PICES-2018 Annual Meeting

Toward integrated understanding of ecosystem variability in the North Pacific

Evaluating the performance of size-frequency based methods for estimating fishing mortality of Fang's blenny (*Pholis fangi*)

Ocean University of China College of Fisheries
Lab of Fisheries Ecosystem Monitoring and Assessment (FEMA)

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Background

- Strict data requirements for traditional fishery stock assessment methods.
- Data-poor situation are still prevalent for fish stocks in many regions.

The importance and practicality of length(weight) data.

- **easily collected and ready to use for almost all stocks**
- **include useful information of fishery stocks**
  maturity, growth, natural mortality, fishing selectivity

Increasing efforts in methodological development for data-poor stock assessment especially in size-based stock assessment methods.

Background

NRC Research Press

ARTICLE

Accounting for variable recruitment and fishing mortality in length-based stock assessments for data-limited fisheries

Merrill B. Rudd and James T. Thorson

Length-based Integrated Mixed Effects (LIME) method

RESEARCH ARTICLE

Length-Based Assessment of Coral Reef Fish Populations in the Main and Northwestern Hawaiian Islands

Marc O. Nadon[1,2,3]*, Jerald S. Ault[1], Ivor D. Williams[3], Steven G. Smith[1], Gerard T. DiNardo[3]

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Mean-length mortality estimation methods

ICES Journal of Marine Science

ICES CIEM

ICES Journal of Marine Science (2018), doi:10.1093/icesjms/fsy078

A new approach for estimating stock status from length frequency data

Rainer Froese[1,*], Henning Winker[2,3], Gianpaolo Coro[4], Nazli Demirel[5], Athanassios C. Tsikliras[6], Donna Dimarchopoulou[6], Giuseppe Scarcella[7], Wolfgang Nikolaus Probst[8], Manuel Dureuil[9,10], and Daniel Pauly[11]

length-based Bayesian biomass estimation method (LBB)

Contents lists available at ScienceDirect

Fisheries Research

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

ELSEVIER

Length based SPR assessment of eleven Indo-Pacific coral reef fish populations in Palau

CrossMark

Jeremy Prince[a,*], Steven Victor[b], Valentino Kloulchad[c], Adrian Hordyk[d]

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[d] Centre for Fish, Fisheries and Aquatic Ecosystems Research, School of Veterinary and Life Sciences, Murdoch University, Murdoch 6150, WA, Australia

Length based SPR assessment (LBSPR)

Methods in Ecology and Evolution

BRITISH ECOLOGICAL SOCIETY

Methods in Ecology and Evolution 2017 doi:10.1111/2041-210X.12791

APPLICATION

TropFishR: an R package for fisheries analysis with length-frequency data

Tobias Karl Mildenberger*[,1], Marc Hollis Taylor[2] and Matthias Wolff[3]

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TropFishR

ICES Journal of Marine Science

ICES CIEM

ICES Journal of Marine Science (2017), 74(1), 69–77. doi:10.1093/icesjms/fsw145

Original Article

Estimating uncertainty of data limited stock assessments

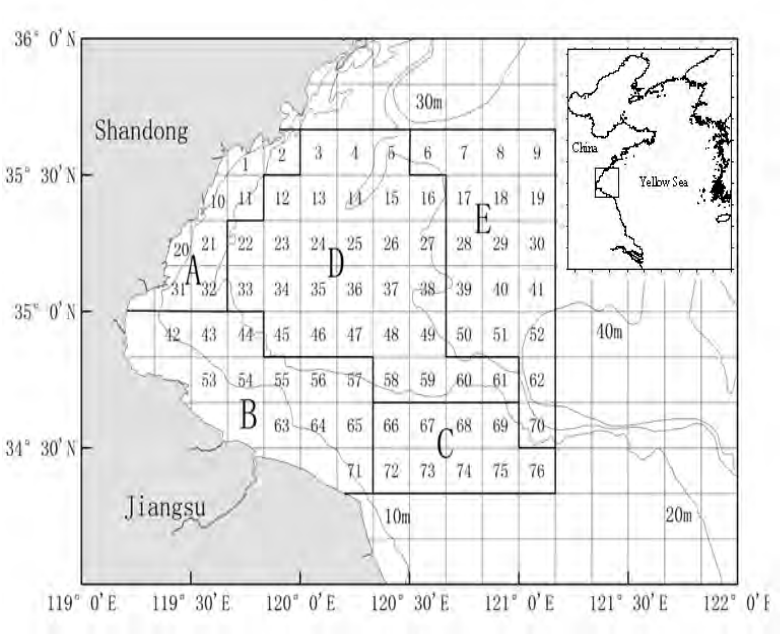
Alexandros Kokkalis[1,*], Anne Maria Eikeset[2], Uffe H. Thygesen[1], Petur Steingrund[3], and Ken H. Andersen[1]

S6model

Evaluating the reliability and comparing the robustness of size-frequency based methods

1. Using simulated data
2. Using observed data

Research object and area



Fang's blenny (Pholis fangi)
Small scale fishery
Important ecological significance
Lack of assessment

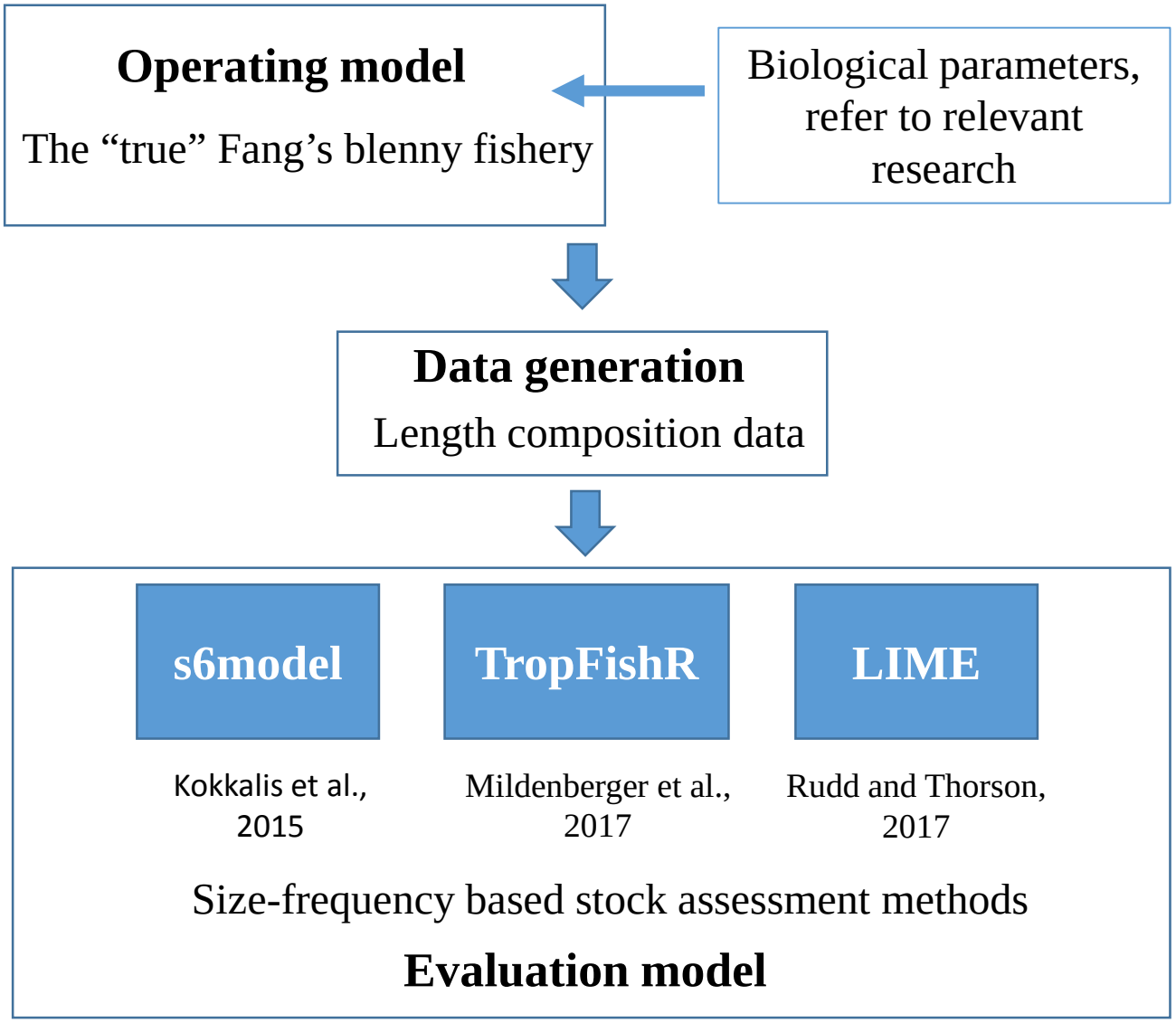
Haizhou Bay, China
from 2011 to 2016 (except for 2012)
Sample size: 2679 in spring, 622 in fall

Evaluating the reliability and comparing the robustness of size-frequency based methods

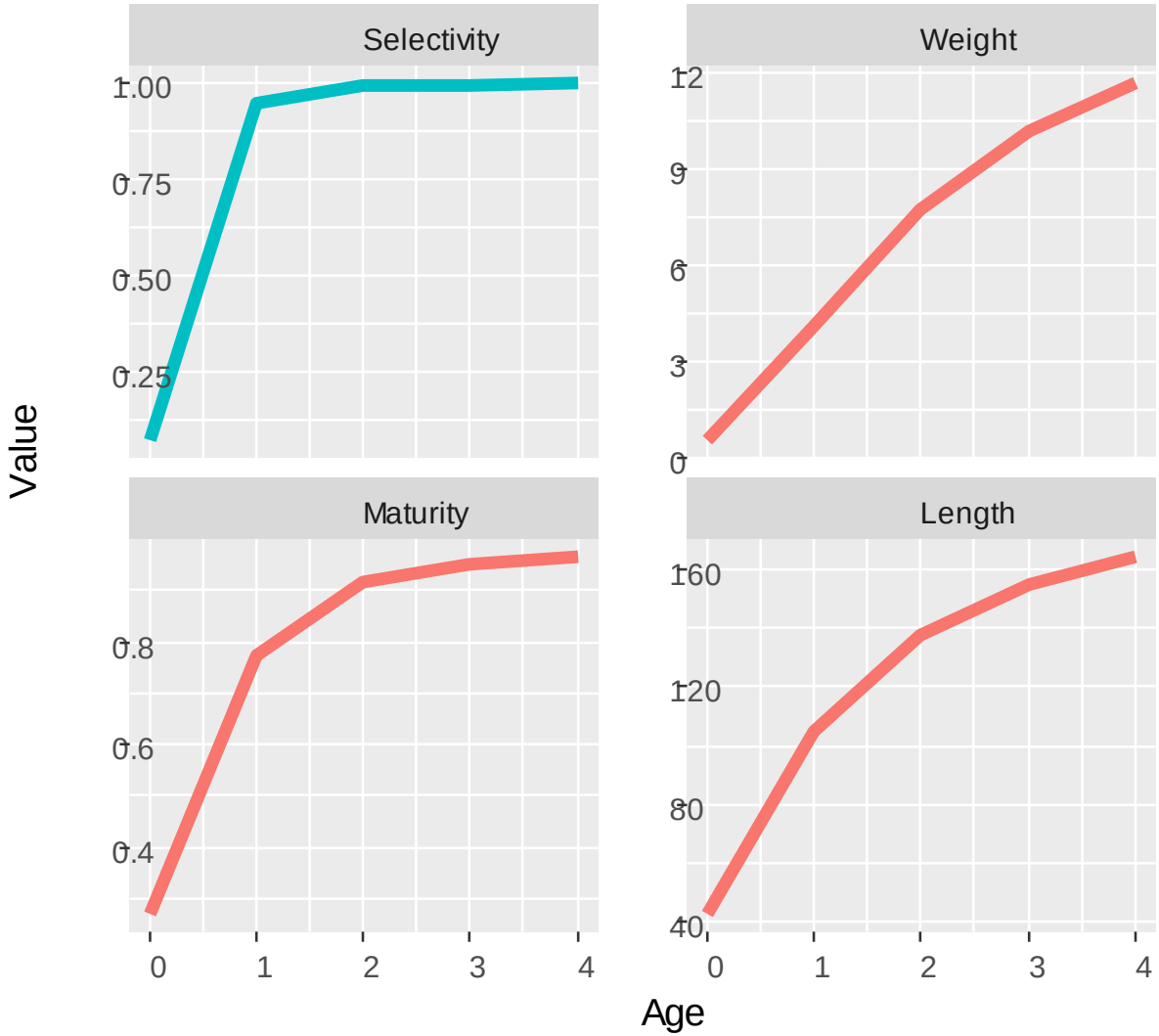
1. Using simulated data

2. Using observed data

Using simulated data

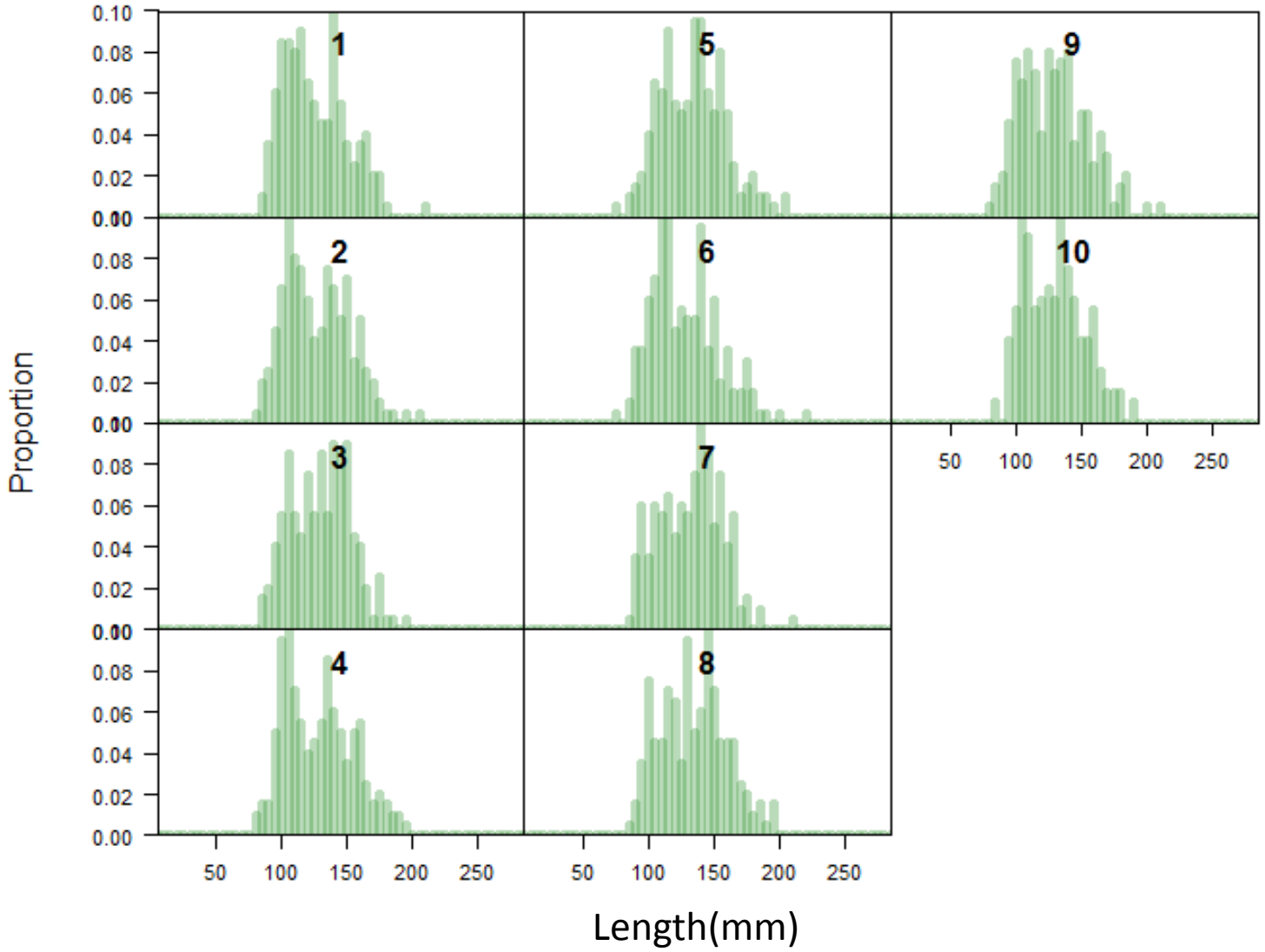


The “true ” blenny fishery



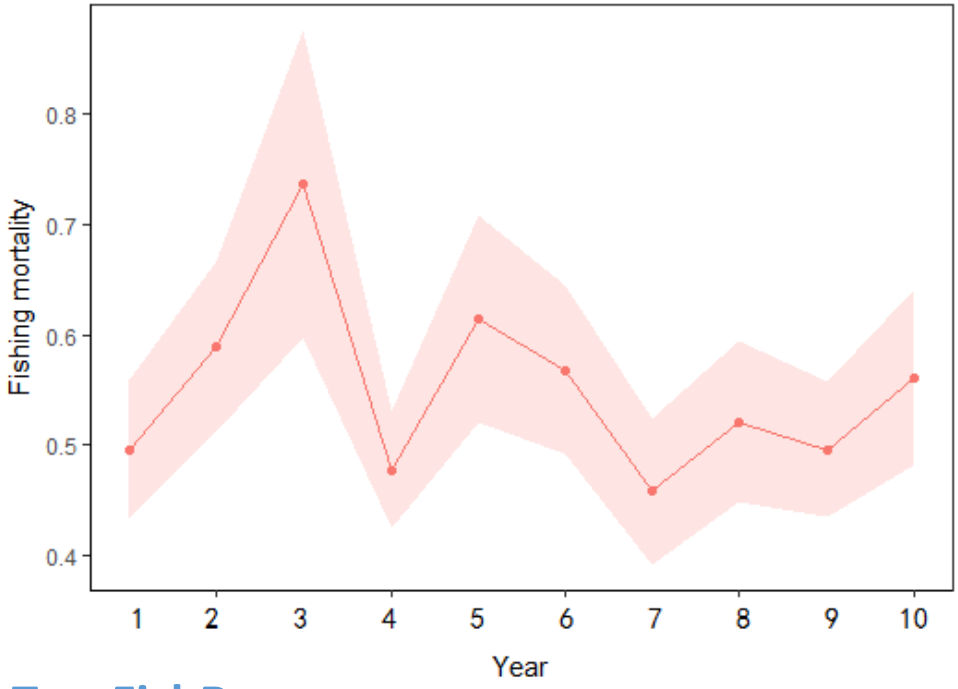
The "true" blenny fishery

Generated length-frequency data

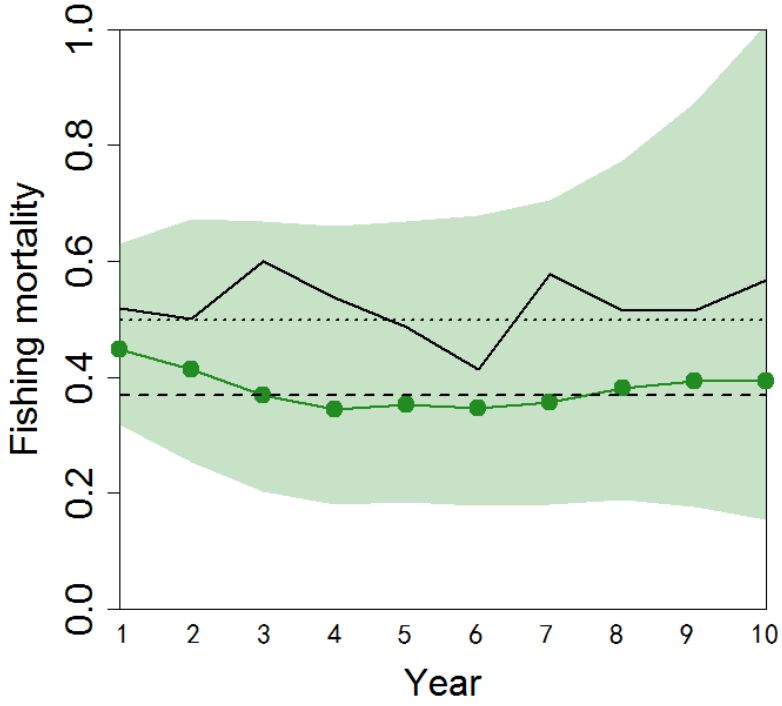


The "true " blenny fishery → Generated length-frequency data → Evaluation process

S6model



LIME



TropFishR

ELEFAN method was used to estimated K and asymptotic body length.
Pauly's empirical formula was used to estimate M.
The catch curve method was used to estimate total mortality (Z).
Fishing mortality was calculated from M and Z accordingly by **F=Z-M**.

Estimated Fishing mortality of different size-based methods

Year	TR	s6	LIME	TRUE
1		0.50	0.45	0.52
2		0.59	0.41	0.50
3		0.74	0.37	0.60
4		0.48	0.35	0.54
5		0.61	0.35	0.49
6		0.57	0.35	0.41
7		0.46	0.36	0.58
8		0.52	0.38	0.51
9		0.50	0.39	0.52
10		0.56	0.39	0.57
average	0.56	0.55	0.38	0.52

Evaluating the reliability and comparing the robustness of size-frequency based methods

1. Using simulated data

2. Using observed data

- Performance consistence
- Data dependency

Evaluating the reliability and comparing the robustness of size-frequency based methods

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- **Performance consistence**
- Data dependency

Estimated stock exploitation of Fang's blenny

		Spring			fall		
Model	Year	F	F_{msy}	F/F_{msy}	F	F_{msy}	F/F_{msy}
S6model	2011	2.34	0.67	3.49	0.61	1.18	0.52
	2013	1.43	0.62	2.30	0.49	1.05	0.47
	2014	1.37	0.62	2.21	0.53	1.62	0.32
	2015	0.78	0.68	1.16	0.48	0.97	0.50
	2016	1.87	0.65	2.85	0.55	1.51	0.36
	2011-2016	1.56	0.65	2.40	0.53	1.26	0.43
TtopFishR		F	F_{msy}	F/F_{msy}	F	F_{msy}	F/F_{msy}
	2011-2016	1.06	0.52	2.05	0.28	0.68	0.41

F/Fmsy varied substantially among seasons: much higher in spring than in fall
Remarkable overfishing (F/Fmsy>1) in spring
Less fishing effort in fall.

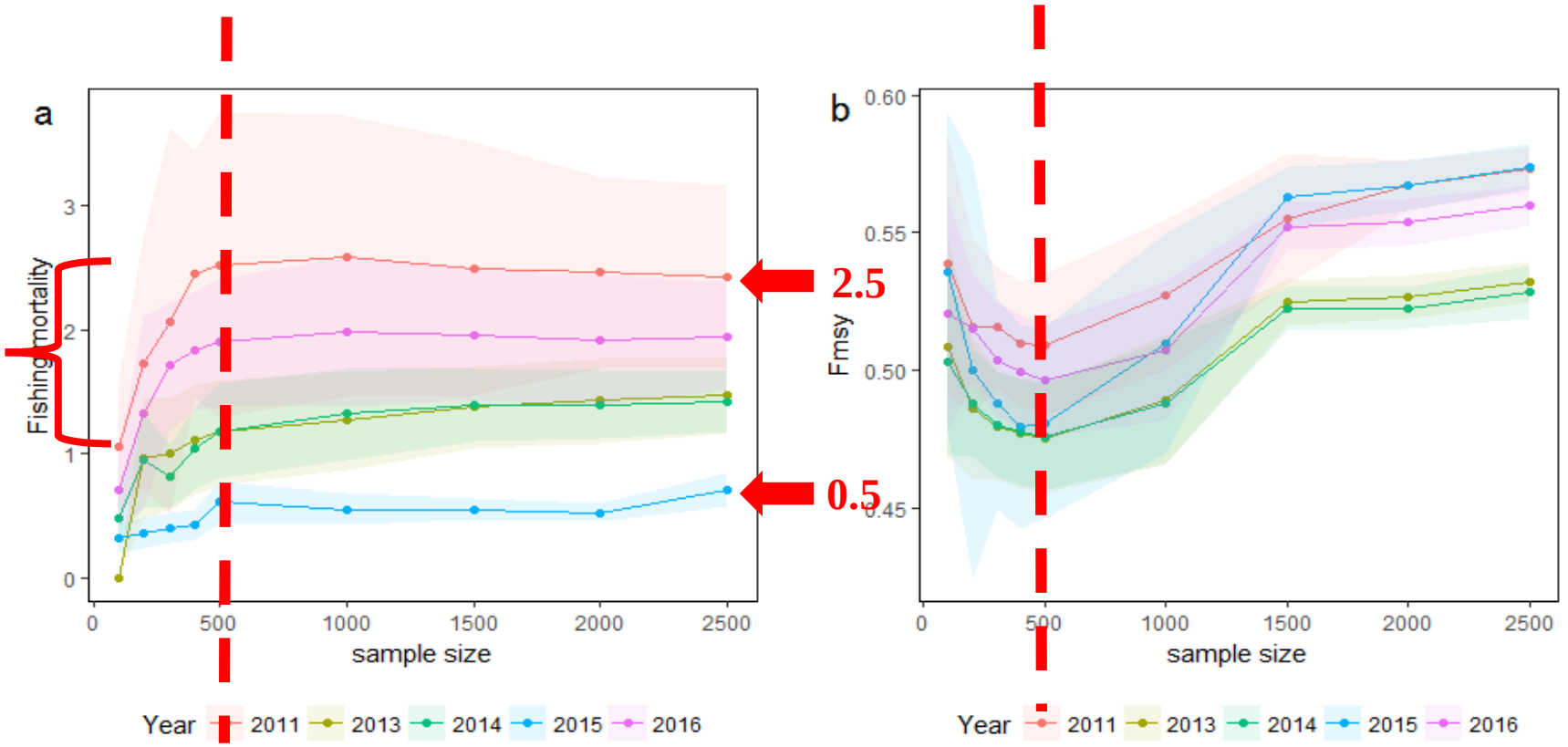
Evaluating the reliability and comparing the robustness of size-frequency based methods

1. Using simulated data

2. Using observed data

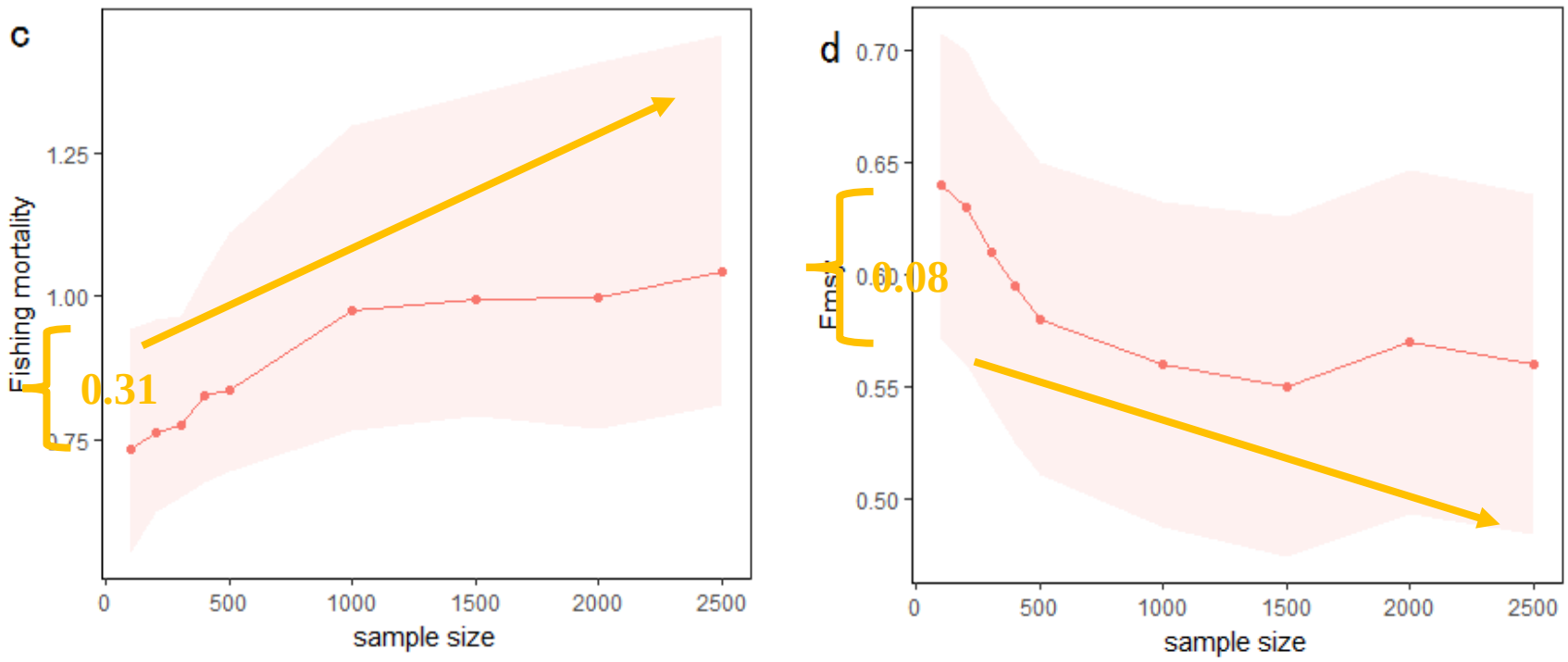
- Performance consistence
- **Data dependency**

Data dependency of s6model



- The estimated F was gradually stable.
- Remarkable variations of F were detected among years.
- F_{msy} decreased with sample size between 100 and 500 and increased when sample size was larger.
- The standard deviation tended to decrease.

Data dependency of TropFishR



- The estimation was less influenced by data size, both F and Fmsy showed slight changes.
- The estimation of F showed a minor increase while Fmsy showed a minor decline with the increase of sample size.
- The standard deviations were stable.

Summary

- The consistency of the method evaluation results indicated **the potential and feasibility of data-limited methods** in stock assessment.

- The high fishing mortality in spring and low mortality in fall accorded to the observed fishing effort in HaiZhou Bay, and the results reflected the **seasonal dynamics** of blenny fishery and its **biological characteristics**.

- The results suggested that **TropFishR** was more robust on sample size and more suitable for the assessment of stock exploitation status when the amount of data is substantially insufficient.

- The importance of **data quality.**

- **Limitation:**

Fisheries species with **different life history characteristics** should be tested within the data-limited methods;

The **biological and model uncertainties** should be accounted for in stock assessment and future fisheries management.

Acknowledgements

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Thanks for your listening!

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