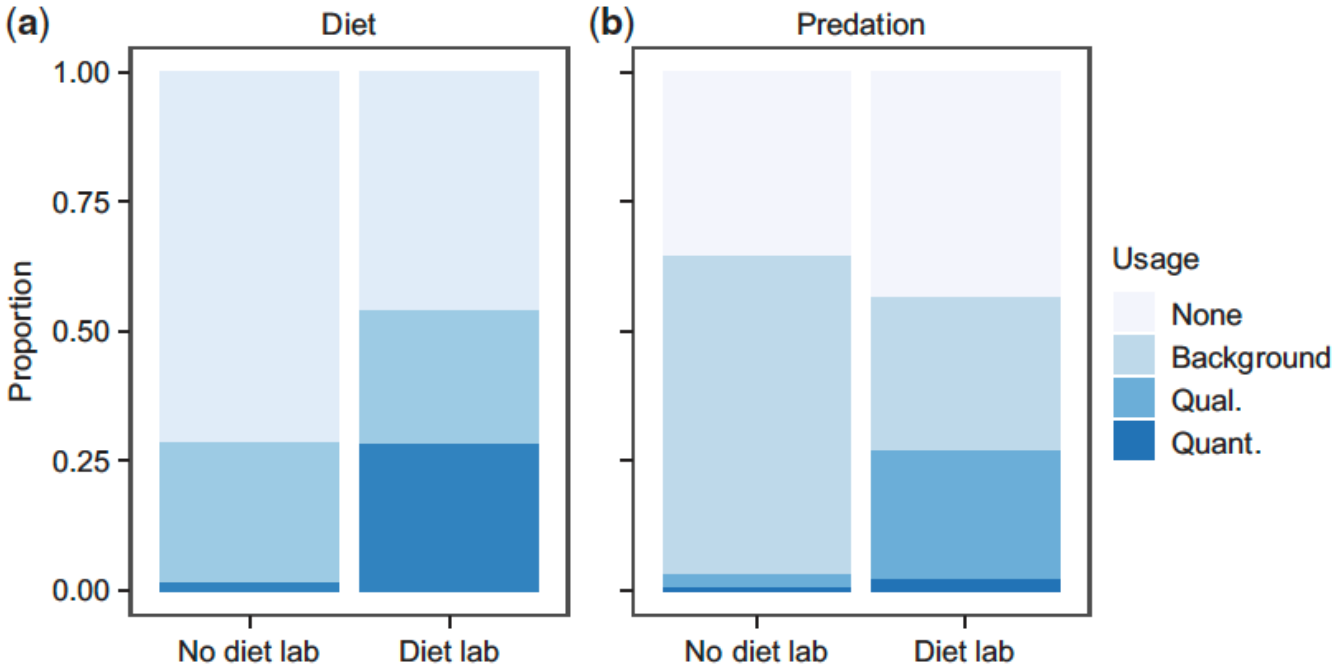
- Multispecies model informs natural mortality

- Higher juvenile mortality

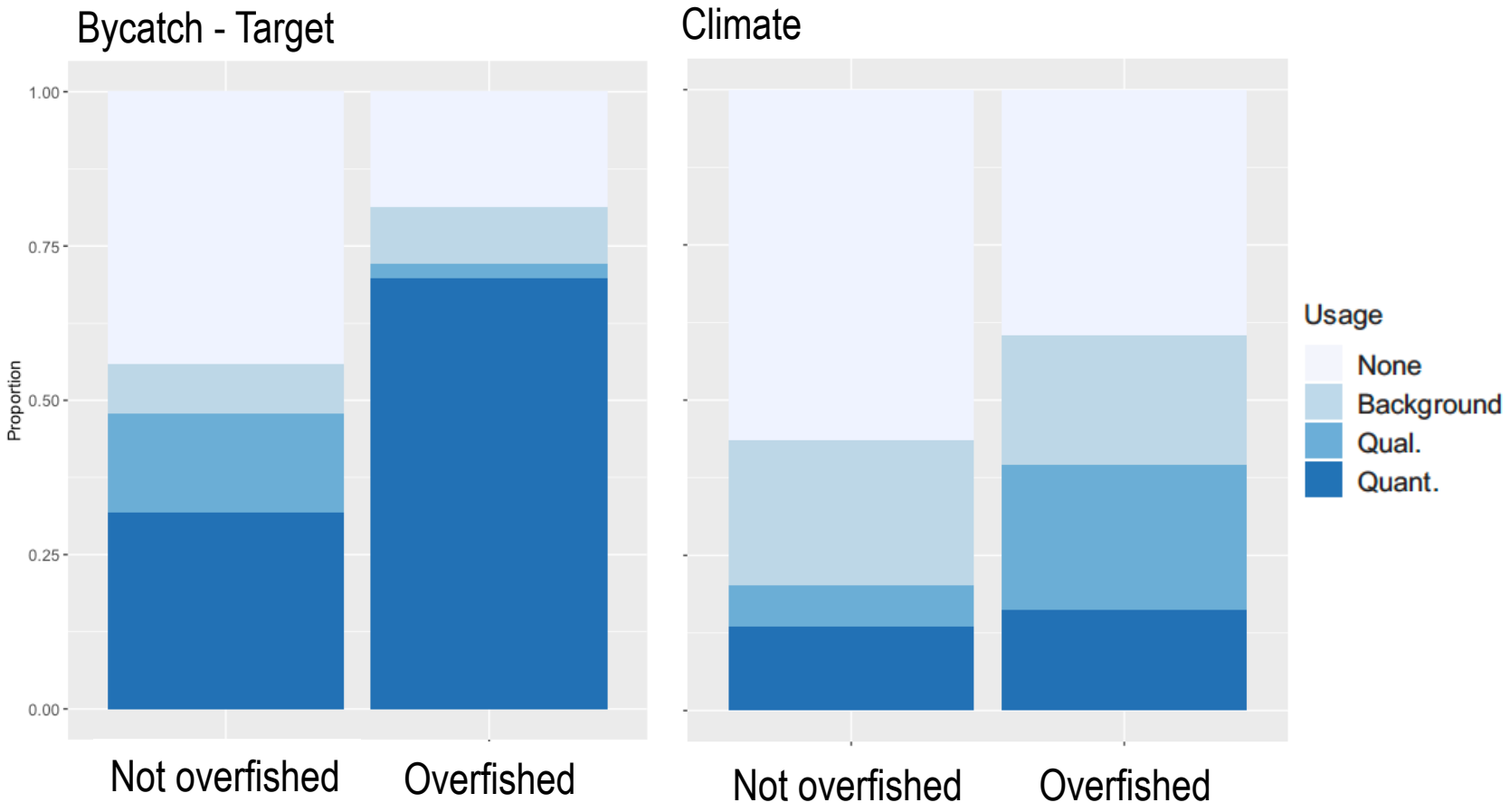
Why?


HISTORY OF DATA AVAILABILITY
HISTORY OF OVERFISHED STATUS
LIFE HISTORY

Data Availability Matters

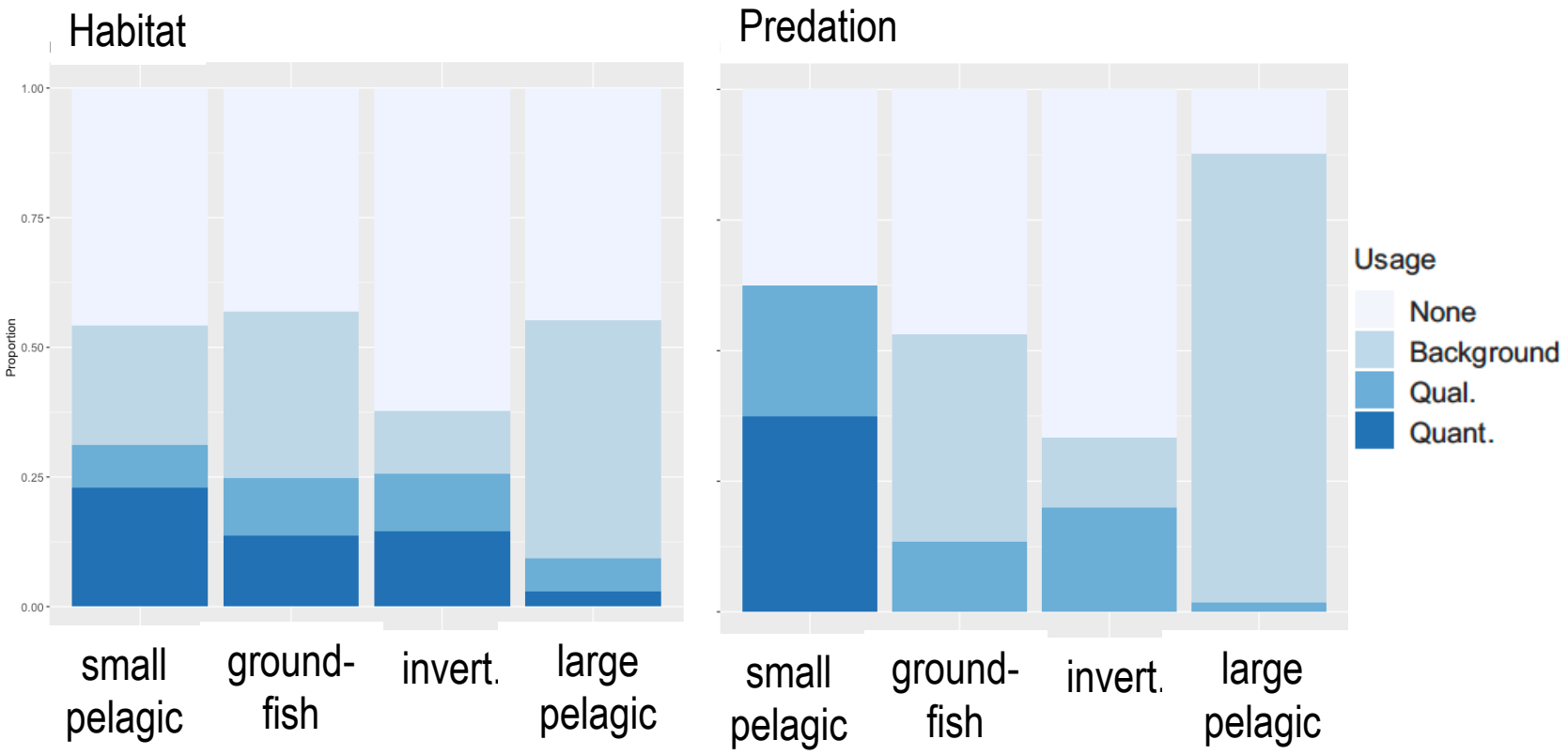


History of Overfished Status



No significant differences for Bycatch Other, Predation, Diet, Habitat

Life History Type



No significant differences for Bycatch, Climate

Conclusions

1 in 4 ASSESSMENTS USED ECOSYSTEM INFORMATION QUANTITATIVELY

URGENCY LEADS TO INNOVATION?

DATA AVAILABILITY MATTERS

SPECIES LIFE HISTORY INFLUENCES ECOSYSTEM INFORMATION USE

Tracking ecosystem information in other regions

FISH and FISHERIES, 2016, 17, 165–175

Global – 2%

Ecosystem processes are rarely included in tactical fisheries management

Mette Skern-Mauritzen[1], Geir Ottersen[1,2], Nils Olav Handegard[1], Geir Huse[1], Gjert E Dingsør[1], Nils C Stenseth[2,3,4] & Olav S Kjesbu[1]

ORIGINAL ARTICLE

FISH and FISHERIES WILEY

Canada – 25%

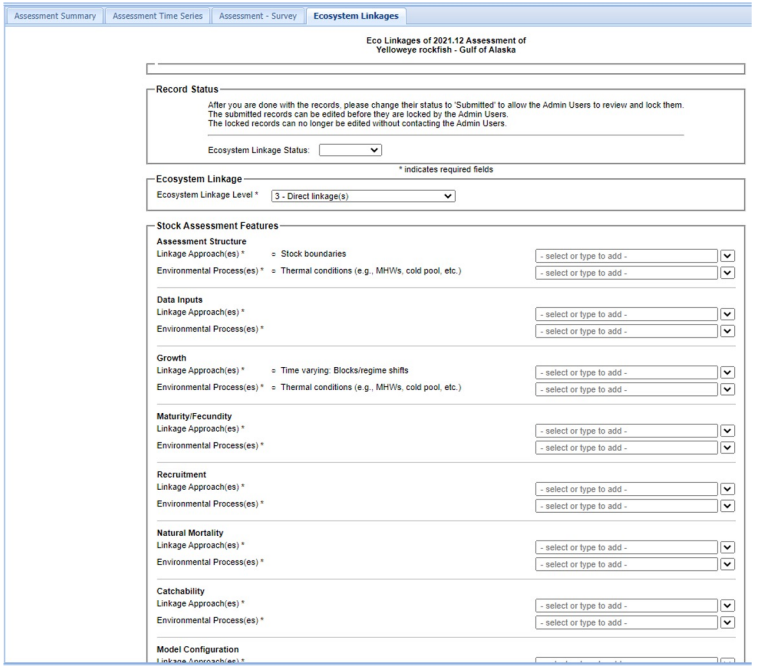
Incorporating knowledge of changes in climatic, oceanographic and ecological conditions in Canadian stock assessments

Pierre Pepin[1] | Jacquelyne King[2] | Carrie Holt[2] | Helen-Gurney Smith[3] | Nancy Shackell[4] | Kevin Hedges[5] | Alida Bundy[4]

What's next for tracking at NMFS?

Species Information System (SIS): Ecosystem-Linkages Module

- **2018 Next Generation Stock Assessment Improvement Plan (SAIP) introduced new Ecosystem linkage levels (0-5)**
  0. None
  1. Inform assessment structure or used to process input data
  2. Random variation, regime shifts, time-varying - not mechanistic
  3. Direct linkage(s) (i.e., inclusion of environmental covariates in final assessment model)
  4. Direct linkage(s) informed by process studies
  5. Fully coupled
- **SIS Ecosystem-linkages module - 2022**
  - Ask follow-up questions to collect additional information beyond the 0-5 linkage level
    - For level 0: (1) was ecosystem information considered but not included in the final assessment model?, (2) Reasons not considered or included
    - For levels 1-5: (1) how was the environmental data linked in the assessment (e.g., Linkage Approach), and (2) what was the environmental factor/process linked?
- **Tracking via this new module will improve our capability to track and understand our progress in incorporating ecosystem info in stock assessments**



NOAA FISHERIES

Slide credit: Melissa Karp

Thank you!

kristin.marshall@noaa.gov