

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Nicholas Grunloh

In Cooperation With:
E.J. Dick, Don Pearson, John Field, Marc Mangel

UCSC :: CSTAR :: SWFSC :: NMFS

30 July 2018



Beta-Binomial Model

$$y_{ijklm\eta} \sim \text{Beta-Binomial}\left(\mu_{jklm\eta}, \sigma_{jklm\eta}^2\right)$$

$$\mu_{jklm\eta} = n \logit^{-1}(\theta_{jklm\eta})$$

$$\sigma_{jklm\eta}^2 = \mu_{jklm\eta} \left(1 - \frac{\mu_{jklm\eta}}{n}\right) \left(1 + (n-1) \rho\right)$$

$$\theta_{jklm\eta} = \beta_0 + \beta_j^{(s)} + \beta_k^{(p)} + \beta_l^{(g)} + \beta_{mn}^{(t)}$$

$y_{ijklm\eta}$: i^{th} sample of the j^{th} species' integer weight, in the k^{th} port, caught with the l^{th} gear, in the η^{th} quarter, of year m , for a particular market category.

$j \in \{1, \dots, J\}$ Species

$k \in \{1, \dots, K\}$ Ports

$l \in \{1, \dots, L\}$ Gears

$m \in \{1, \dots, M\}$ Years

$\eta \in \{1, \dots, H\}$ Quarters

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Diagnostic Tutorial

Request: As a diagnostic template, for each sampled stratum compare the posterior predictive distributions at the 68th, 95th, and 99th percentiles with the current observed species proportions (create fully stratified versions of tables 2 and 3 in the Grunloh et al. methods documentation). With each row, include sample sizes and associated landing weights with a graphical display to highlight problems and outliers (circle size proportional to landing weights).

Rationale: The Team provided broad-scale summary metrics (e.g., MSE and DIC) for evaluating the goodness-of-fit of the different model forms and structures. Fine-scale diagnostics are needed to help identify aspects of the data that are not adequately addressed by the different models. The diagnostic template will provide a mechanism for fine-scale exploration of goodness-of-fit.

Response: The following slides show the requested diagnostic plot and demonstrate how to maneuver as well as interpret them.

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Diagnostic Tutorial

Likelihood

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Proofs

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Diagnostic Tutorial

Information Criterion

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Diagnostic Tutorial

MAD Diagnostic

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Diagnostic Tutorial

Marginal Plot

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Diagnostic Tutorial

Stratum Plot

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○

Request: Provide a summary table of species sample sizes in each market category by time block.

Rationale: The requested information will assist in understanding where there are gaps in the available data that the model is filling in by means of its pooling structure.

Response: The following slides show tables of total sample sizes and the frequency of occurrence by species within each sample (across all years, gears, ports and quarters within a time period) for the three rockfish market categories that we focus on in the presentation, as well as elasmobranchs and flatfish. Supplementary excel files include data summaries and pivot tables that can be used to review the same information for all other market categories, as well as these and other market categories at higher levels of stratification (year, port complex, gear, quarter) to address specific questions or concerns.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
○○	○○○	○	○○	○○	○	○
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Interaction Model

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Proofs

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Request: Redo the modeling of the early time block without southern CA ports. Explore spatially and temporally (i.e., alternative time blocks).

Rationale: The available dataset does not have any sample data in the early time block from the southern CA ports. It was unclear how this lack of data influenced the model results. The requested analysis will clarify the situation.

Response: All of the model runs and plots from this point forward only model ports north of point conception.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Request: The diagnostic template should be developed for each of the sensitivity runs (vary across a range of plausible time models and priors and limit to the top 2-3 market categories).

Rationale: Application of the diagnostics across a wide range of models will form a test of how well the diagnostics illustrate whether the models capture important structural features that are thought to be embedded in the data.

Response: The following slides show the requested diagnostic plots as applied to models across a range of time models and prior choices.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Time Models

(M1)

$$\beta_{m\eta}^{(t)} = \beta_m^{(y)} + \beta_\eta^{(q)}$$

$$\beta_m^{(y)} \sim N(0, 32^2)$$

$$\beta_\eta^{(q)} \sim N(0, 32^2)$$

(M2)

$$\beta_{m\eta}^{(t)} = \beta_m^{(y)} + \beta_\eta^{(q)}$$

$$\beta_m^{(y)} \sim N(0, v^{(y)})$$

$$\beta_\eta^{(q)} \sim N(0, v^{(q)})$$

(M3)

$$\beta_{m\eta}^{(t)} = \beta_m^{(y)} + \beta_\eta^{(q)} + \beta_{m\eta}^{(y:q)}$$

$$\beta_m^{(y)} \sim N(0, v^{(y)})$$

$$\beta_\eta^{(q)} \sim N(0, v^{(q)})$$

$$\beta_{m\eta}^{(y:q)} \sim N(0, v)$$

(M4)

$$\beta_{m\eta}^{(t)} = \beta_{m\eta}^{(y:q)}$$

$$\beta_{m\eta}^{(y:q)} \sim N(0, v)$$

(M5)

$$\beta_{m\eta}^{(t)} = \beta_{m\eta}^{(y:q)}$$

$$\beta_{m\eta}^{(y:q)} \sim N(0, v_\eta)$$

(M6)

$$\beta_{m\eta}^{(t)} = \beta_{m\eta}^{(y:q)}$$

$$\beta_{m\eta}^{(y:q)} \sim N(0, v_m)$$

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MCAT 250

	M1	M2	M3	M4	M5	M6
Δ DIC	6448.98	0.33	0	4.45	9.3	7.42
Δ WAIC	6421.5	0.37	0	4.52	8.25	6.55

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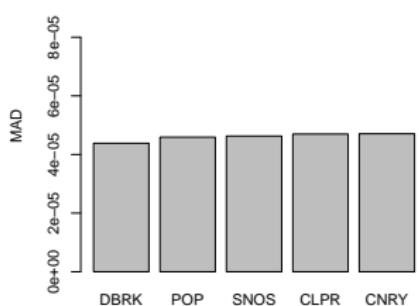
MCAT 250

M2

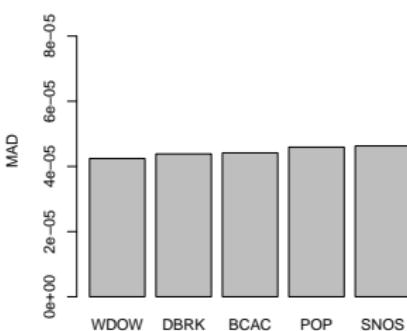
M3

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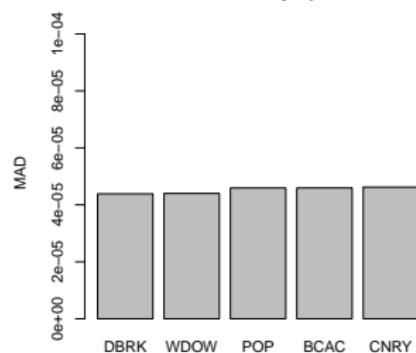
MAD Ordered by Species



MAD Ordered by Species

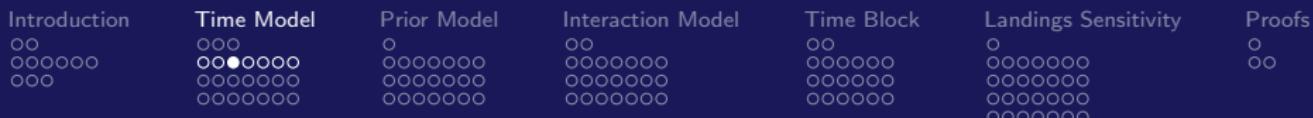


MAD Ordered by Species

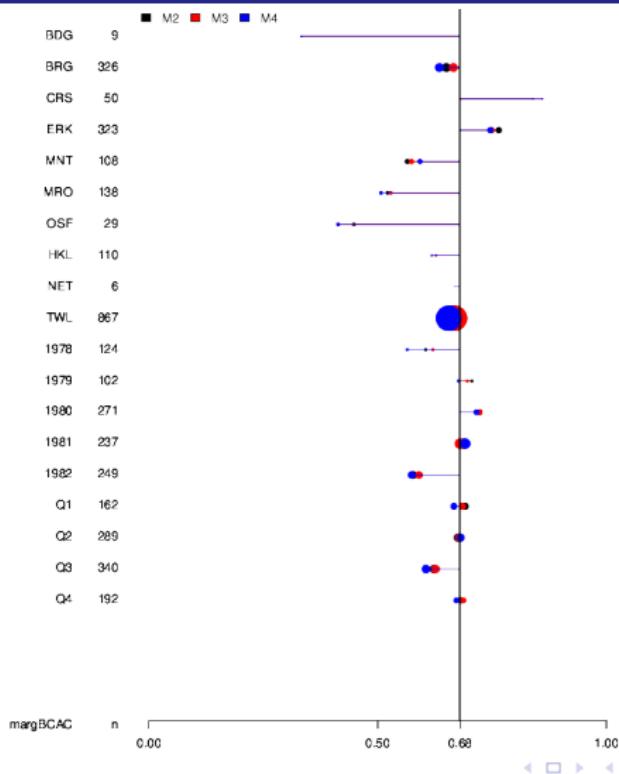


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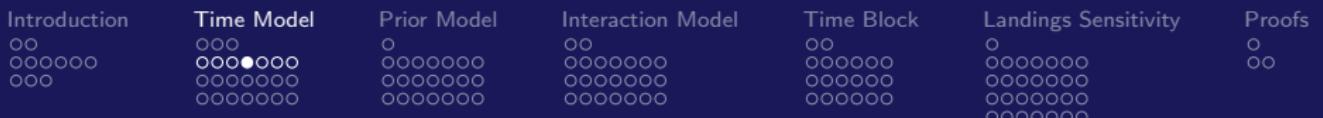


MCAT 250

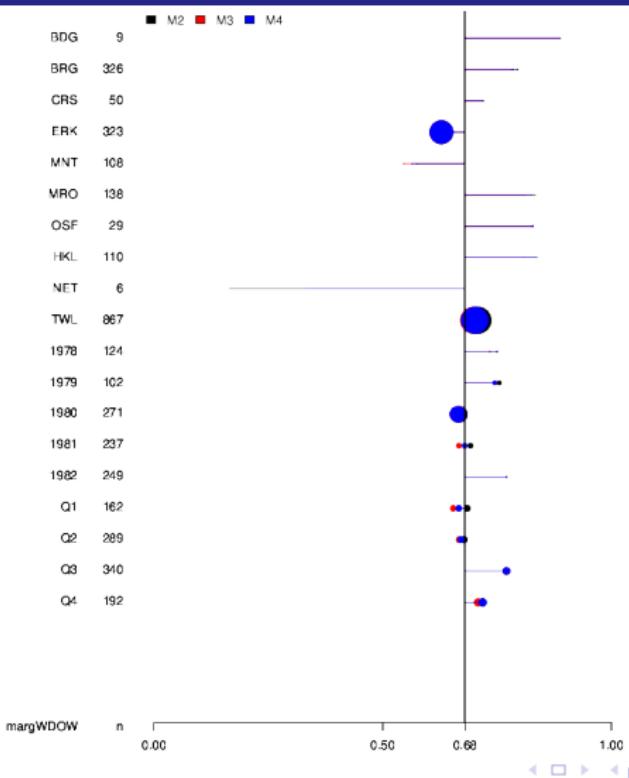


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MCAT 250



Introduction

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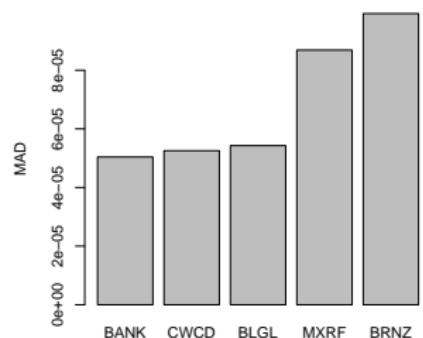
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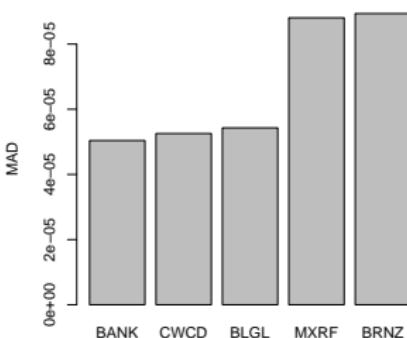
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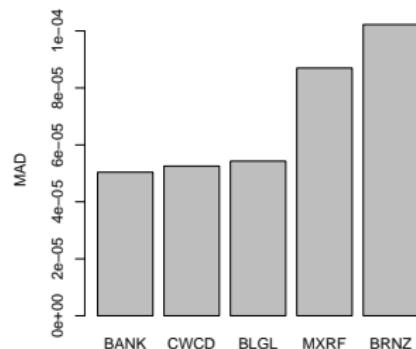
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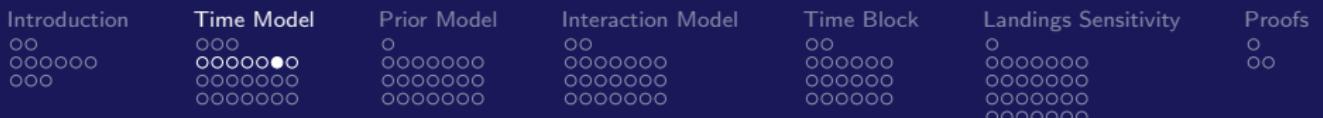
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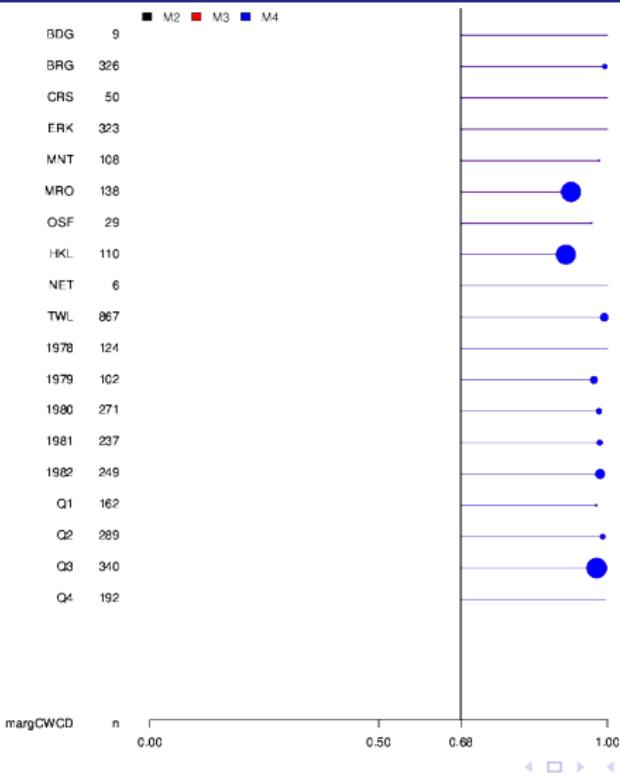
MAD Ordered by Species

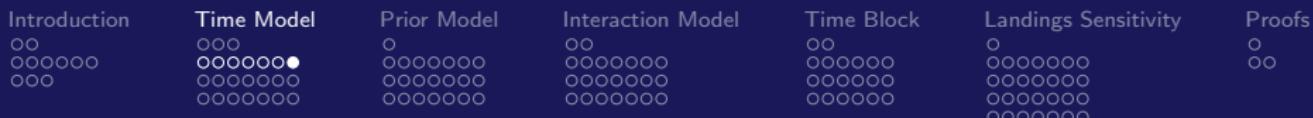


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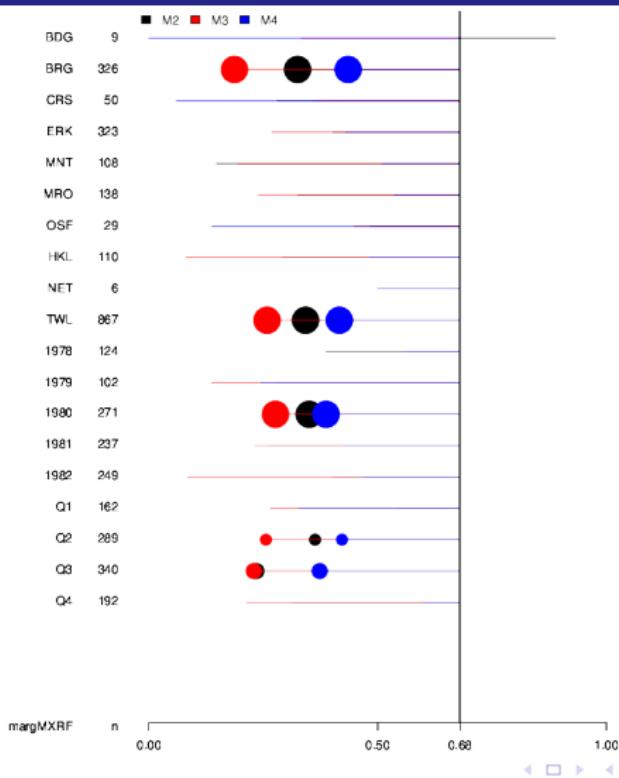


MCAT 250





MCAT 250



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Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

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MCAT 253

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Δ WAIC	1391.66	0.16	0.18	0	0.13	0.08

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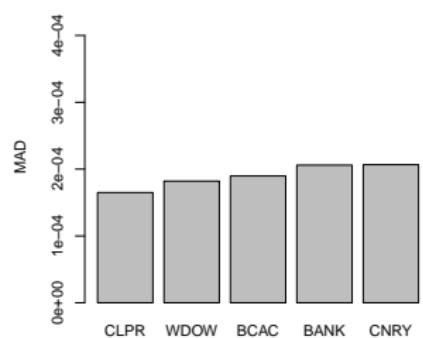
MCAT 253

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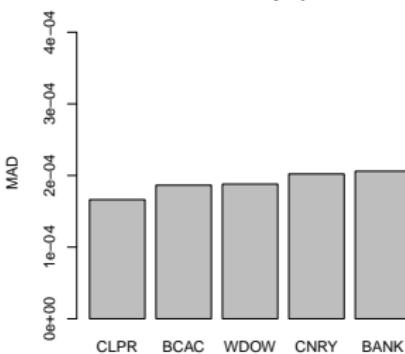
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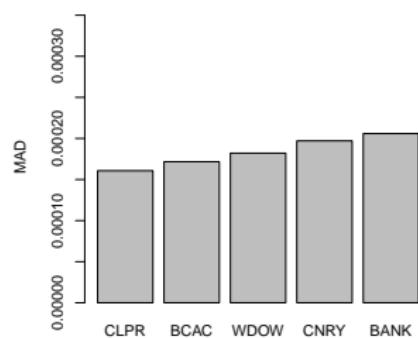
MAD Ordered by Species



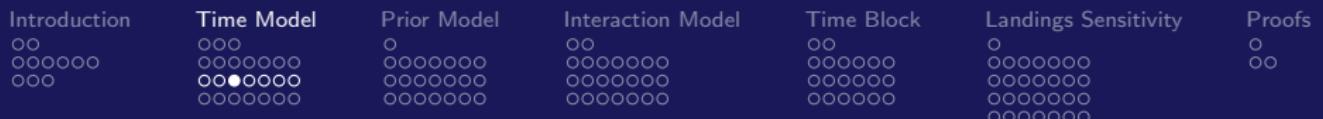
MAD Ordered by Species



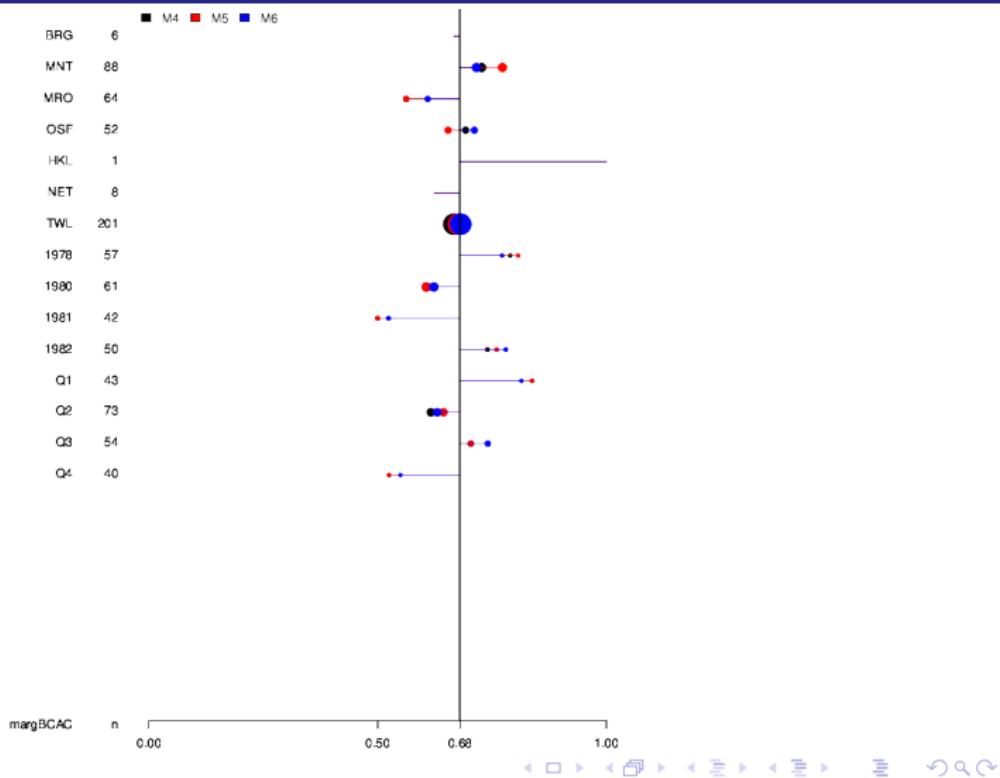
MAD Ordered by Species

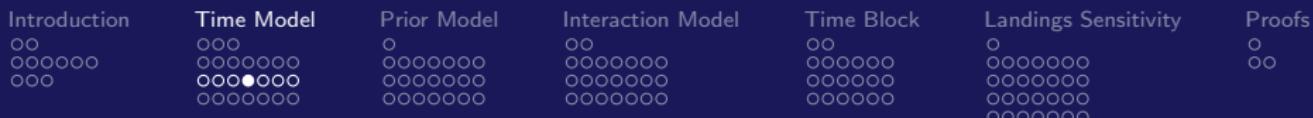


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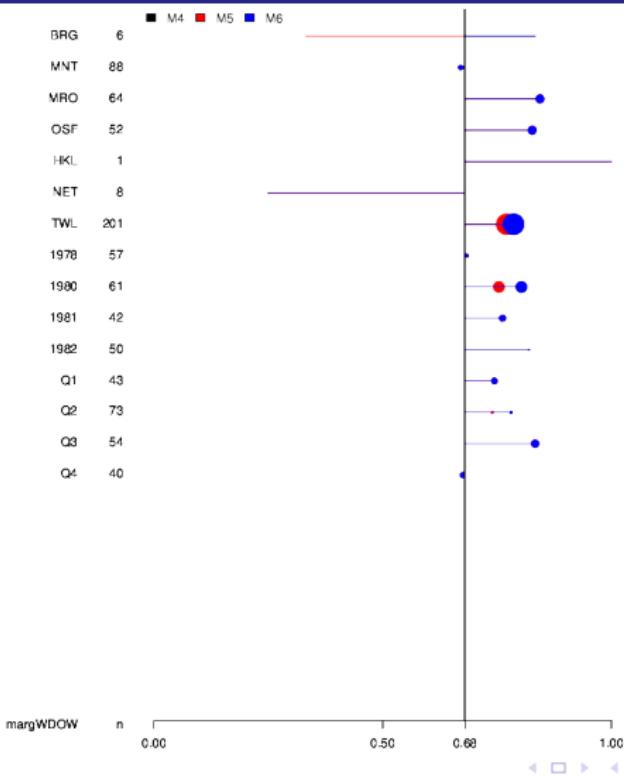


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MCAT 253



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Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

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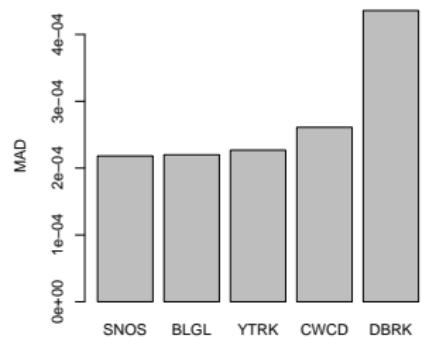
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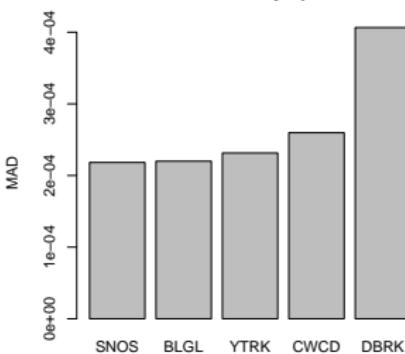
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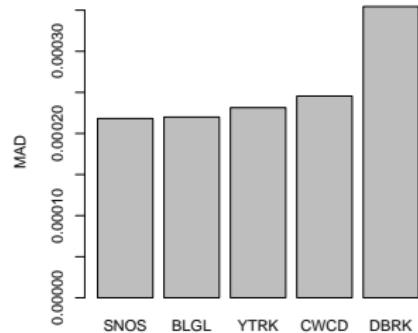
MAD Ordered by Species



MAD Ordered by Species



MAD Ordered by Species



Combined



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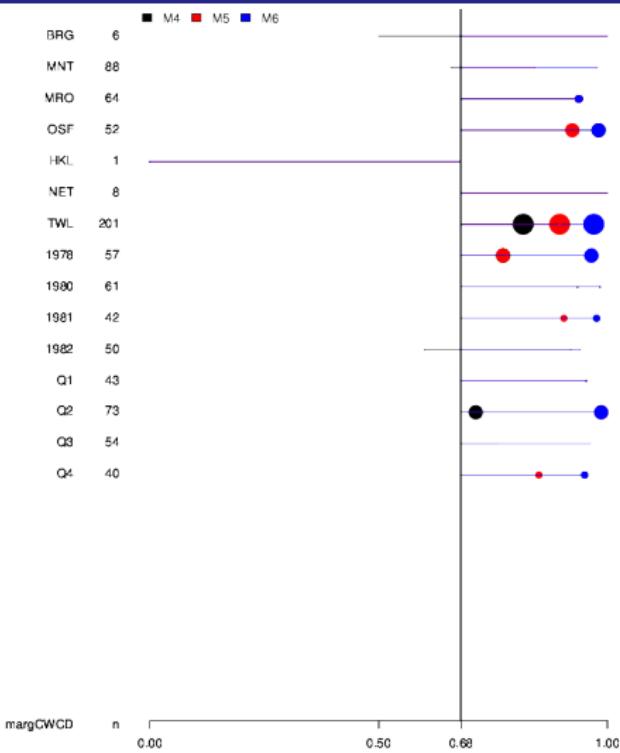
Landings Sensitivity

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Proofs

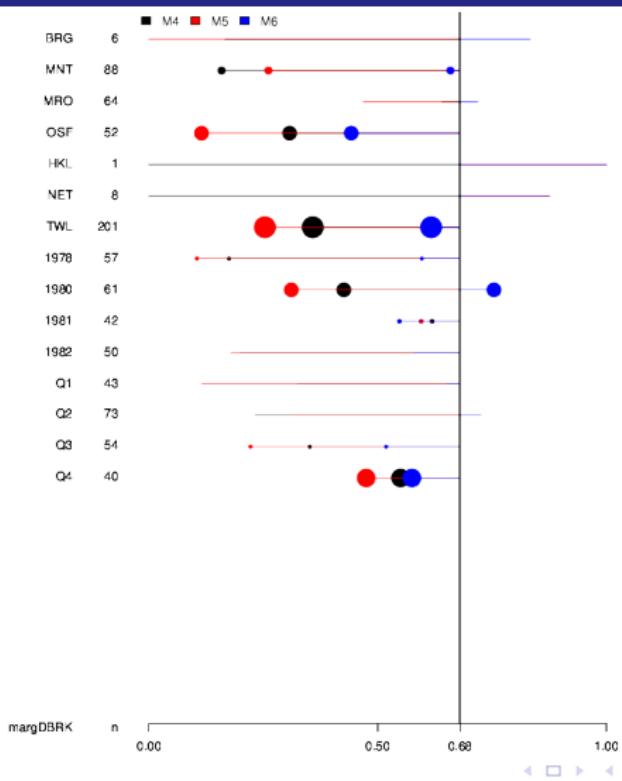
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MCAT 253





MCAT 253



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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MCAT 269

	M1	M2	M3	M4	M5	M6
Δ DIC	572.51	176.63	599.41	0.57	0	193.35
Δ WAIC	427.48	69.37	454.41	0.23	0	78.07

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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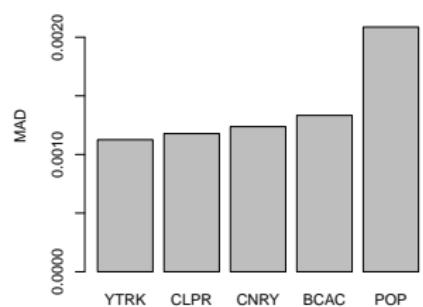
MCAT 269

M4

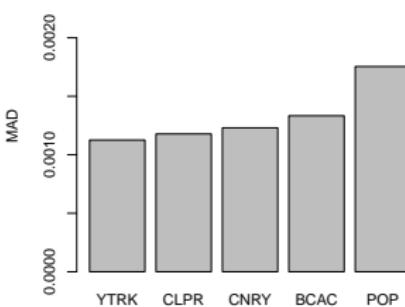
M5

M6

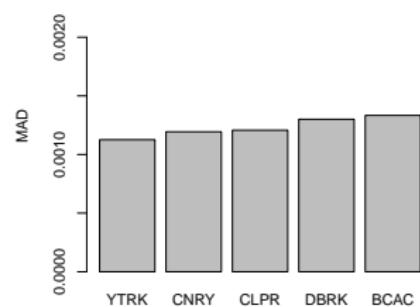
MAD Ordered by Species



MAD Ordered by Species

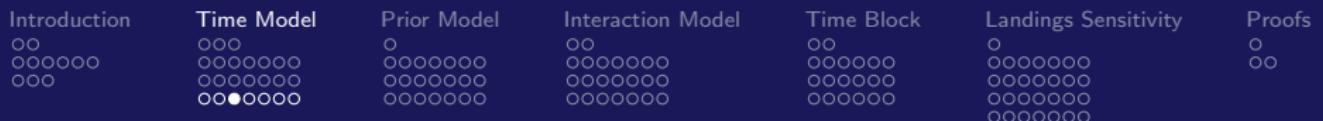


MAD Ordered by Species

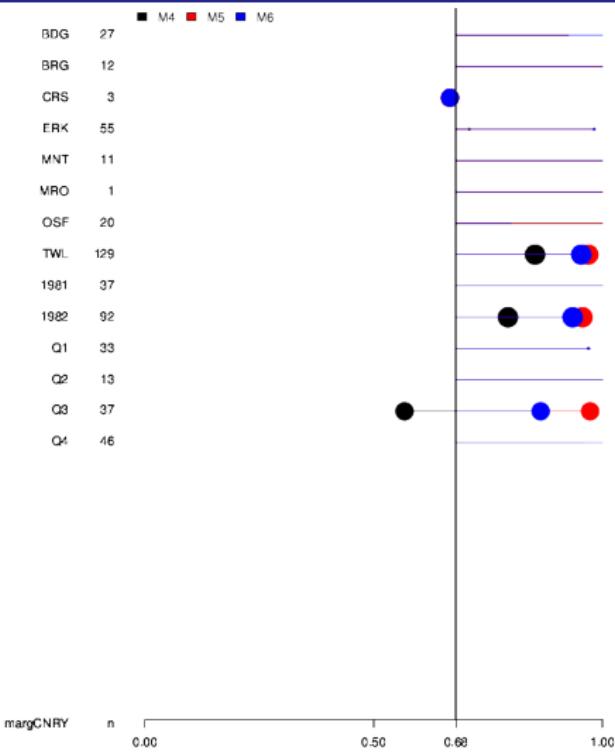


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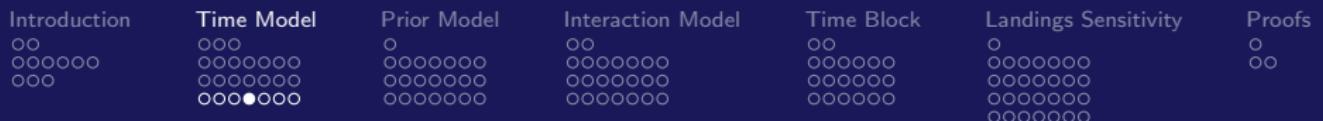


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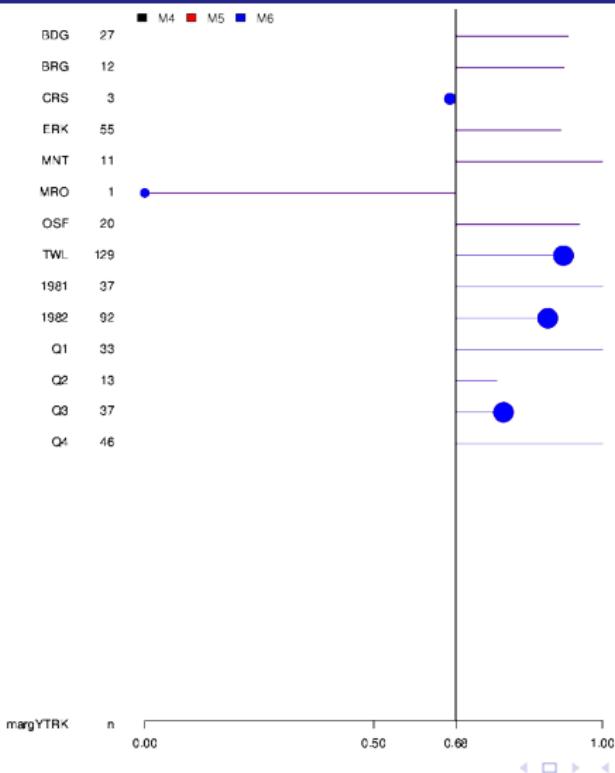


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Interaction Model

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Time Block

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Landings Sensitivity

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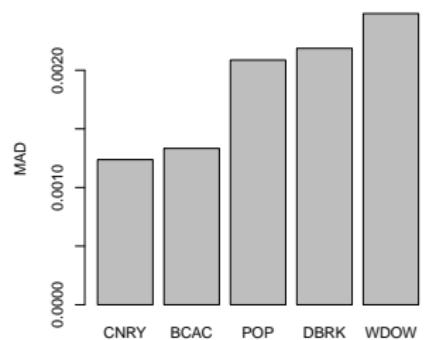
MCAT 269

M4

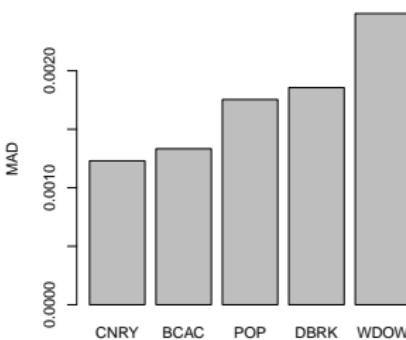
M5

M6

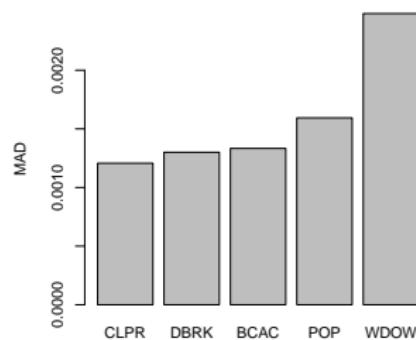
MAD Ordered by Species



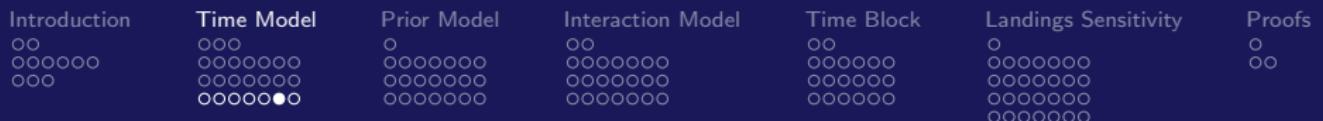
MAD Ordered by Species



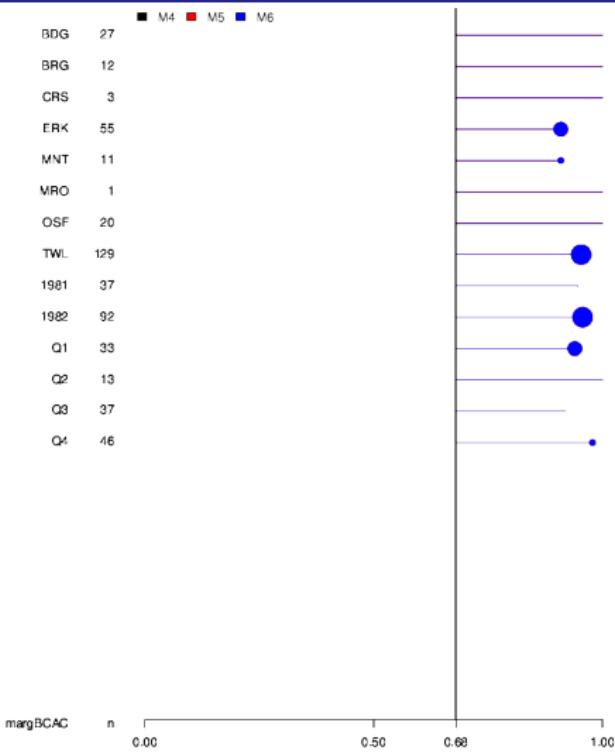
MAD Ordered by Species

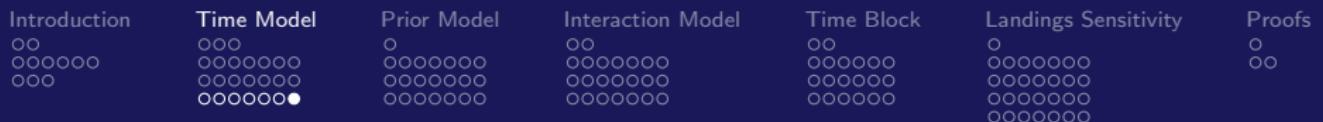


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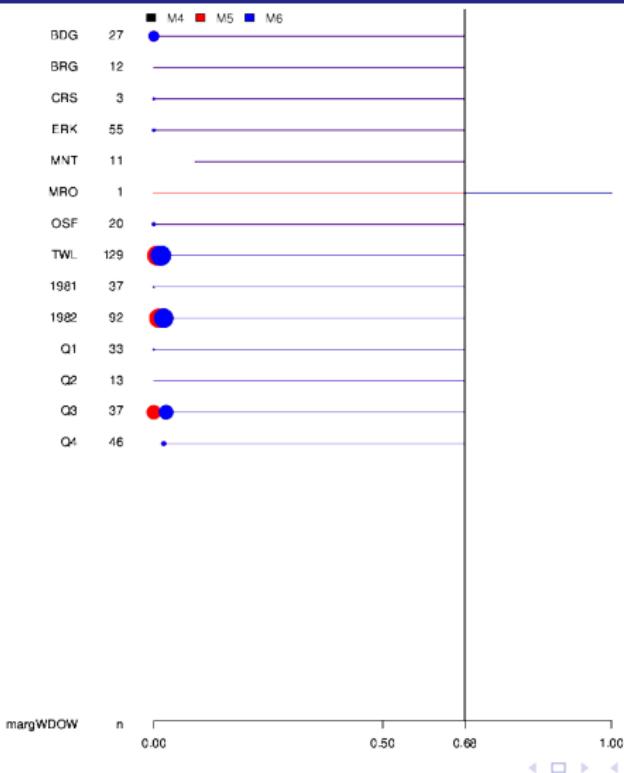


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Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
oo	ooo	●	oo	oo	o	o
oooooo	oooooooo	ooooooo	oooooooo	oooooo	oooooooo	oo
ooo	oooooooo	ooooooo	oooooooo	oooooo	oooooooo	oooo
ooooooo	oooooooo	ooooooo	oooooooo	oooooo	oooooooo	oooo

Priors

$$\beta_0 \propto 1$$

$$\beta_j^{(s)} \sim N(0, 32^2)$$

$$\beta_k^{(p)} \sim N(0, 32^2)$$

$$\beta_I^{(g)} \sim N(0, 32^2)$$

$$\text{logit}(\rho) \sim N(0, 2^2)$$

$$\text{IG} : v \sim \text{Inv-Gamma}(1, 2 \times 10^3) \quad \forall v$$

$$\text{HC1} : \sqrt{v} \sim \text{Half-Cauchy}(10^1) \quad \forall v$$

$$\text{HC3} : \sqrt{v} \sim \text{Half-Cauchy}(10^3) \quad \forall v$$

$$\text{U4} : \sqrt{v} \sim \text{Uniform}(0, 10^4) \quad \forall v$$

Introduction

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Time Model

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Prior Model

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Interaction Model

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Landings Sensitivity

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Proofs

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MCAT 250

	M4IG	M4HC1	M4HC3	M4U4
Δ DIC	3.87	0.02	0.1	0
Δ WAIC	3.78	0.03	0.11	0

Introduction

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Time Model

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Prior Model

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Interaction Model

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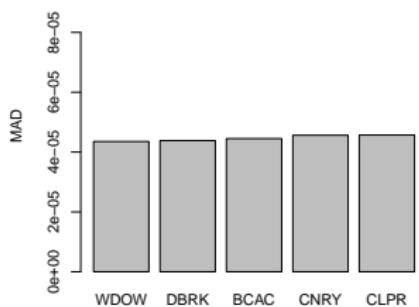
MCAT 250

M4HC1

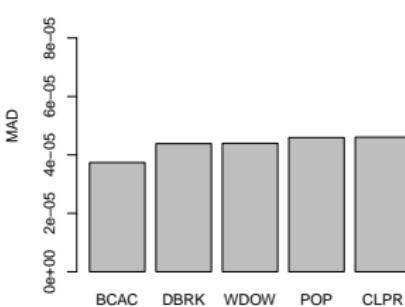
M4HC3

M4U4

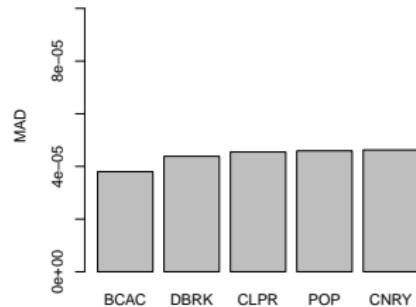
MAD Ordered by Species



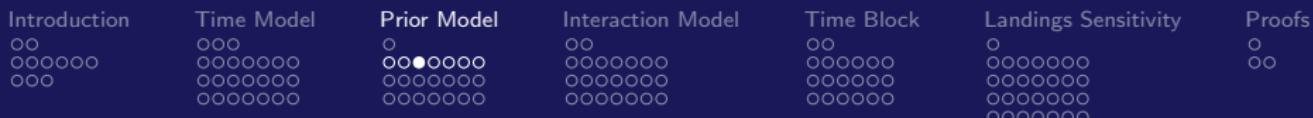
MAD Ordered by Species



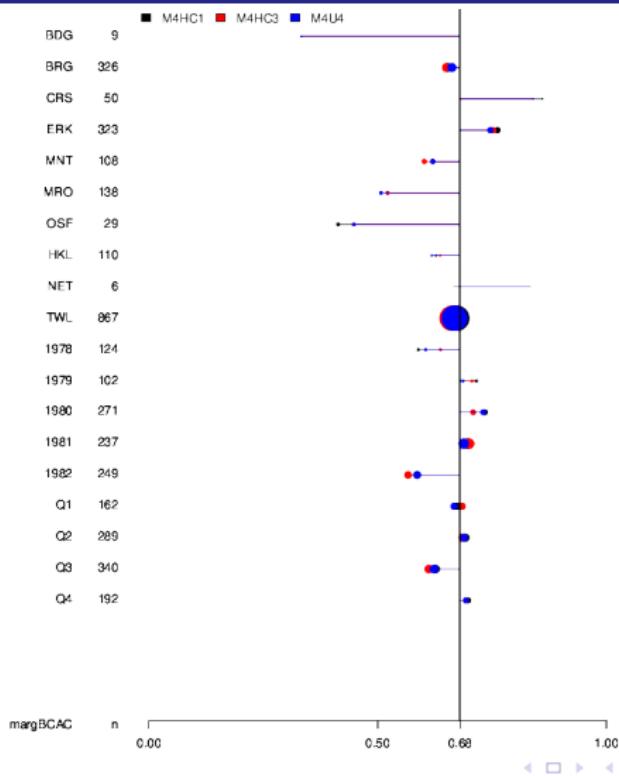
MAD Ordered by Species



Combined

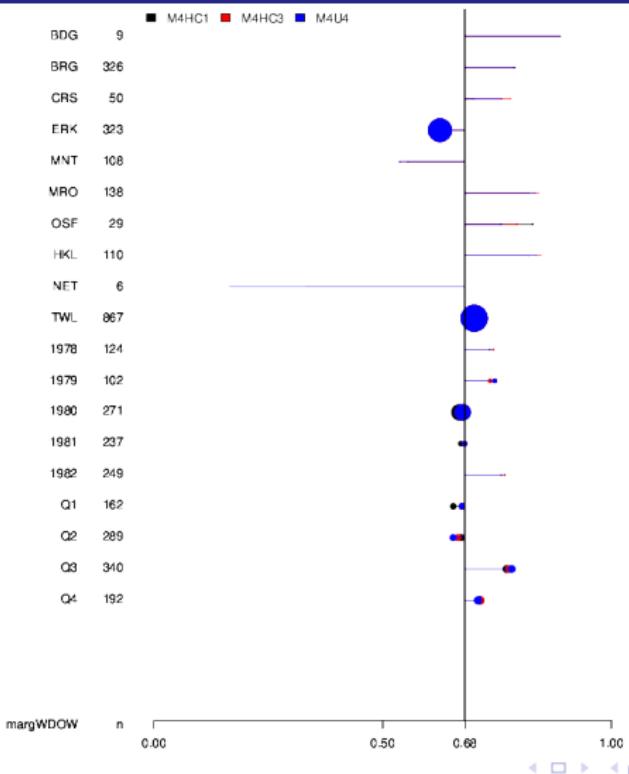


MCAT 250



Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
oo	ooo	o	oo	oo	o	o
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ooo	oooooooo	oooooooo	oooooooo	ooooooo	ooooooo	oo

MCAT 250



Introduction

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Time Model

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Prior Model

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Interaction Model

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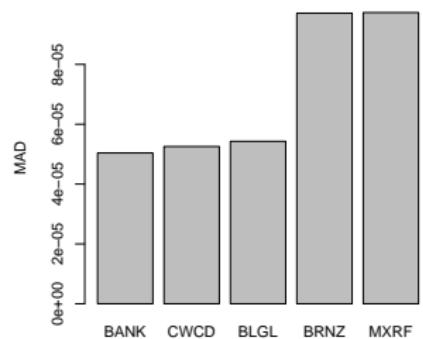
MCAT 250

M4HC1

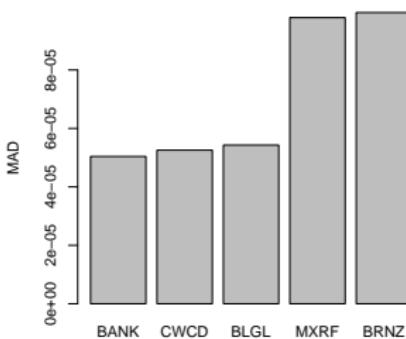
M4HC3

M4U4

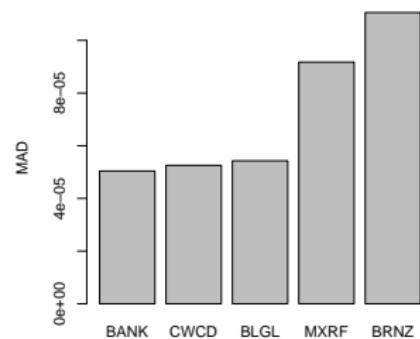
MAD Ordered by Species



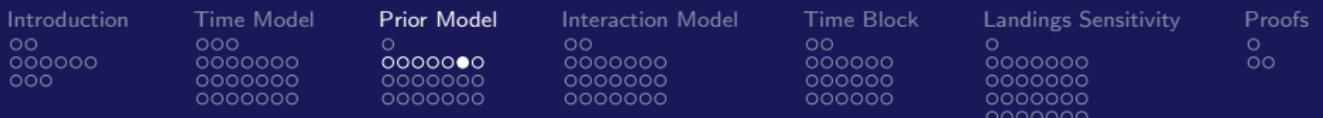
MAD Ordered by Species



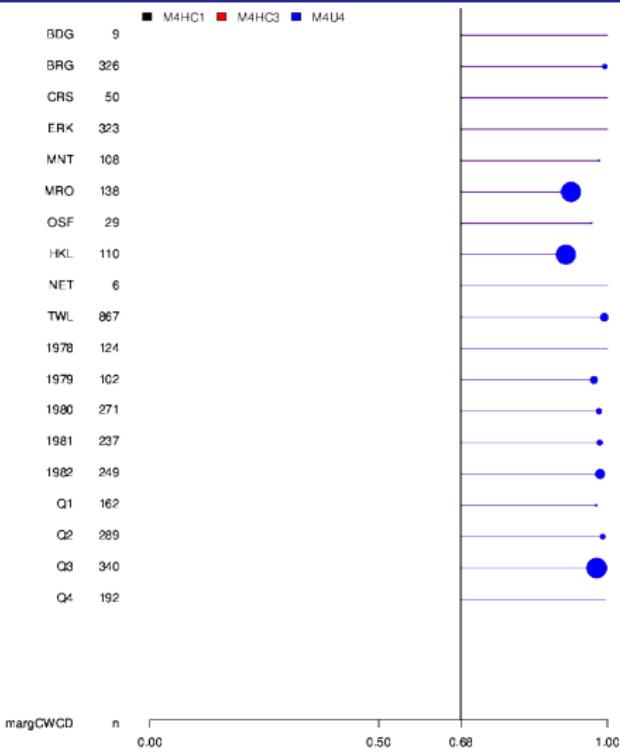
MAD Ordered by Species

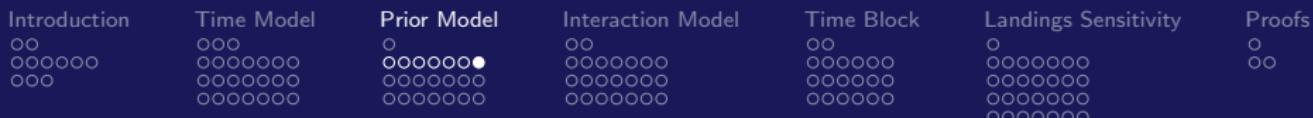


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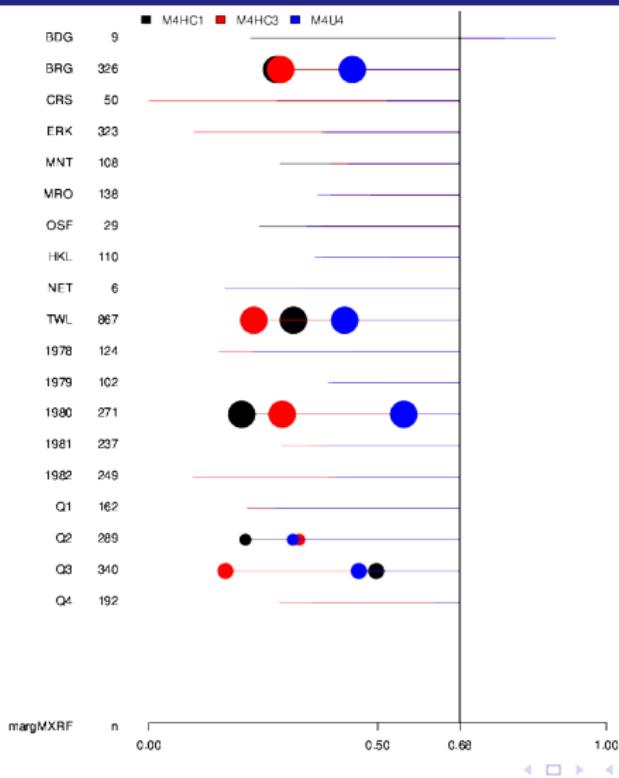


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Introduction

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Time Model

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Interaction Model

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Landings Sensitivity

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Proofs

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MCAT 253

	M4IG	M4HC1	M4HC3	M4U4
Δ DIC	0.88	0.8	0.8	0
Δ WAIC	0.76	0.83	0.83	0

Introduction

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Time Model

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Prior Model

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Interaction Model

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Landings Sensitivity

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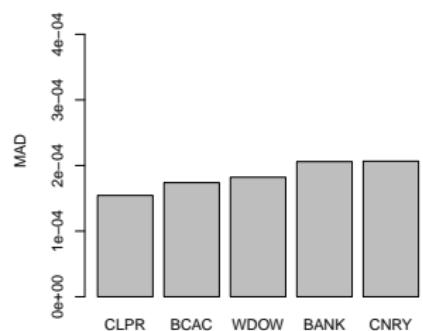
MCAT 253

M4HC1

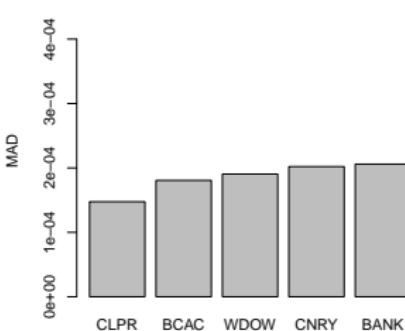
M4HC3

M4U4

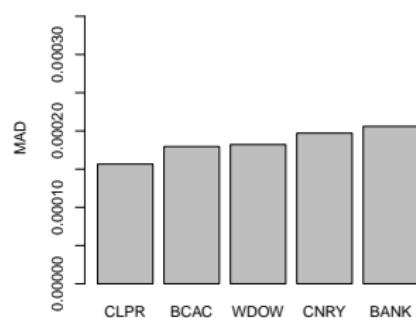
MAD Ordered by Species



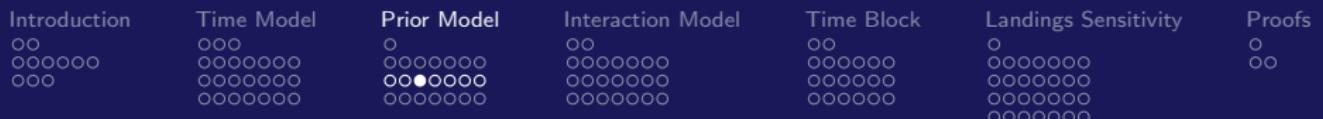
MAD Ordered by Species



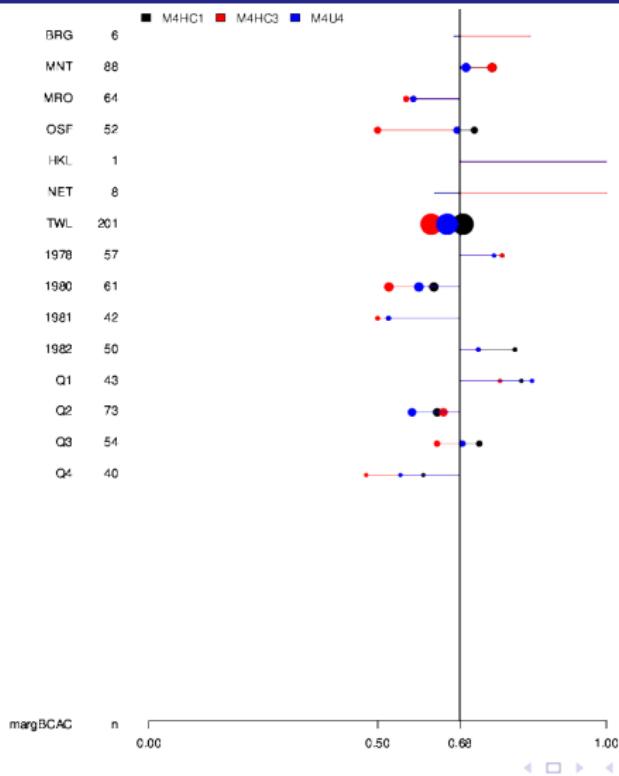
MAD Ordered by Species

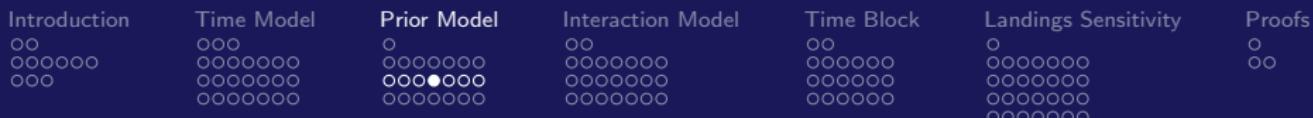


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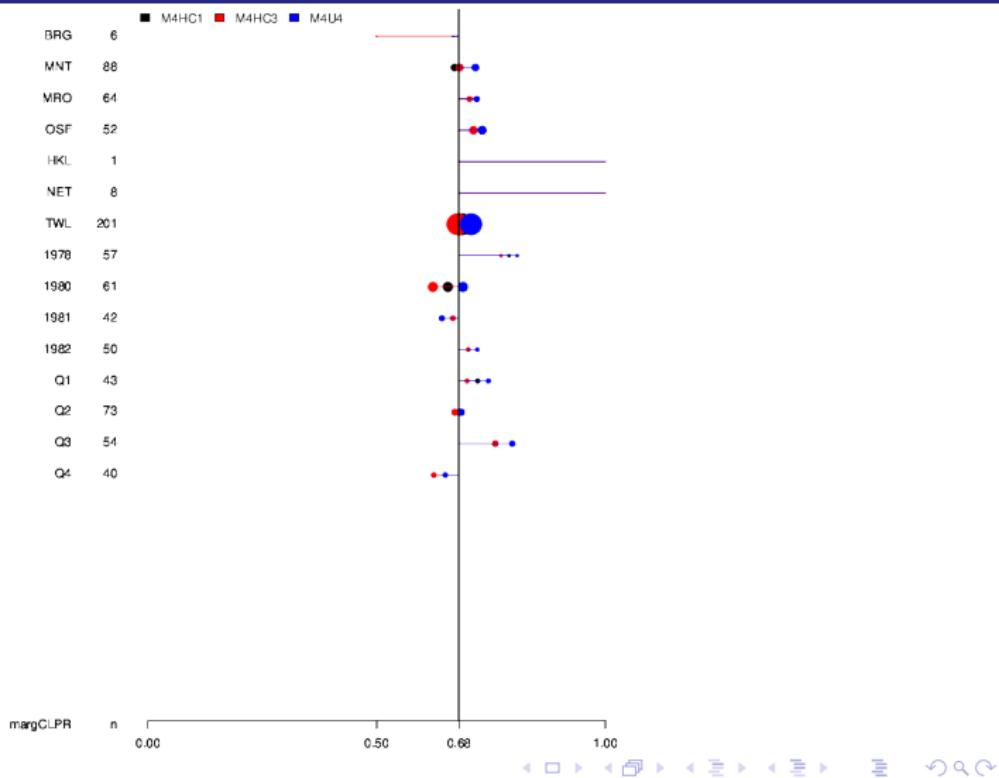


MCAT 253





MCAT 253



Introduction

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Time Model

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Interaction Model

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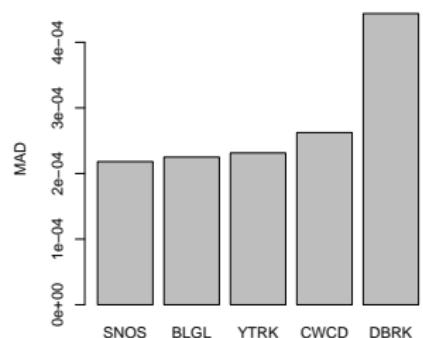
MCAT 253

M4HC1

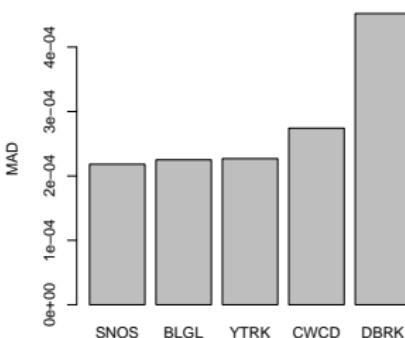
M4HC3

M4U4

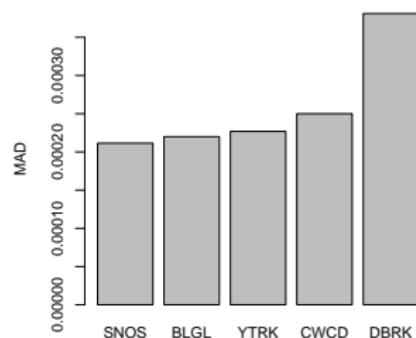
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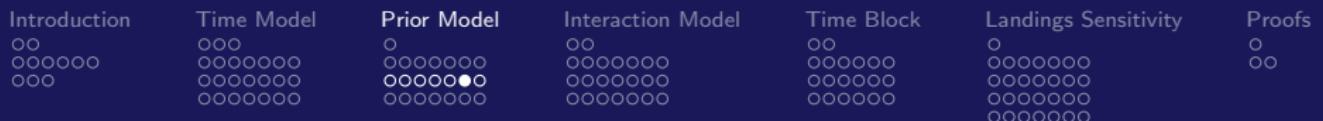
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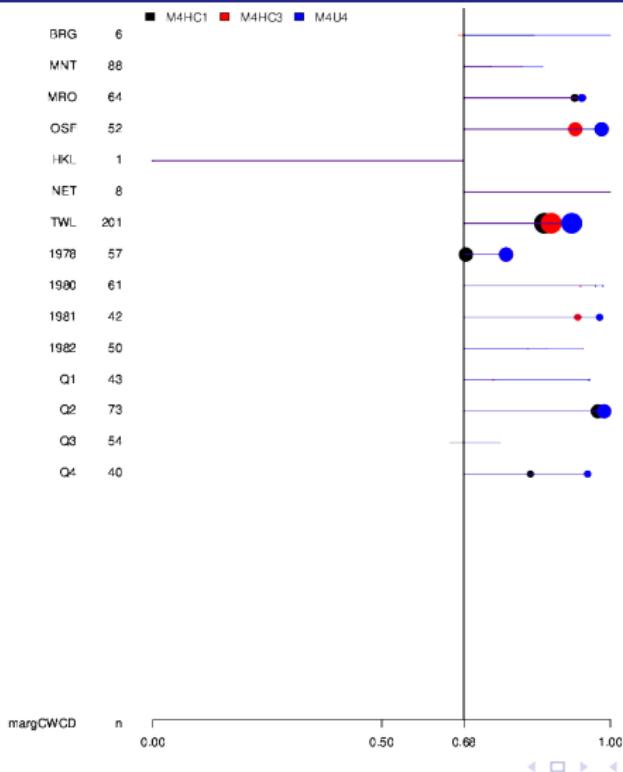
MAD Ordered by Species



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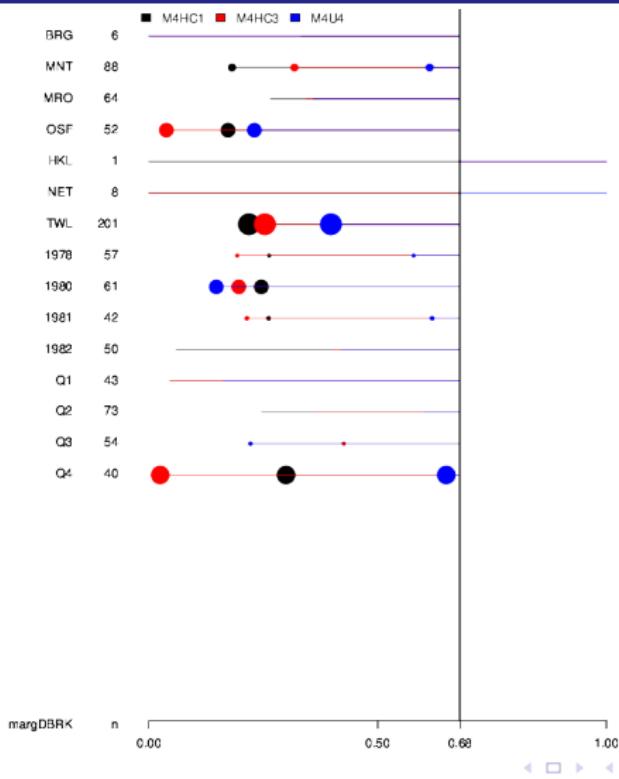


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Time Block

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Landings Sensitivity

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Proofs

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	M4IG	M4HC1	M4HC3	M4U4
Δ DIC	0.18	176.33	0.2	0
Δ WAIC	0.08	69.19	0.08	0

Introduction

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Time Model

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Prior Model

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Interaction Model

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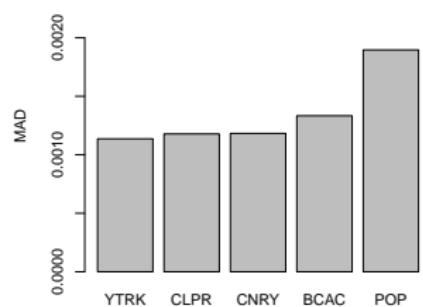
MCAT 269

M4HC1

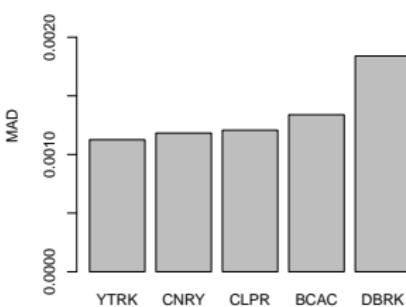
M4HC3

M4U4

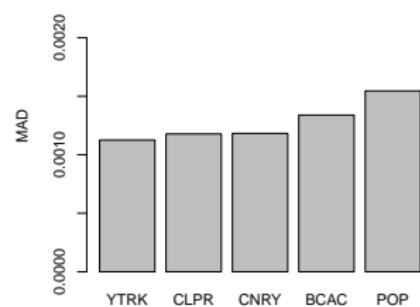
MAD Ordered by Species



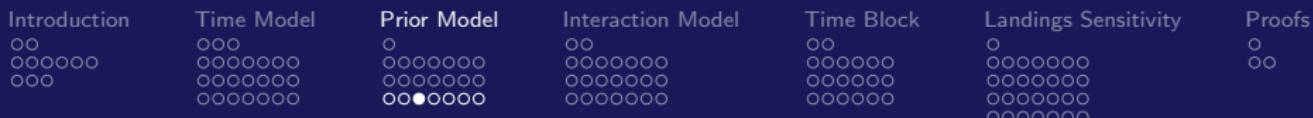
MAD Ordered by Species



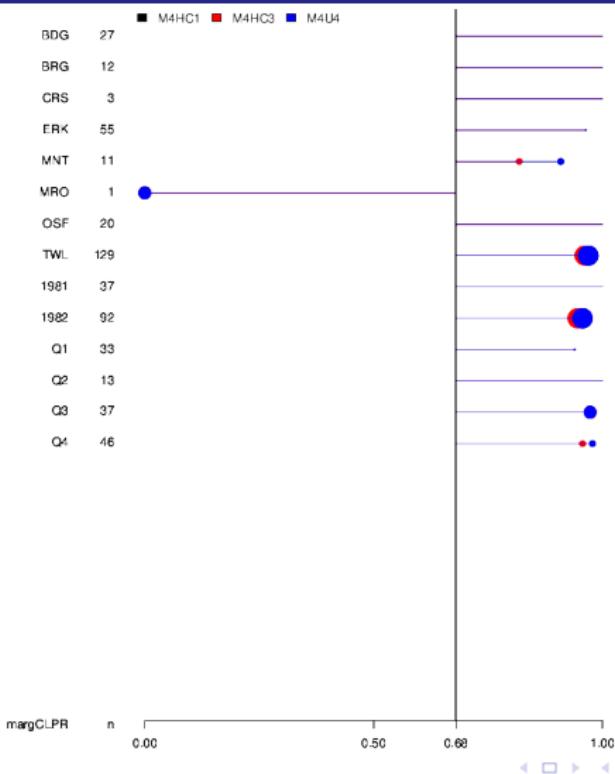
MAD Ordered by Species



Combined

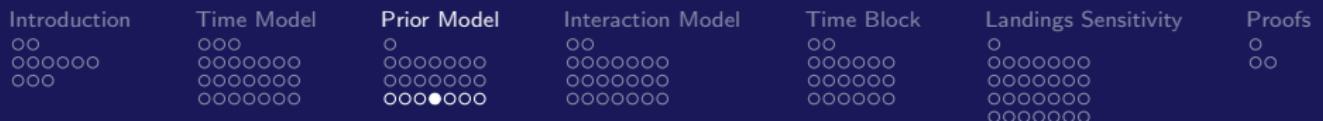


MCAT 269

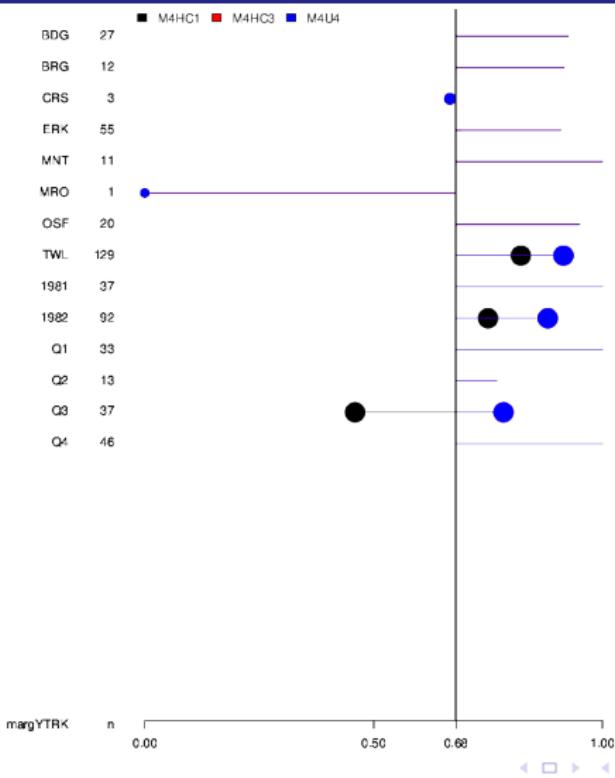


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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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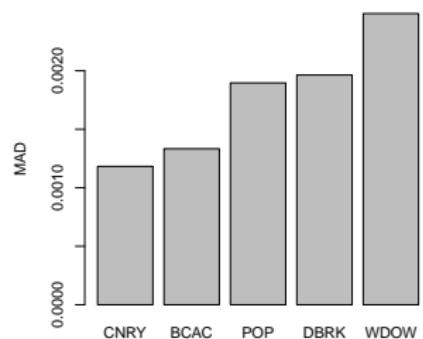
MCAT 269

M4HC1

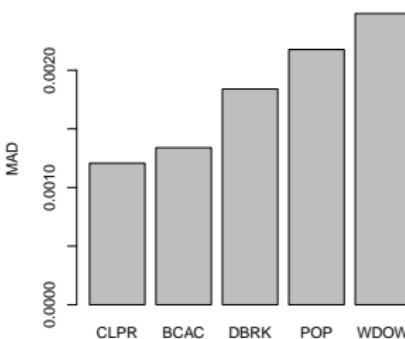
M4HC3

M4U4

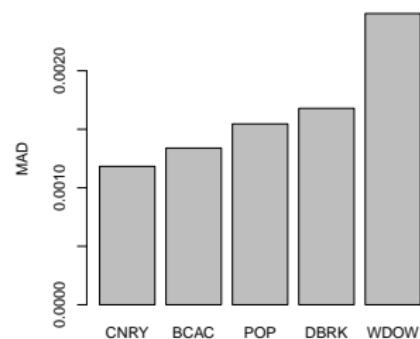
MAD Ordered by Species



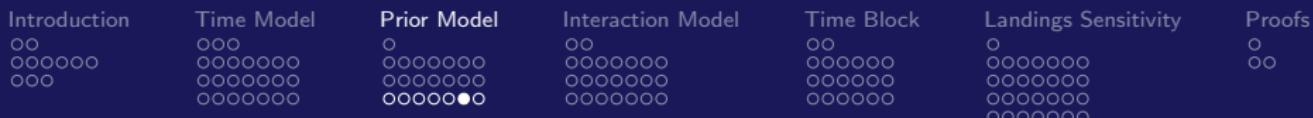
MAD Ordered by Species



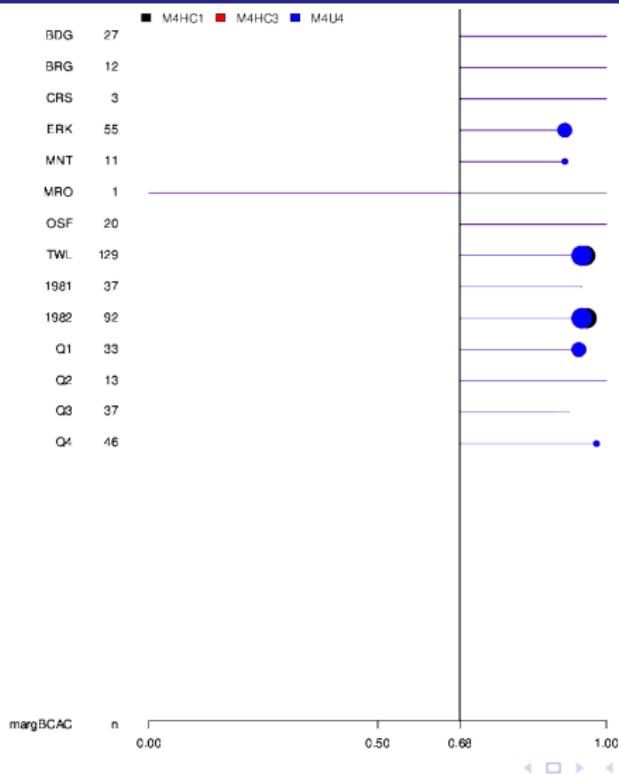
MAD Ordered by Species

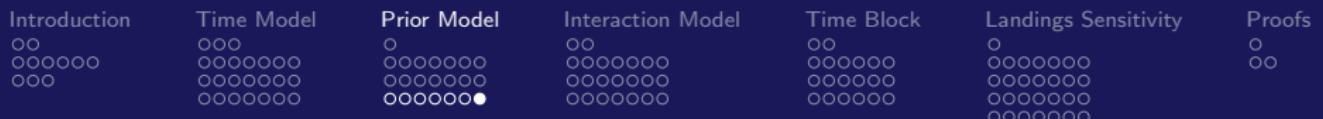


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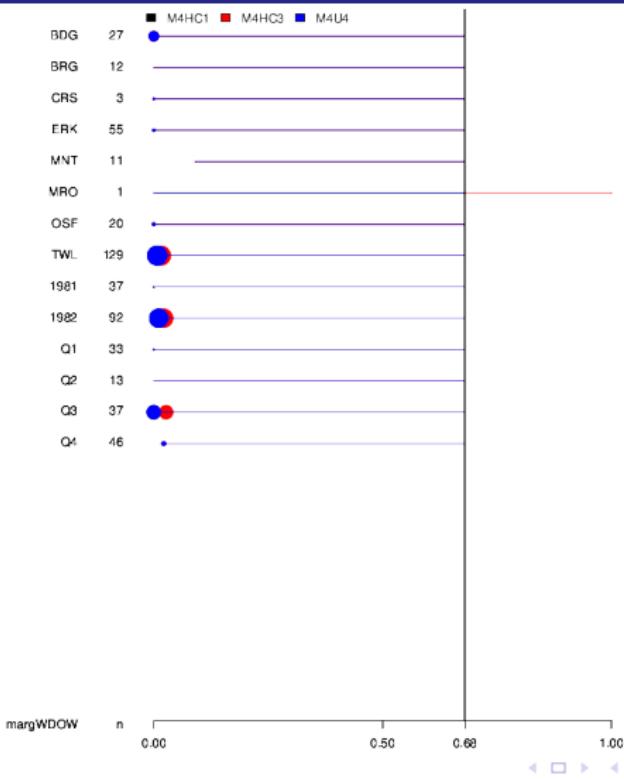


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Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
oo	ooo	o	●○	oo	o	o
oooooo	oooooooo	ooooooo	oooooooo	oooooo	oooooooo	oo
ooo	oooooooo	ooooooo	oooooooo	oooooo	oooooooo	oo

Request: Explore various two-way interactions (beyond the current explorations; e.g., Species : Port and Species : Gear).

Rationale: The Team did not have time to search across the multitude of possible interaction terms that they could have included in the model. From various anecdotal comments made during the review it seemed likely that the model would benefit from the inclusion of other interaction terms. Explorations with the diagnostic template may suggest potentially beneficial terms.

Response: The following slides show the diagnostic plots as applied to models exploring the inclusion of species:port and species:gear interaction terms.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
oo	ooo	o	oo●	oo	o	o
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Port and Gear Interactions

Model Description

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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MCAT 250

	M4	M4IGSG	M4IGSP
Δ DIC	58229.78	21403.07	0
Δ WAIC	24203.2	10186.57	0

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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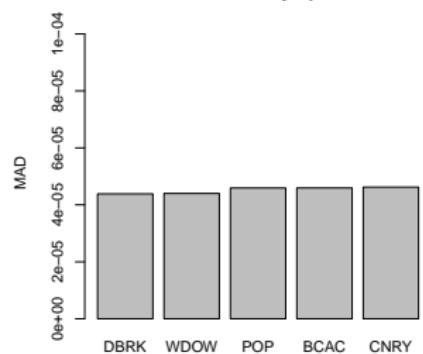
MCAT 250

M4

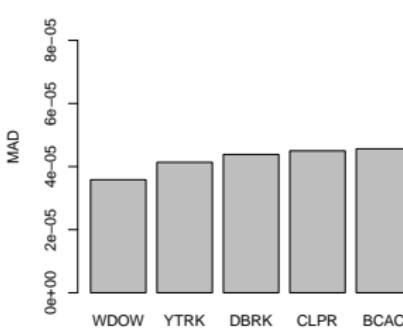
M4SG

M4SP

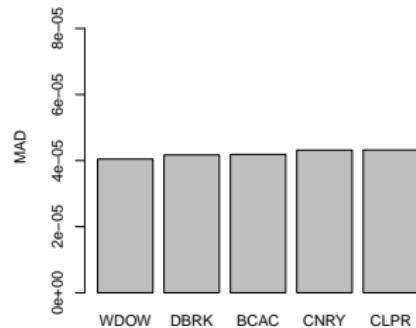
MAD Ordered by Species



MAD Ordered by Species



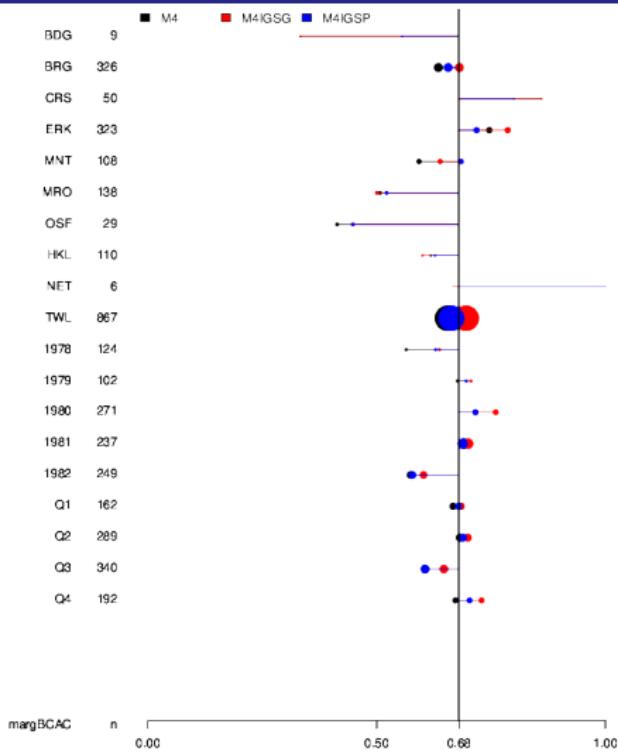
MAD Ordered by Species



Combined

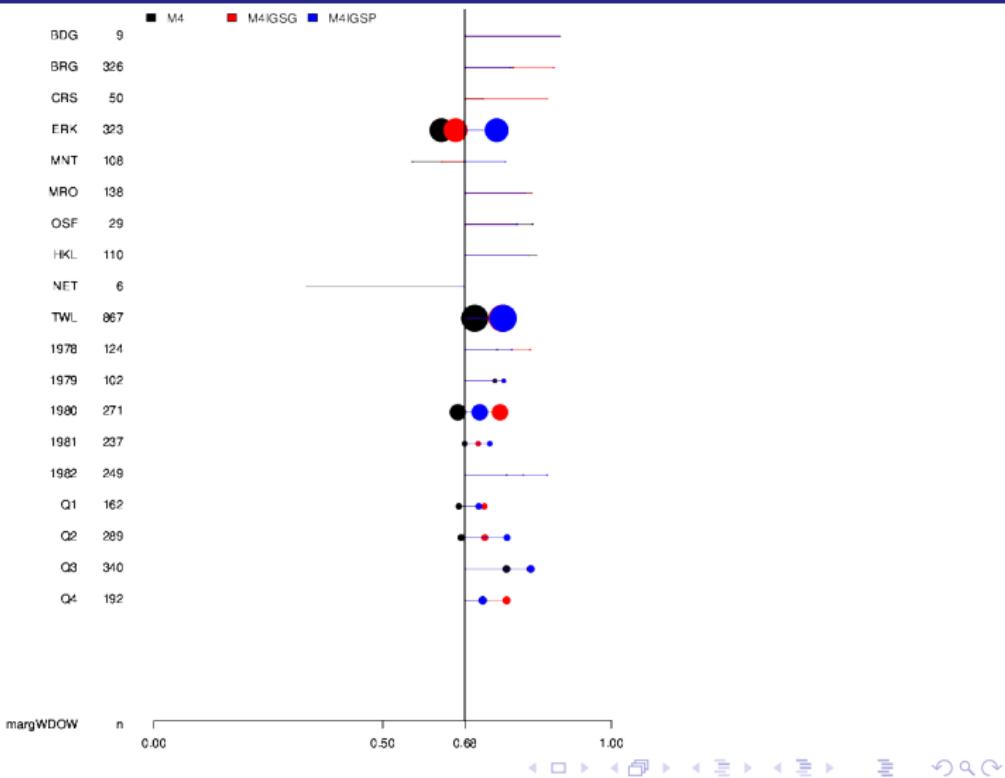


MCAT 250





MCAT 250



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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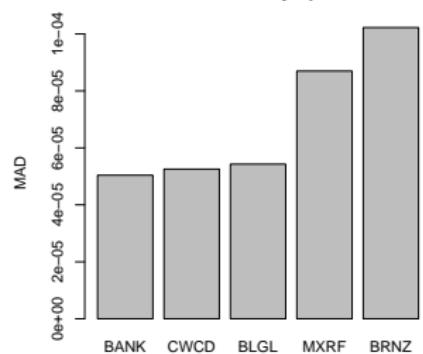
MCAT 250

M4

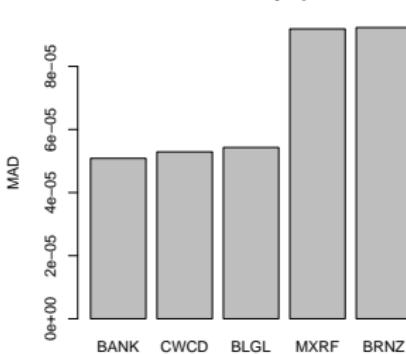
M4SG

M4SP

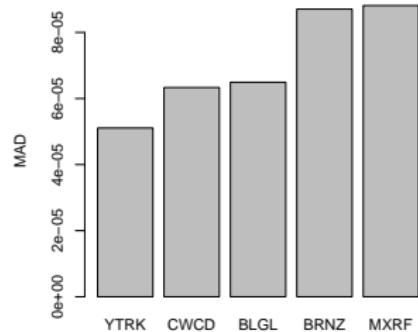
MAD Ordered by Species



MAD Ordered by Species



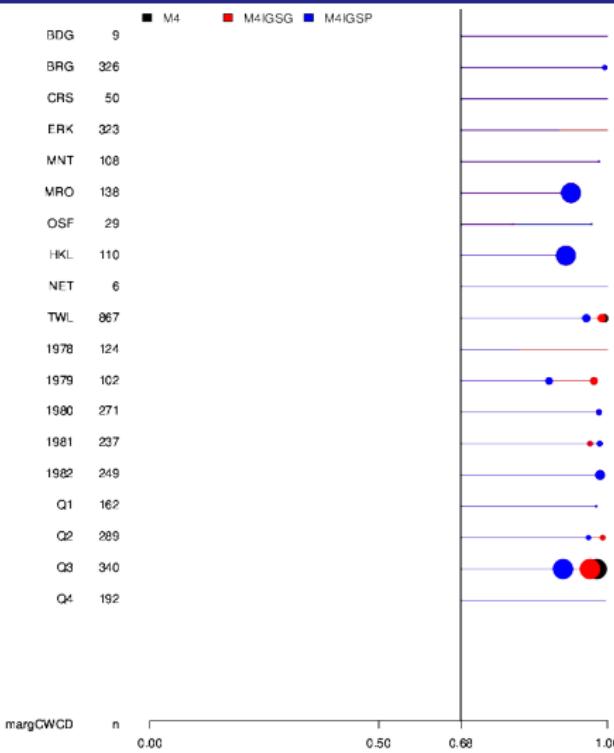
MAD Ordered by Species



Combined

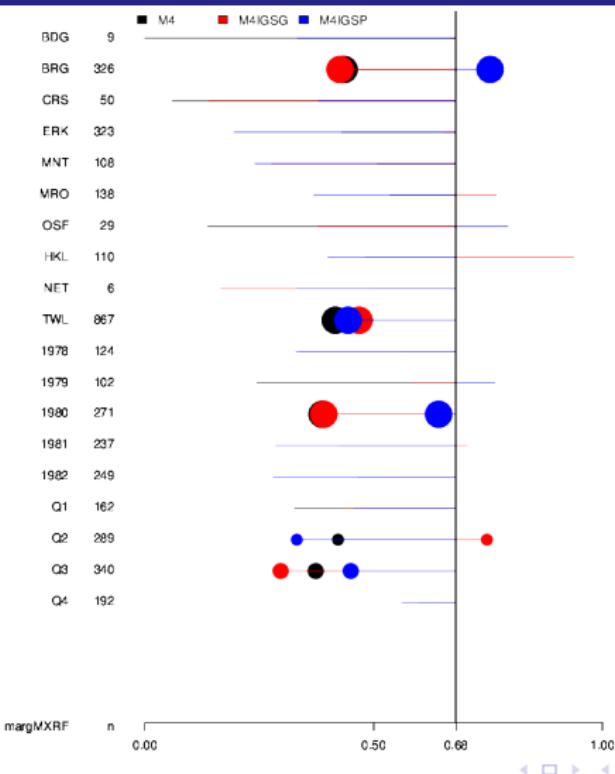


MCAT 250





MCAT 250



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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MCAT 253

	M4	M4SG	M4SP
Δ DIC	403.42	308.65	0
Δ WAIC	872.35	778.17	0

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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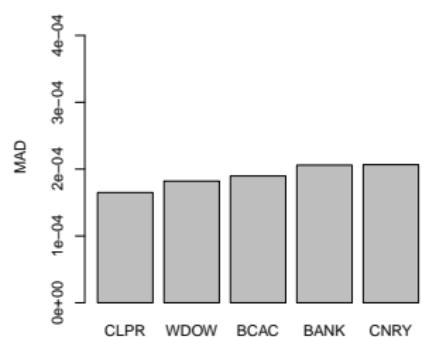
MCAT 253

M4

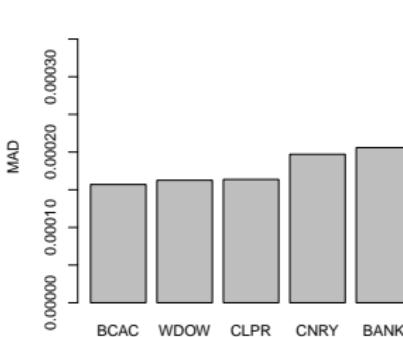
M4SG

M4SP

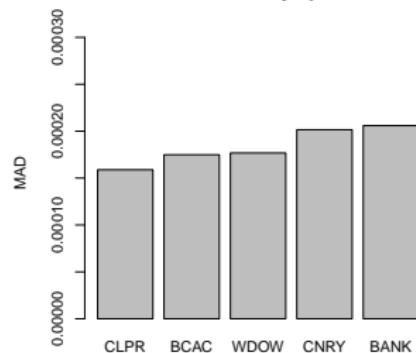
MAD Ordered by Species



MAD Ordered by Species



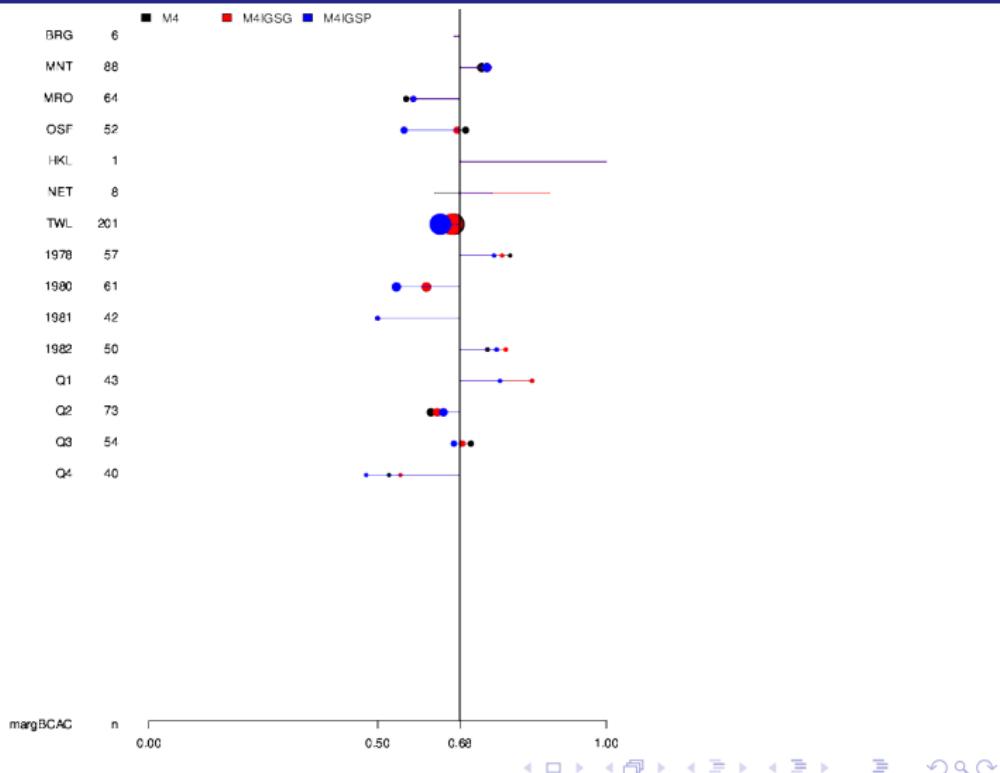
MAD Ordered by Species



Combined

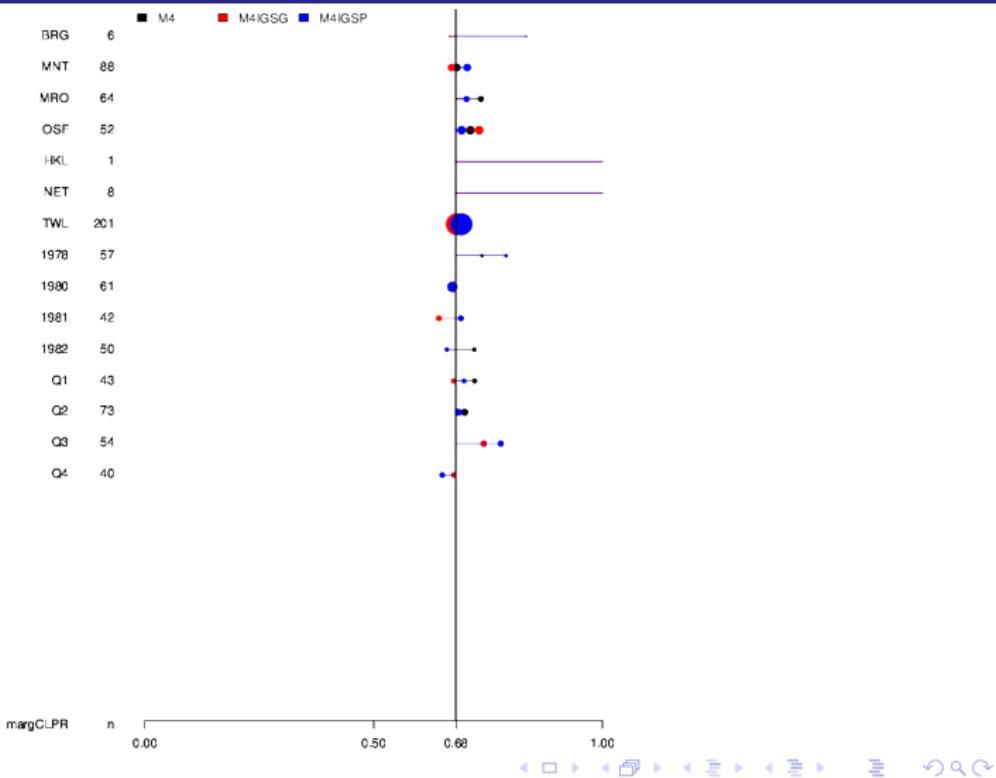


MCAT 253





MCAT 253



Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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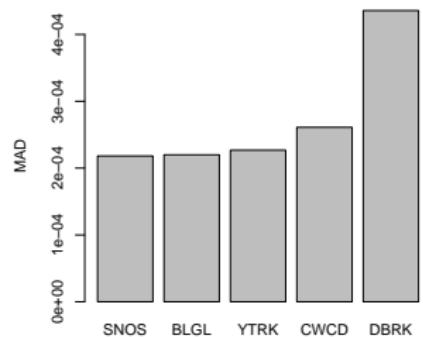
MCAT 253

M4

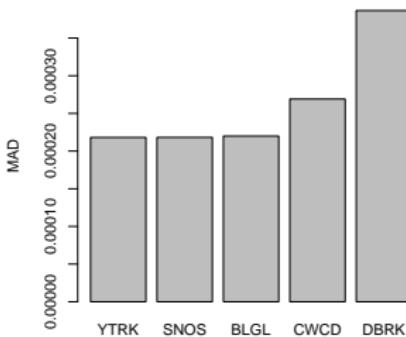
M4SG

M4SP

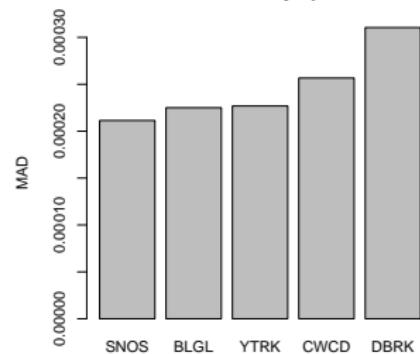
MAD Ordered by Species



MAD Ordered by Species



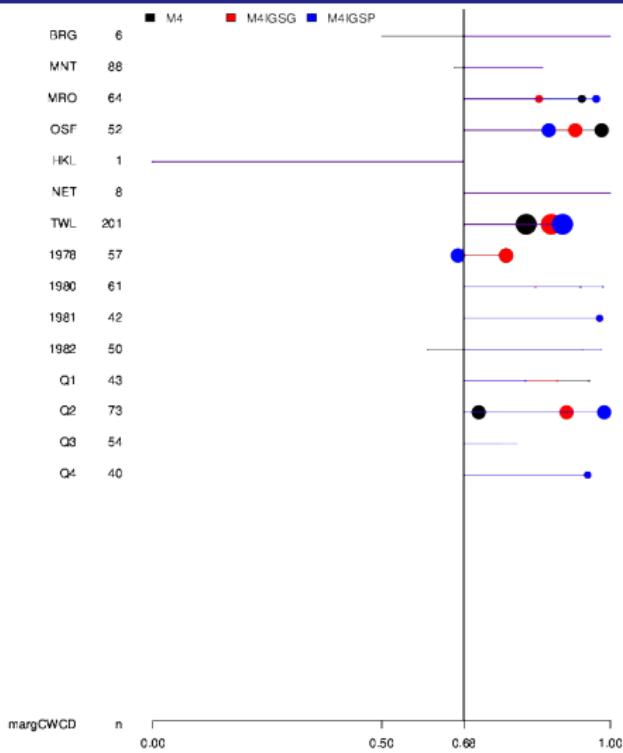
MAD Ordered by Species



Combined

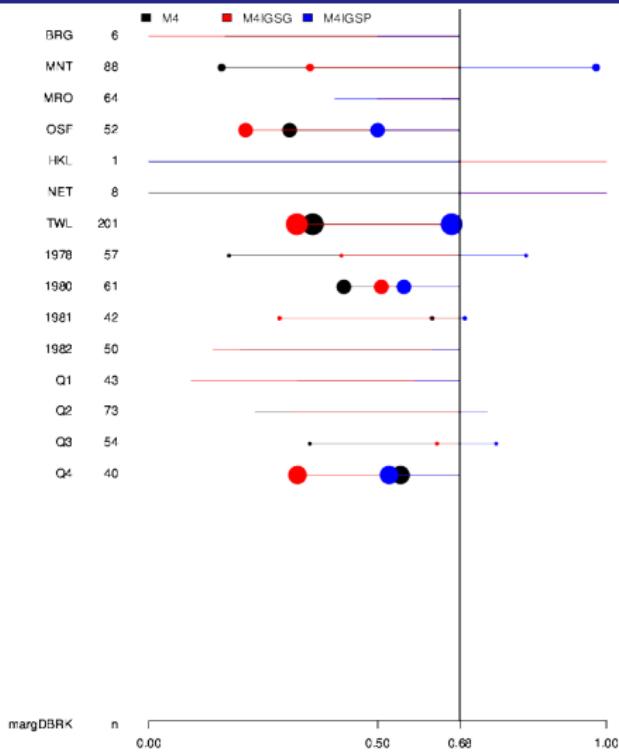


MCAT 253





MCAT 253



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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MCAT 269

	M4	M4SG	M4SP
Δ DIC	0	0.31	182.15
Δ WAIC	0	0.13	68.48

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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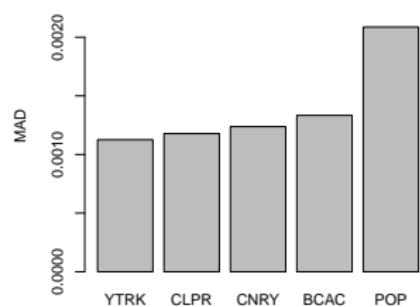
MCAT 269

M4

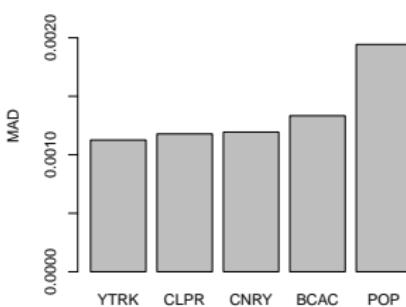
M4SG

M4SP

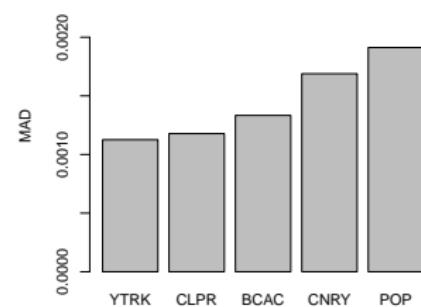
MAD Ordered by Species



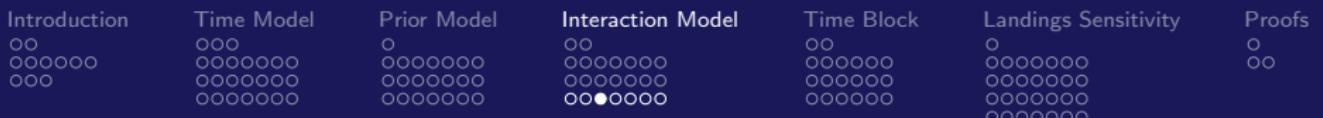
MAD Ordered by Species



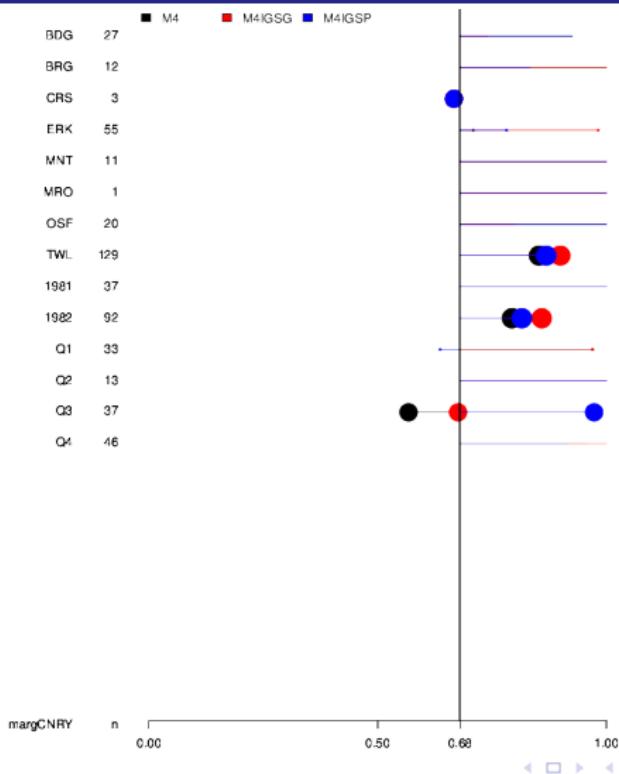
MAD Ordered by Species



Combined



MCAT 269

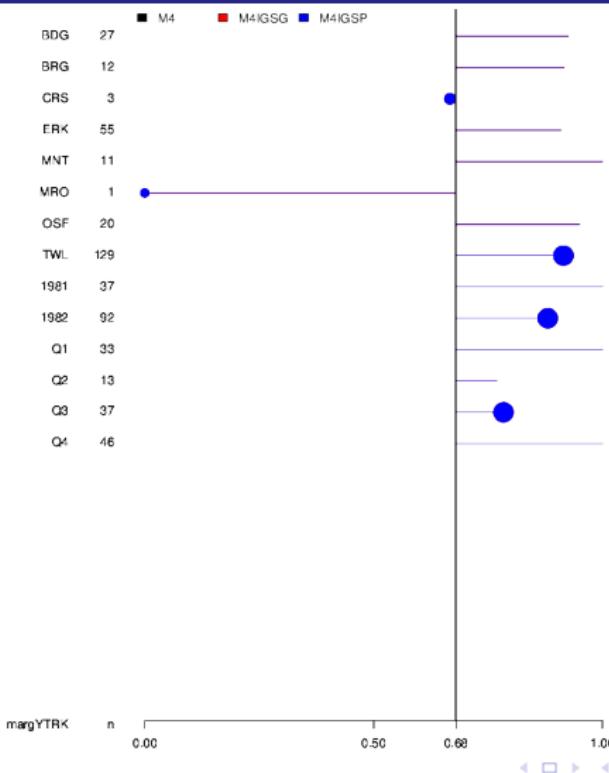


Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.



MCAT 269



Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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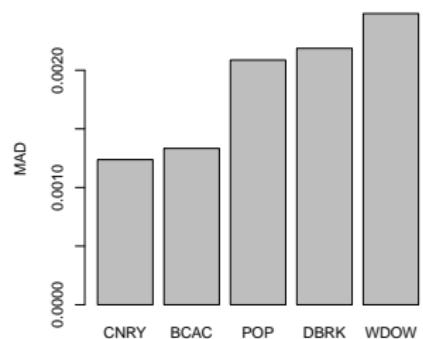
MCAT 269

M4

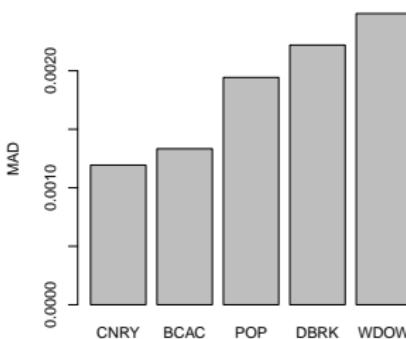
M4SG

M4SP

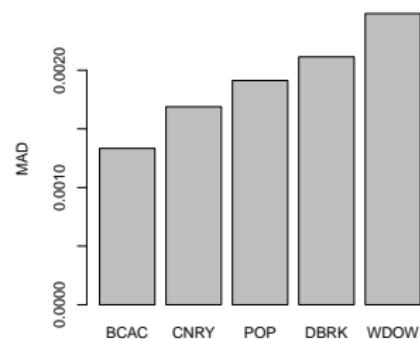
MAD Ordered by Species



MAD Ordered by Species



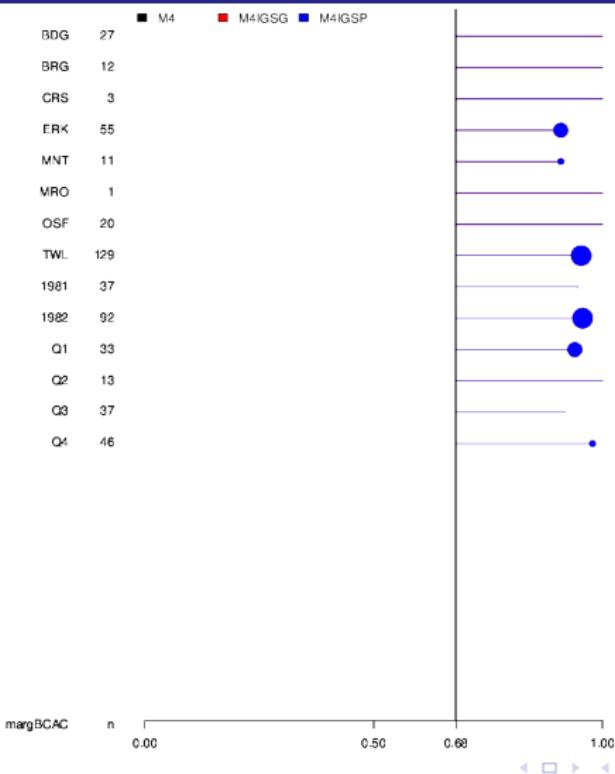
MAD Ordered by Species



Combined

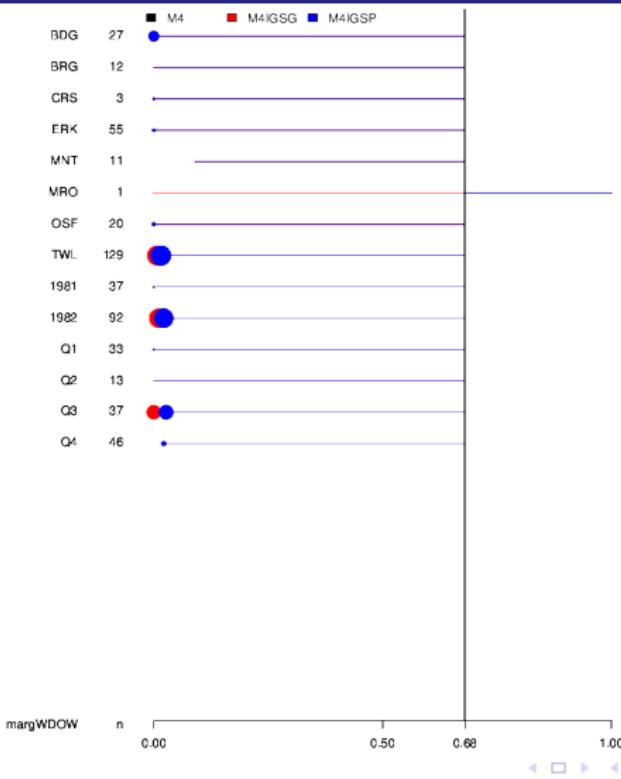


MCAT 269





MCAT 269



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
oo	ooo	o	oo	●o	o	o
oooooo	oooooooo	ooooooo	oooooooo	oooooooo	oooooooo	oo
ooo	oooooooo	ooooooo	oooooooo	ooooooo	oooooooo	ooo

Request: Explore an alternative time block: an extension of 1983 and 1984 to the first time block.

Rationale: The panel expressed concerns about how the model would perform when applied to shorter time periods, as will occur when the model is used with data more recent than 1990. Results from the above recommendation could be compared to the results from the current two time blocks (1978-1982; 1983-1990) to explore how fits to data from the late period degrade when the model for the late period is based on fewer years of data. Also, comparisons of the two forms of blocking serve as a sensitivity evaluation of the selection of the block boundary, which was chosen on a fairly arbitrary basis.

Response: The following slides show the diagnostic plots as applied to model M4 when fit to data from 78-82 as well as data from 78-83, 78-84, and 78-85.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
oo	ooo	o	oo	o●	o	o
oooooo	oooooooo	oooooooo	oooooooo	oooooo	oooooooo	oo
ooo	oooooooo	oooooooo	oooooooo	oooooo	oooooooo	oooooo

Time Blocks

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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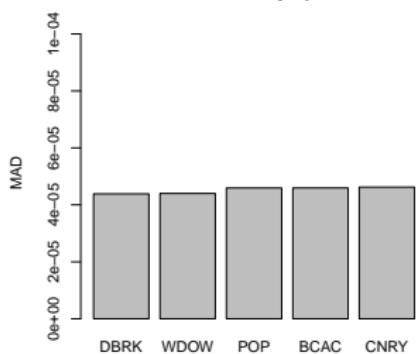
MCAT 250

78-82

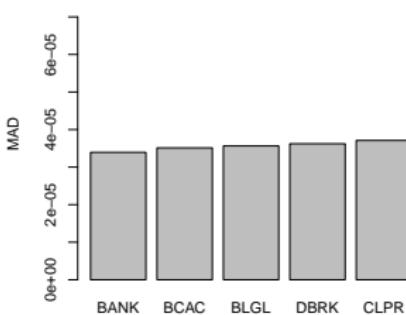
78-83

78-84

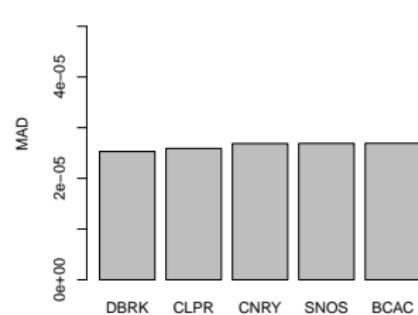
MAD Ordered by Species



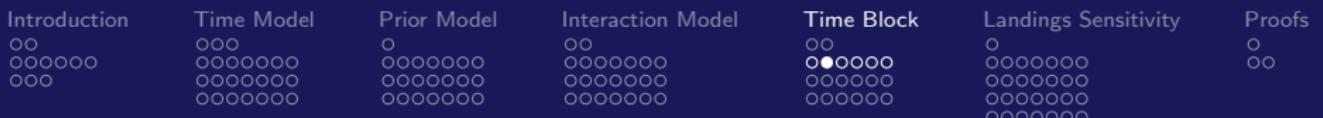
MAD Ordered by Species



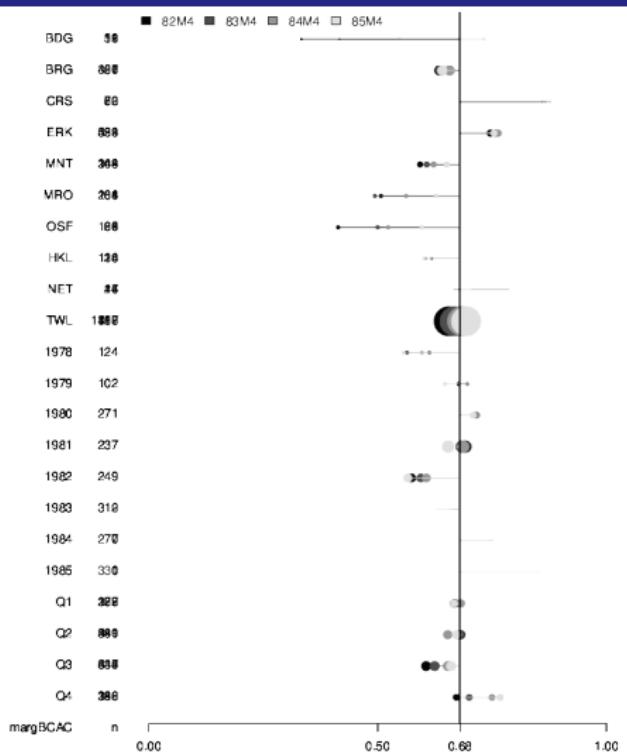
MAD Ordered by Species



Combined

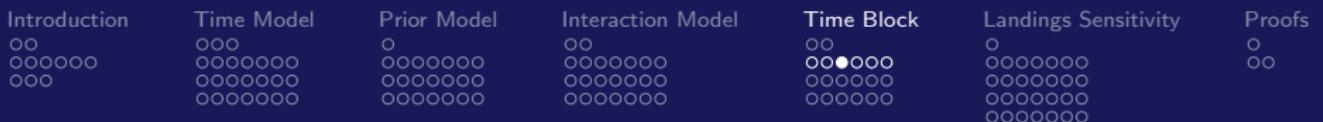


MCAT 250

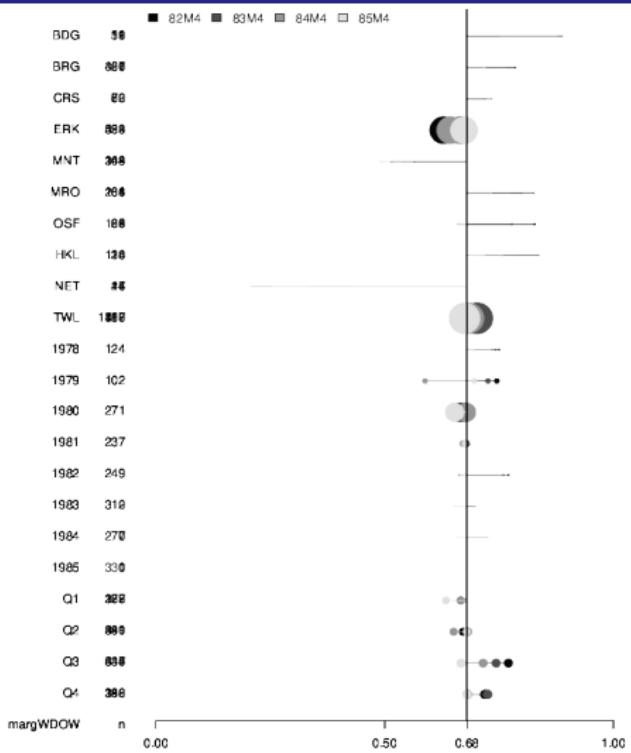


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Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.



MCAT 250



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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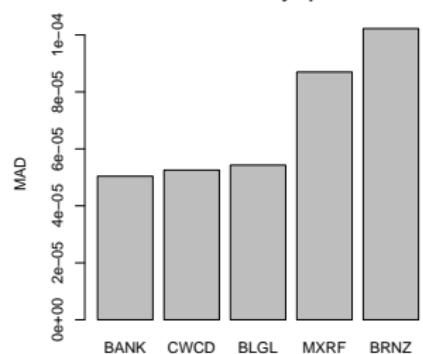
MCAT 250

78-82

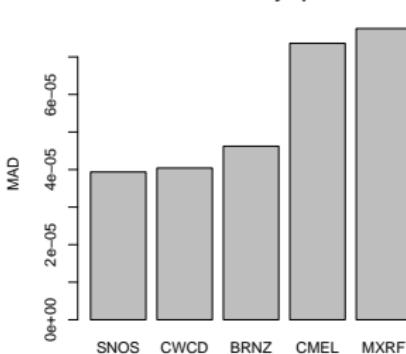
78-83

78-84

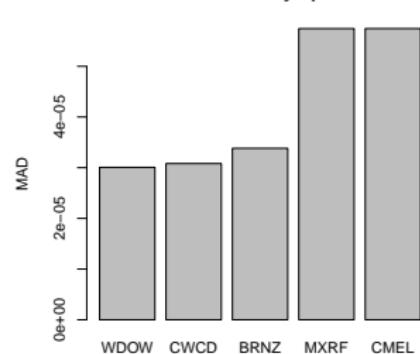
MAD Ordered by Species



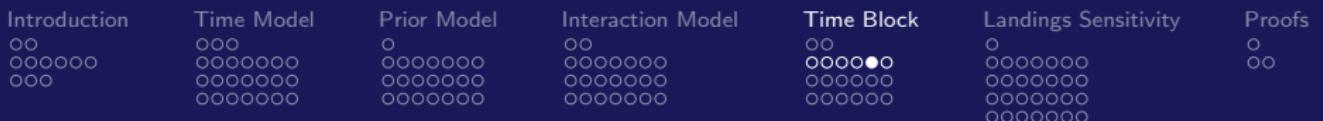
MAD Ordered by Species



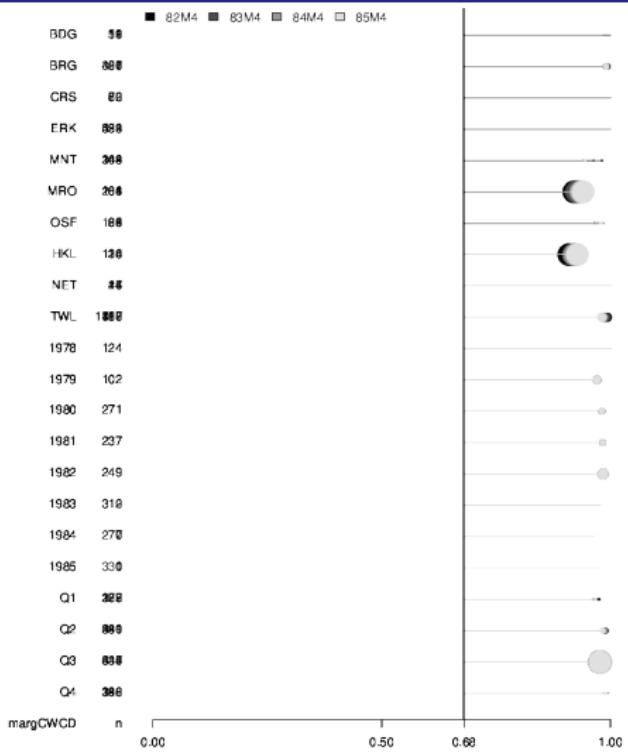
MAD Ordered by Species

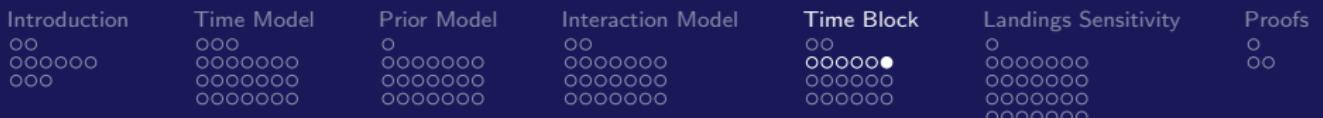


Combined

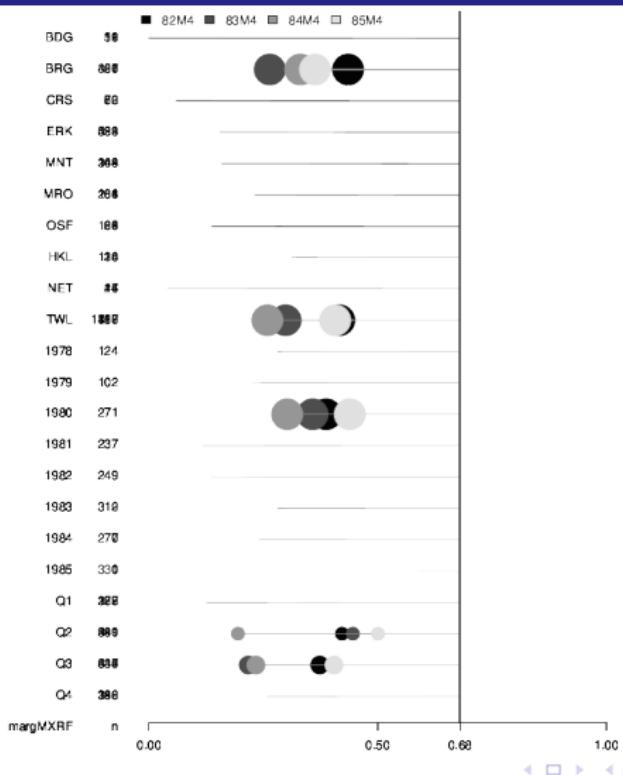


MCAT 250





MCAT 250



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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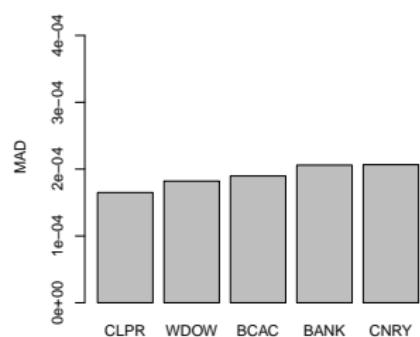
MCAT 253

78-82

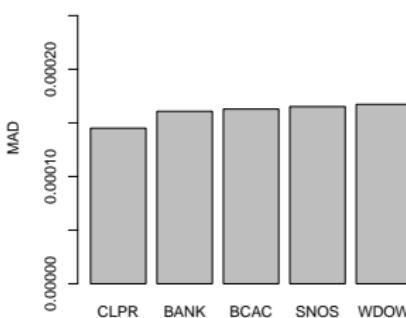
78-83

78-84

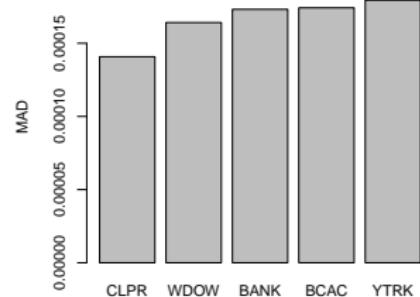
MAD Ordered by Species



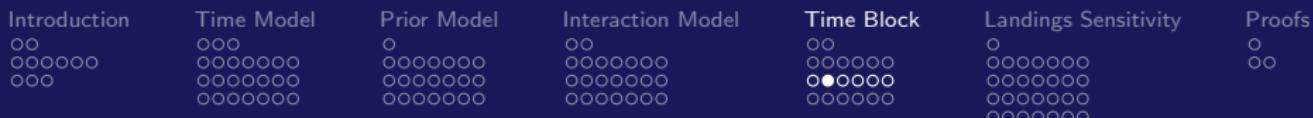
MAD Ordered by Species



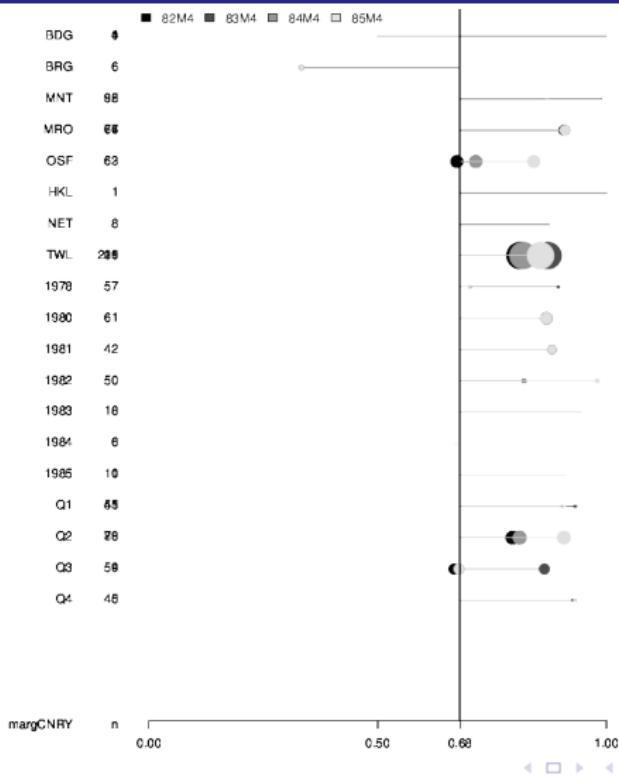
MAD Ordered by Species

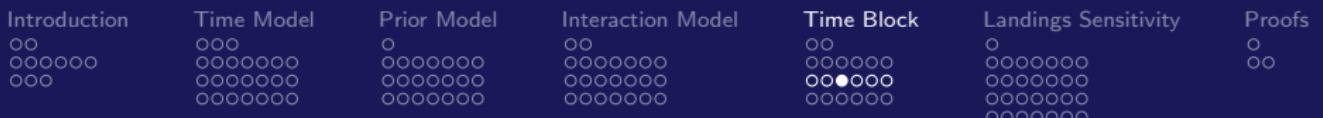


Combined

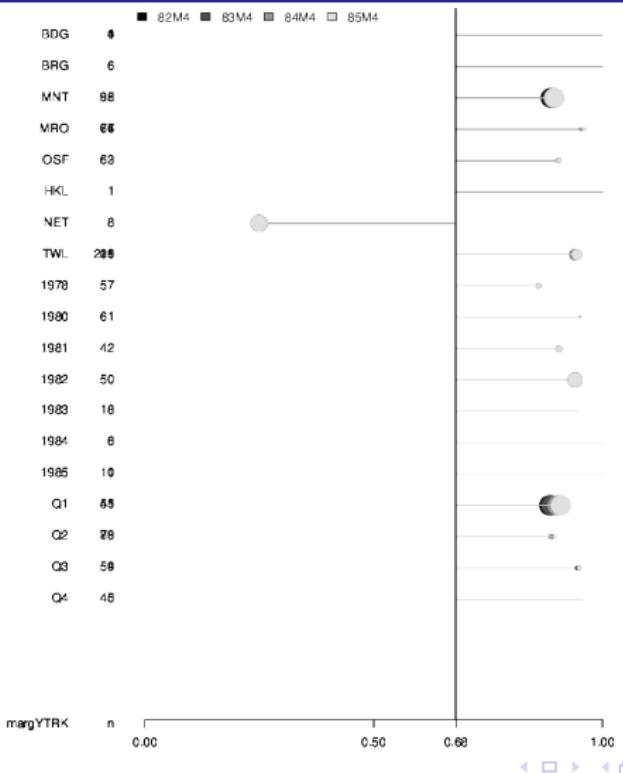


MCAT 253





MCAT 253



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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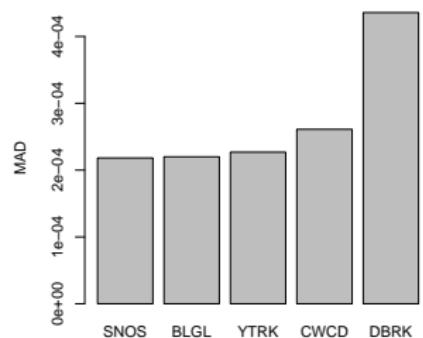
MCAT 253

78-82

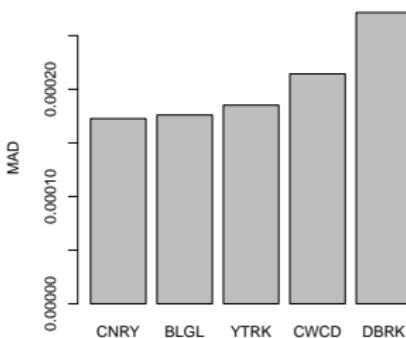
78-83

78-84

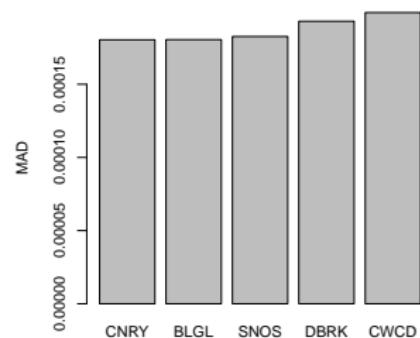
MAD Ordered by Species



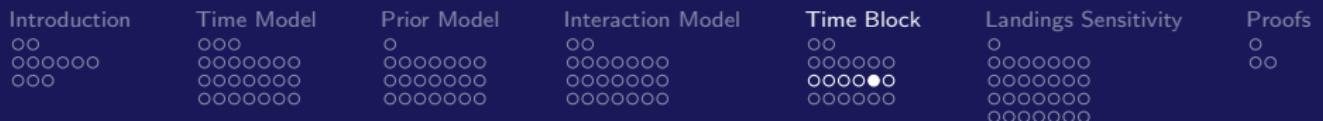
MAD Ordered by Species



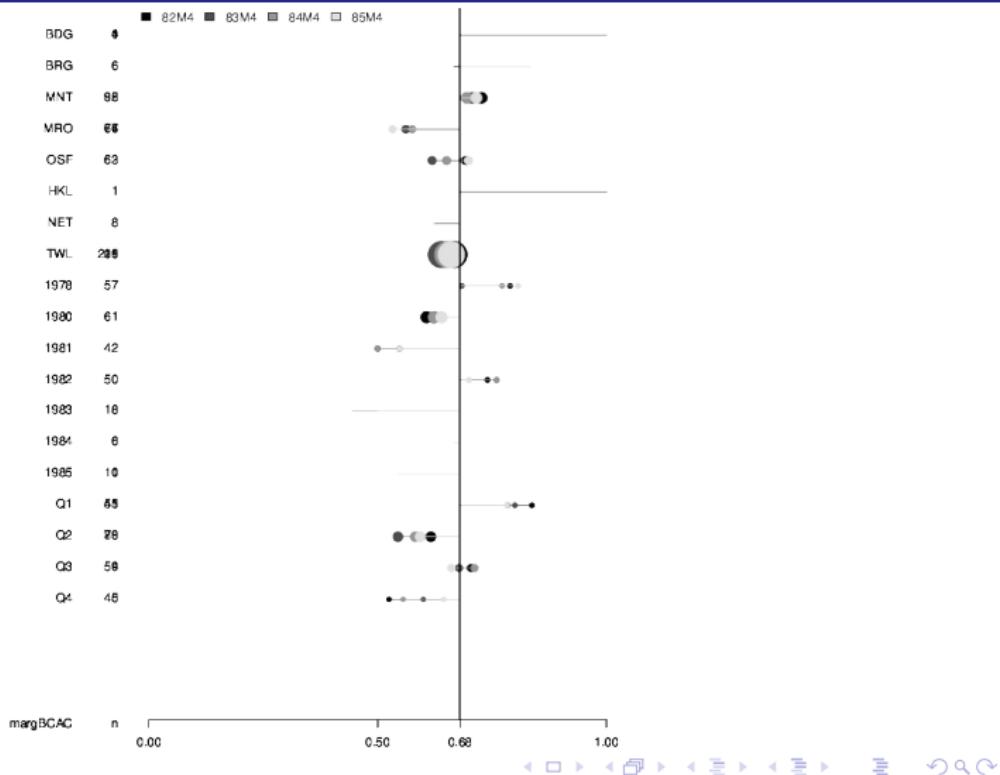
MAD Ordered by Species



Combined

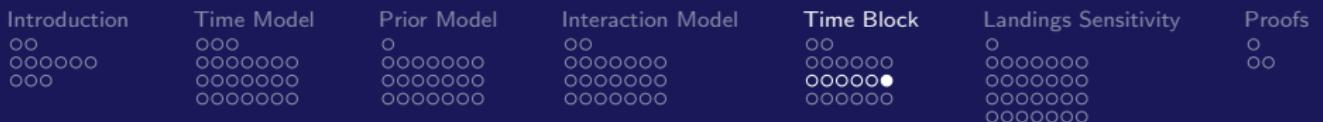


MCAT 253

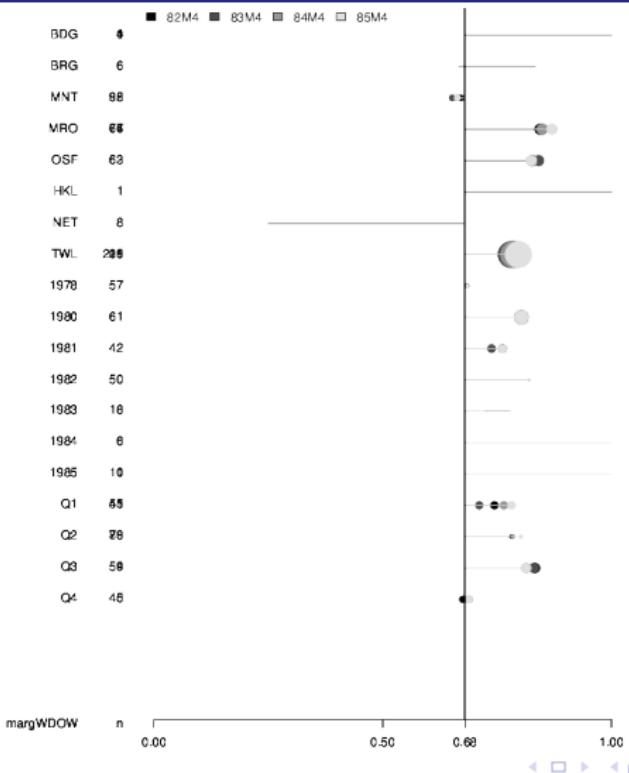


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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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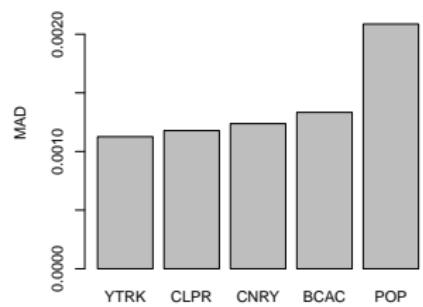
MCAT 269

78-82

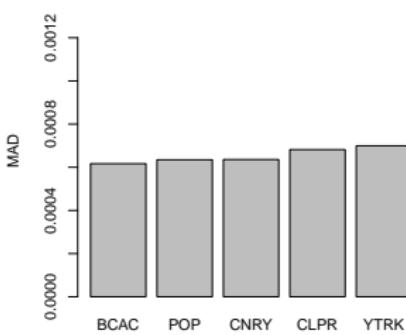
78-83

78-84

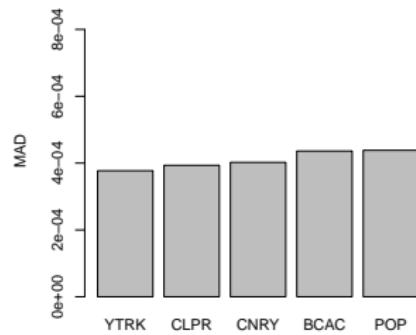
MAD Ordered by Species



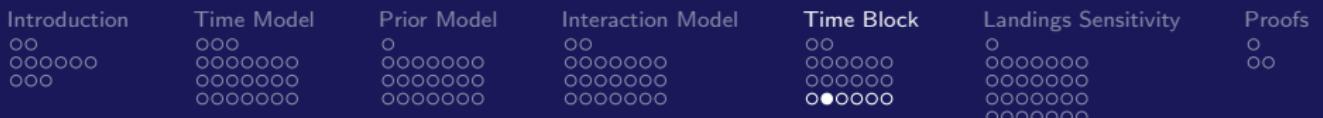
MAD Ordered by Species



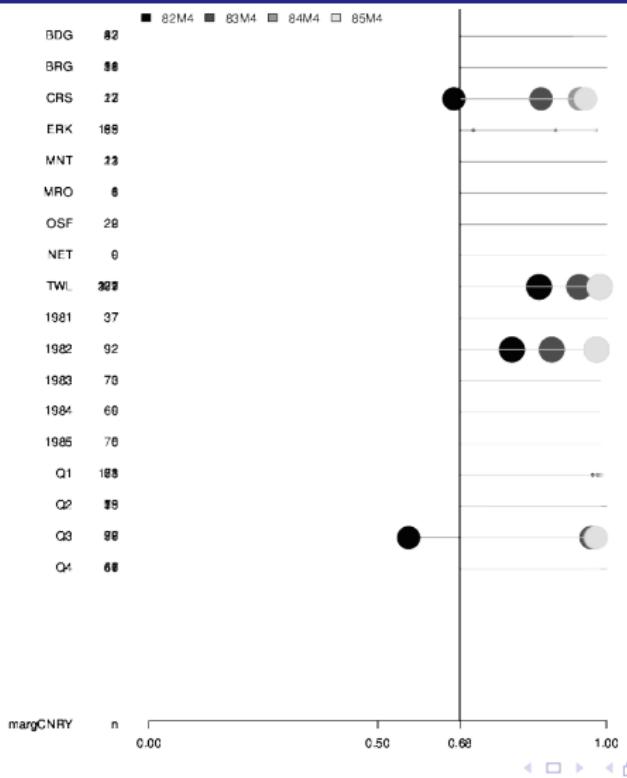
MAD Ordered by Species



Combined

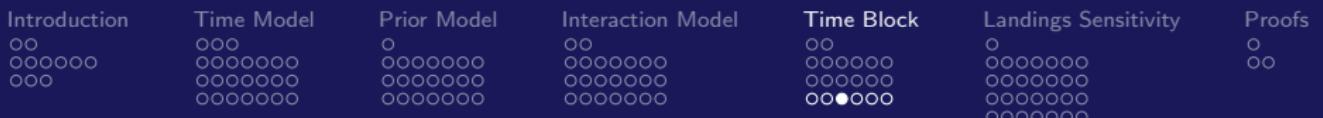


MCAT 269

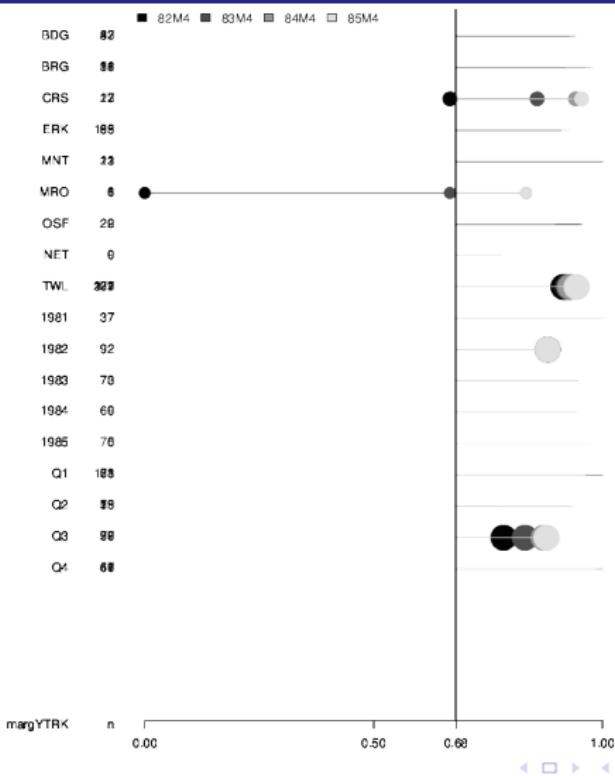


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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

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Proofs

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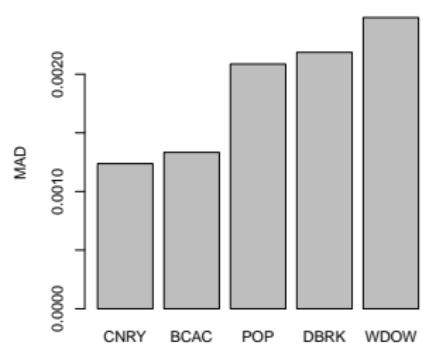
MCAT 269

78-82

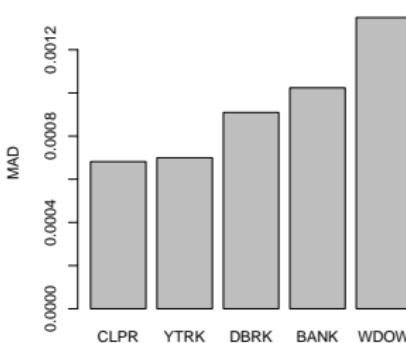
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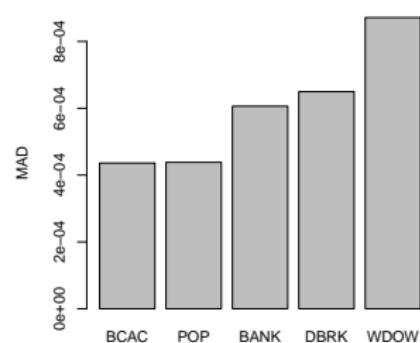
MAD Ordered by Species



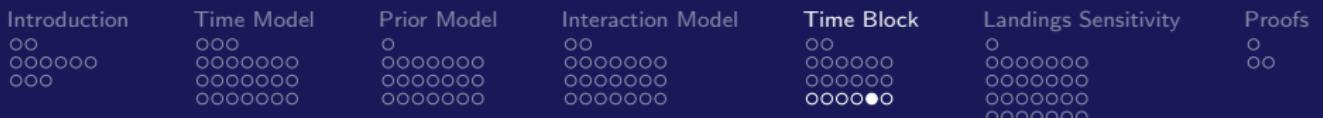
MAD Ordered by Species



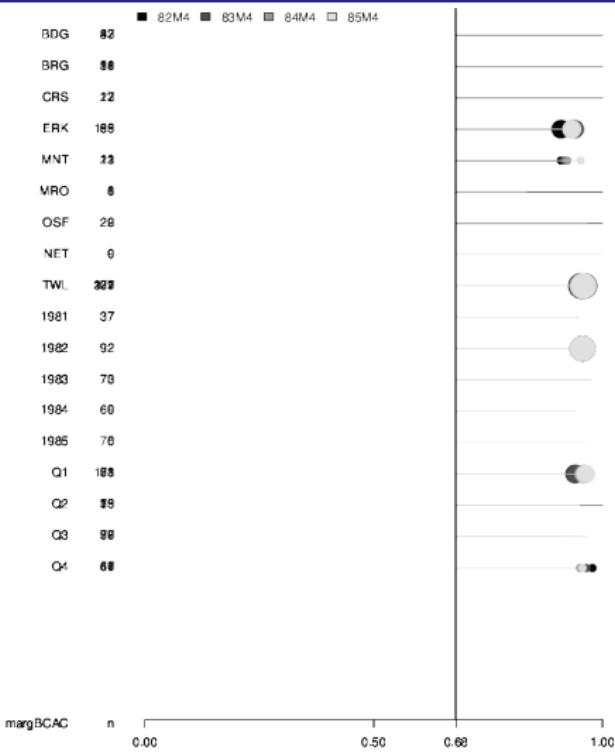
MAD Ordered by Species



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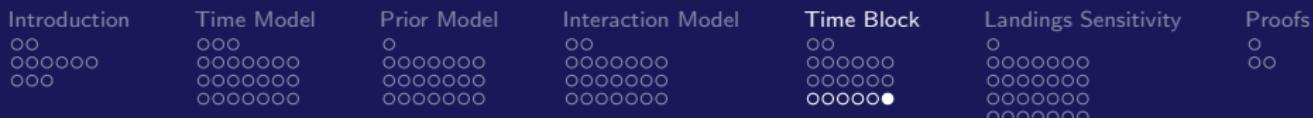


MCAT 269

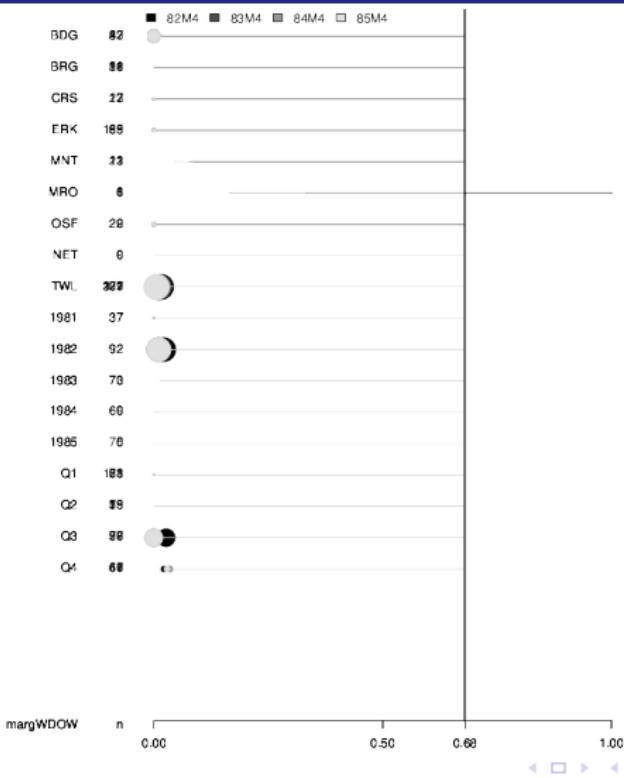


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MCAT 269



Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Request: Compare alternative ComX outputs and the current time series of estimated catches.

Rationale: It would be informative to see the landings estimates corresponding to the additional models developed in response to the above requests. The landings estimates can be generated for a small set of illustrative species and do not need to be comprehensive.

Response: The following slides show explanded landings (by year and by year:gear) from the early time period, summing across market categories 250, 253, and 269 associated with time model, prior, intereaction model, and time block sensativity runs.

Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Time Model

All Species

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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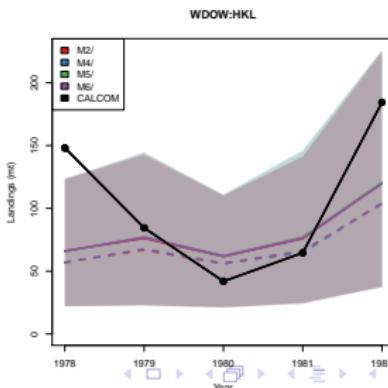
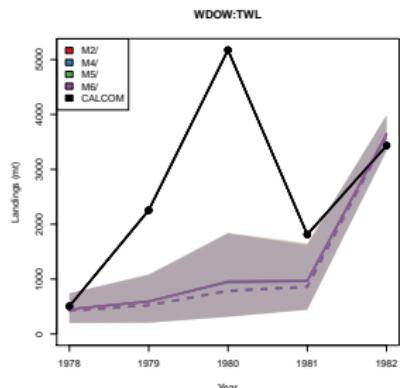
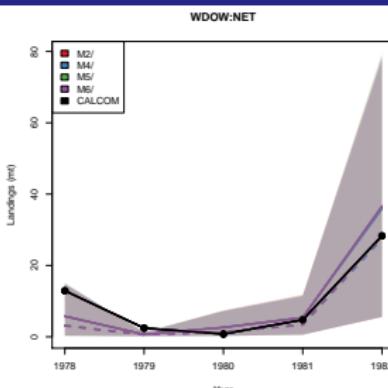
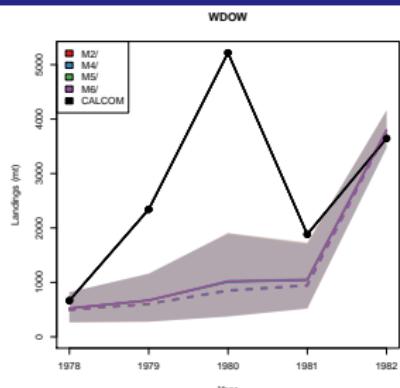
Landings Sensitivity

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Proofs

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Time Model



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Landings Sensitivity

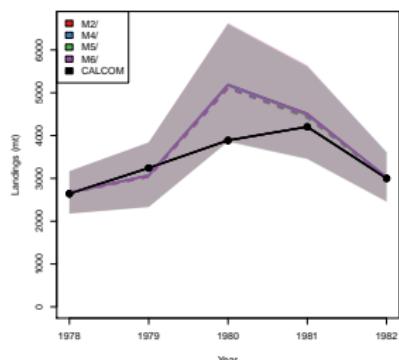
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Proofs

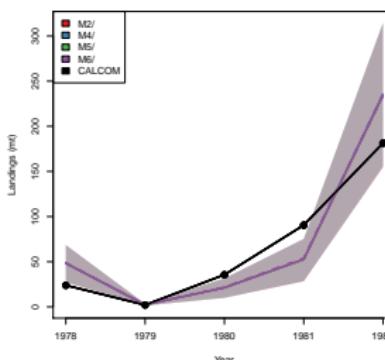
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Time Model

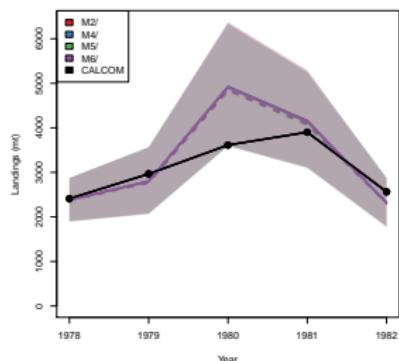
BCAC



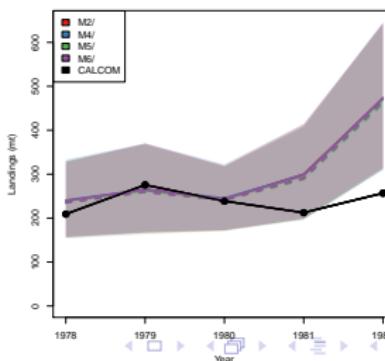
BCAC:NET



BCAC:TWL



BCAC:HKL



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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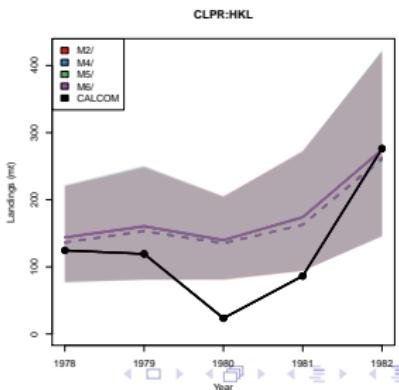
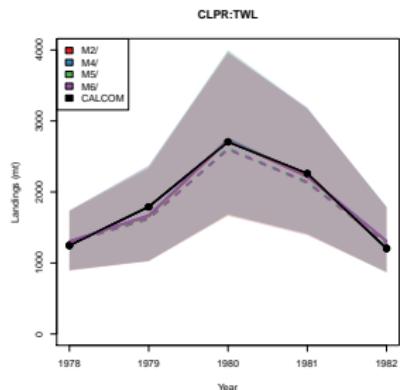
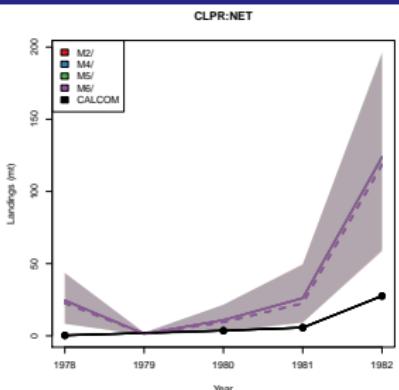
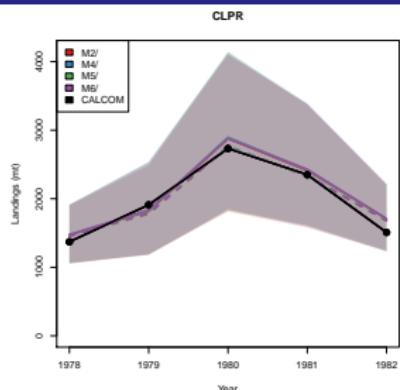
Landings Sensitivity

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Proofs

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Time Model



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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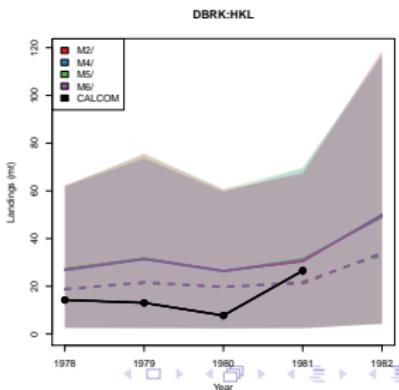
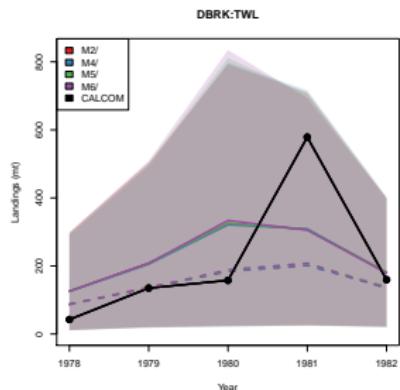
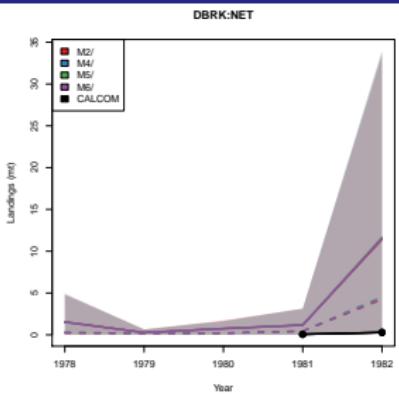
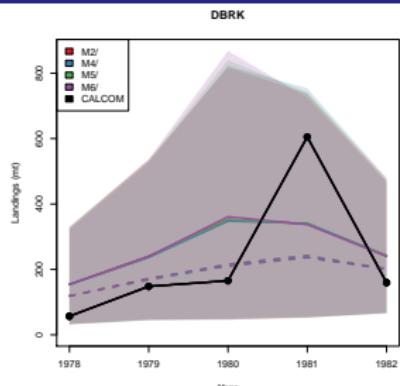
Landings Sensitivity

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Proofs

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Time Model



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Introduction

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Time Model

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Prior Model

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Interaction Model

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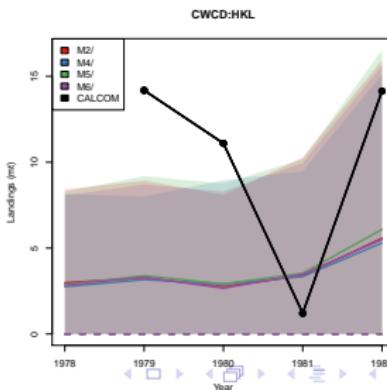
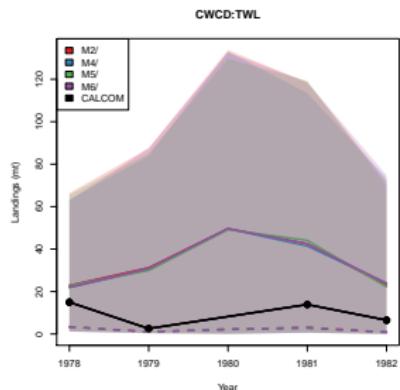
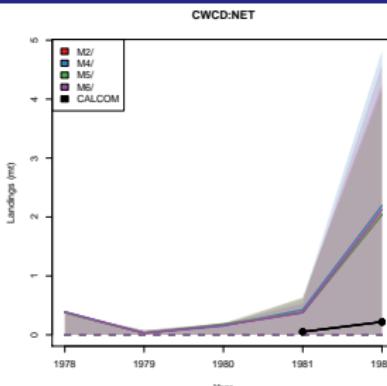
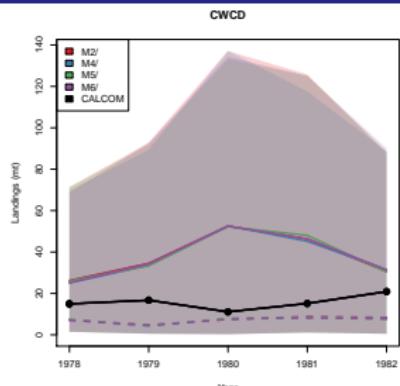
Landings Sensitivity

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Proofs

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Time Model



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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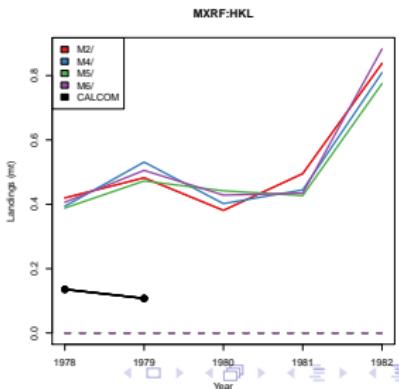
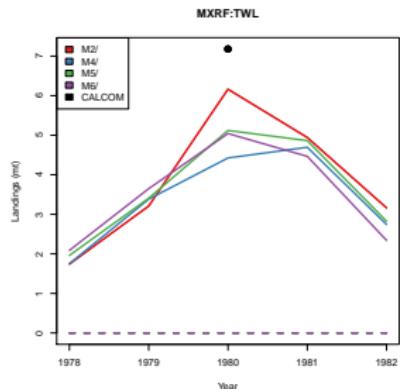
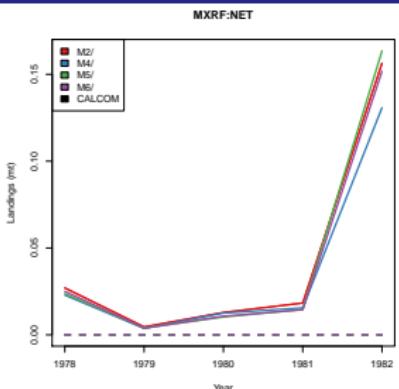
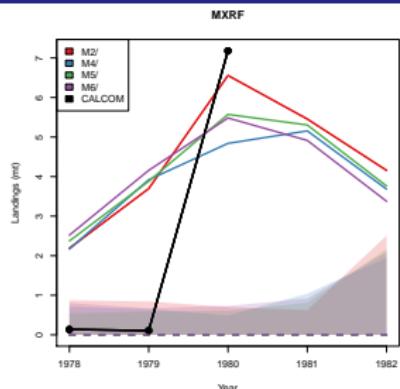
Landings Sensitivity

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Proofs

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Time Model



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Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Prior Model

All Species

Introduction

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Time Model

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Interaction Model

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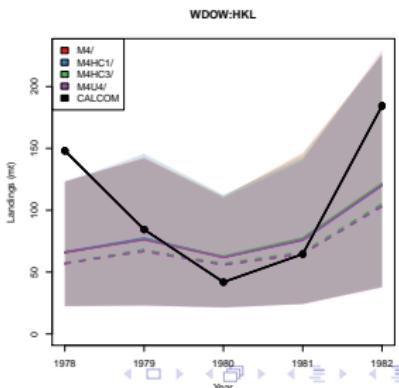
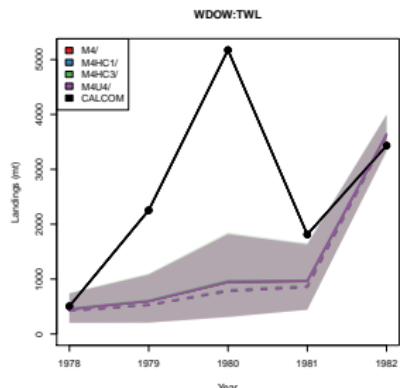
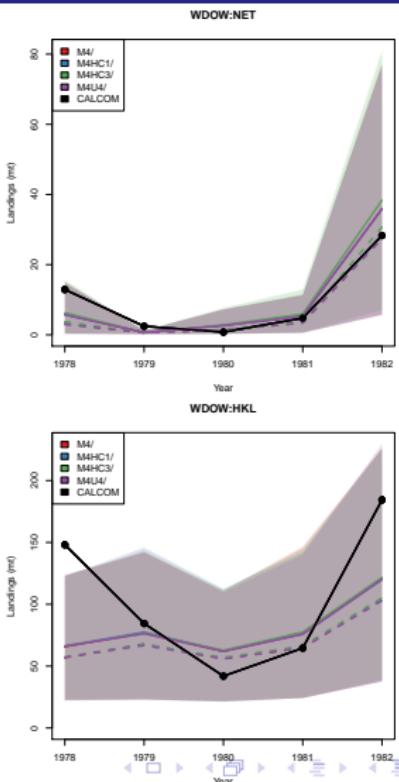
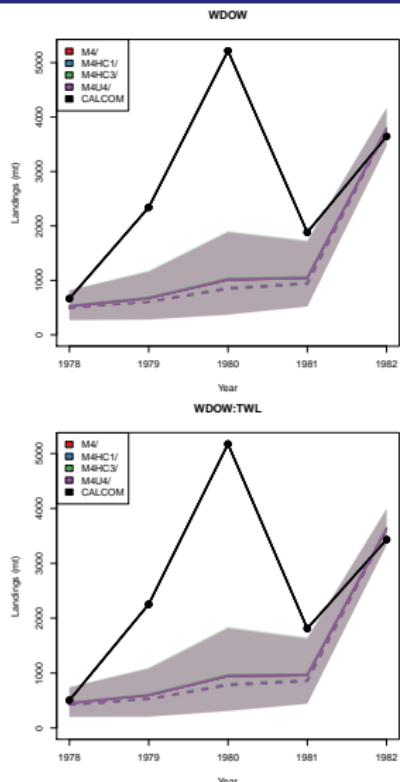
Landings Sensitivity

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Proofs

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Prior Model



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

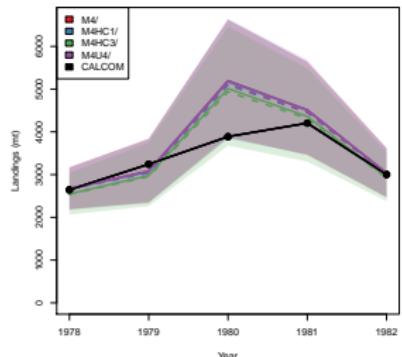
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Proofs

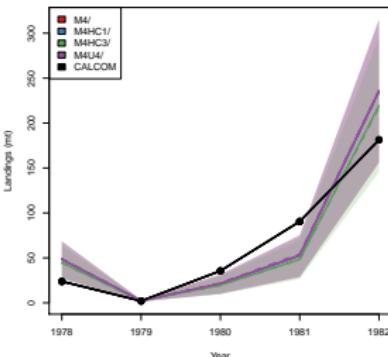
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Prior Model

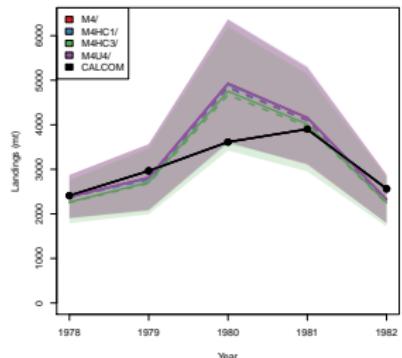
BCAC



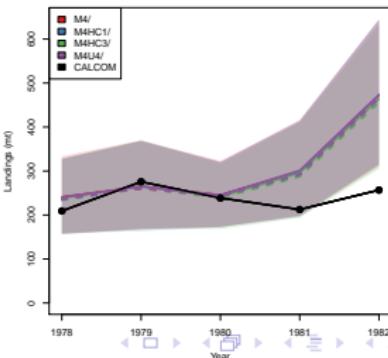
BCAC:NET



BCAC:TWL



BCAC:HKL



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

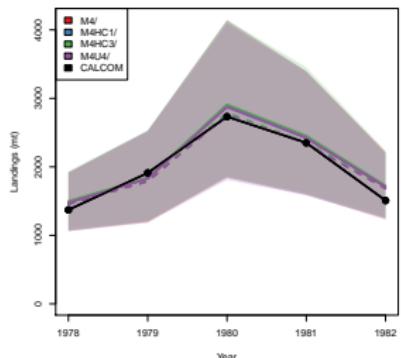
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Proofs

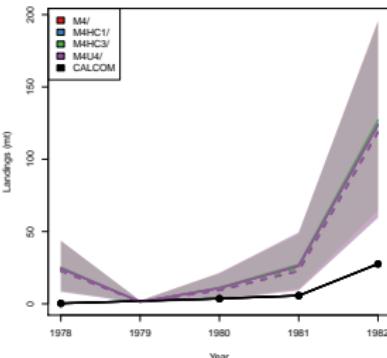
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Prior Model

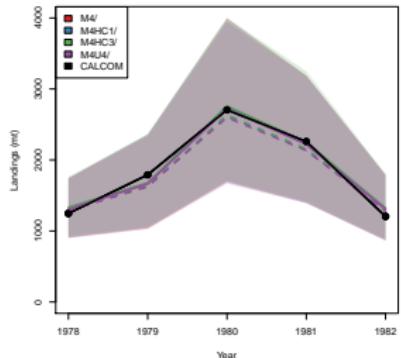
CLPR



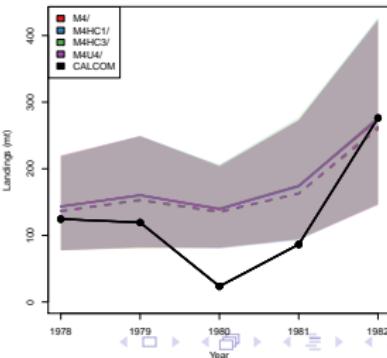
CLPR:NET



CLPR:TWL



CLPR:HKL



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Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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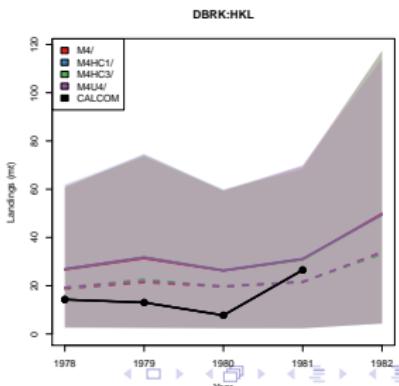
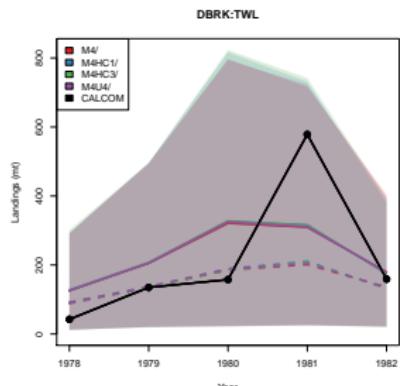
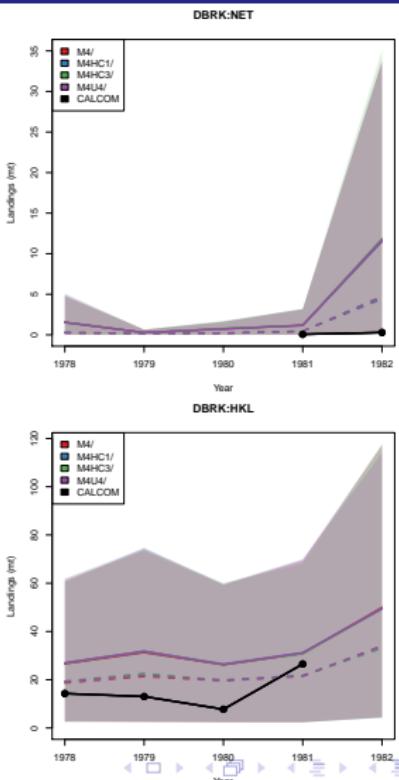
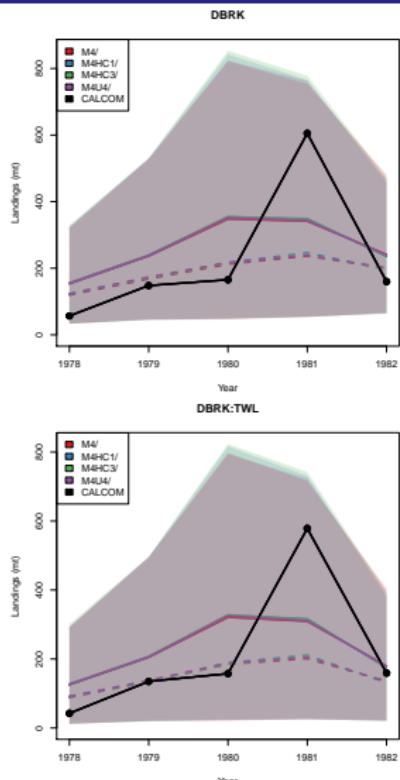
Landings Sensitivity

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Proofs

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Prior Model



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Time Model

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Prior Model

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Interaction Model

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Time Block

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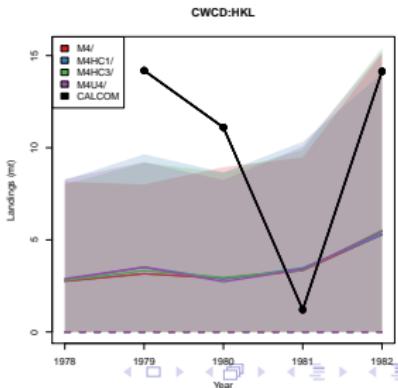
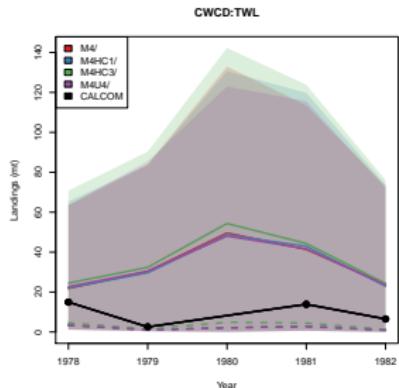
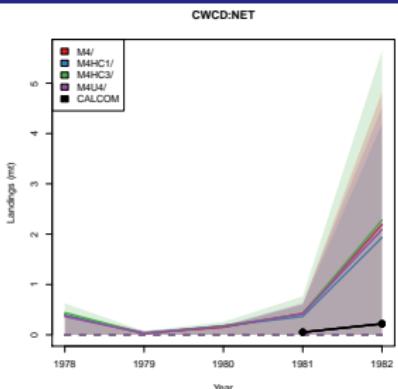
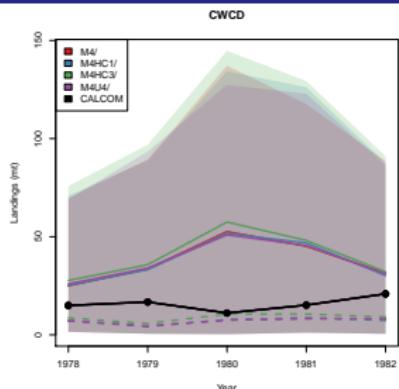
Landings Sensitivity

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Proofs

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Prior Model



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Time Model

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Prior Model

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Interaction Model

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Time Block

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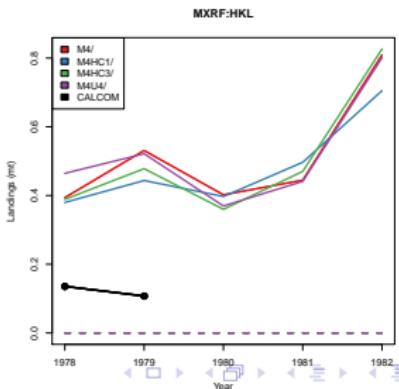
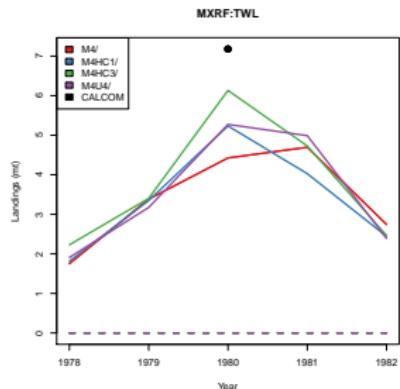
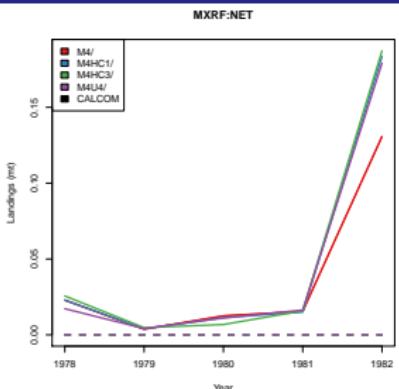
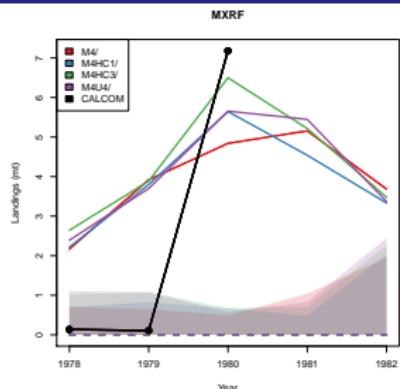
Landings Sensitivity

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Proofs

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Prior Model



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Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Interaction Model

All Species

Introduction

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Time Model

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Prior Model

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Interaction Model

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Time Block

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Landings Sensitivity

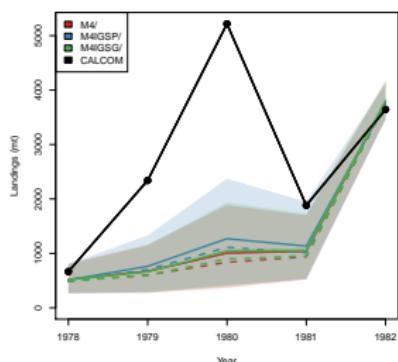
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Proofs

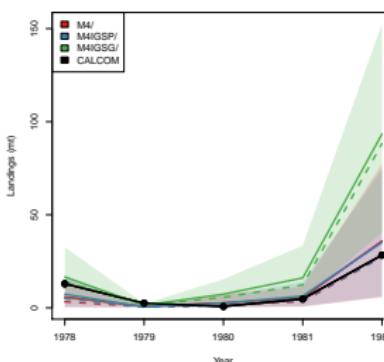
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Interaction Model

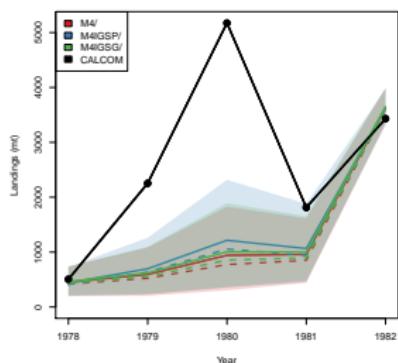
WDOW



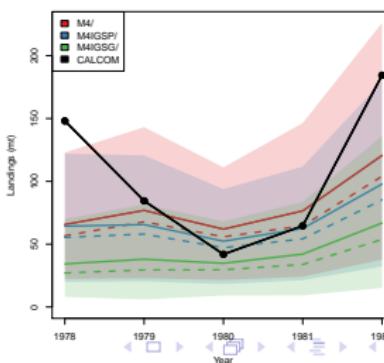
WDOW:NET



WDOW:TWL



WDOW:HKL



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Time Model

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Prior Model

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Interaction Model

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Landings Sensitivity

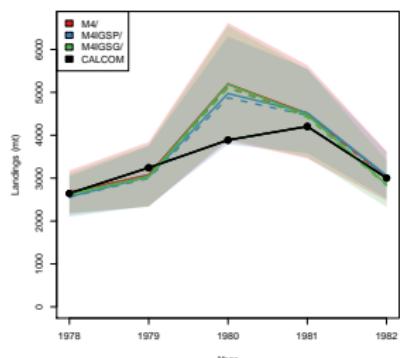
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Proofs

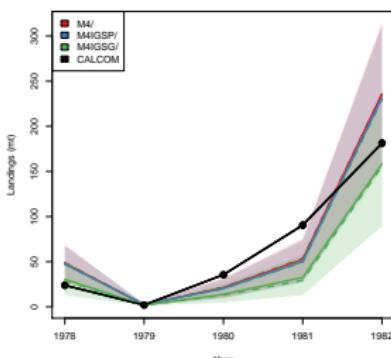
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Interaction Model

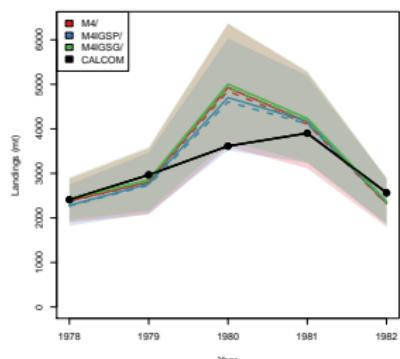
BCAC



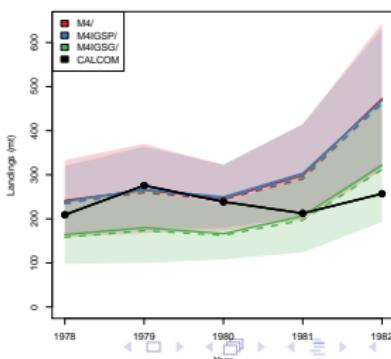
BCAC:NET



BCAC:TWL



BCAC:HKL



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Time Model

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Interaction Model

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Landings Sensitivity

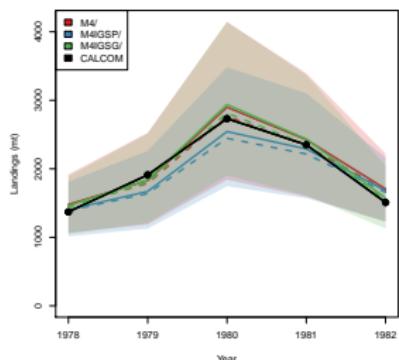
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Proofs

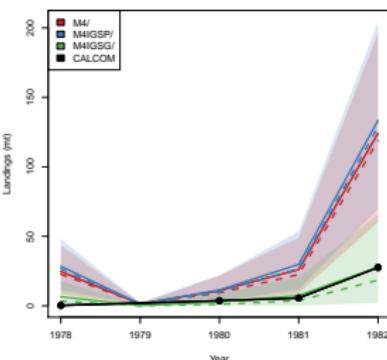
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Interaction Model

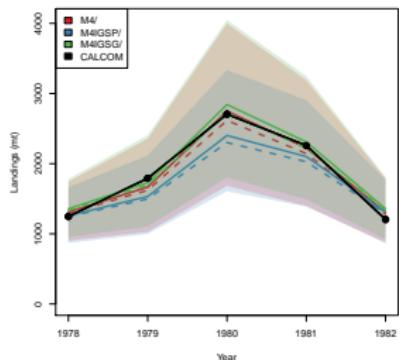
CLPR



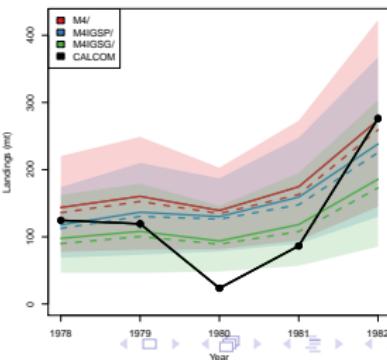
CLPR:NET



CLPR:TWL



CLPR:HKL



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Time Model

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Prior Model

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Interaction Model

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Time Block

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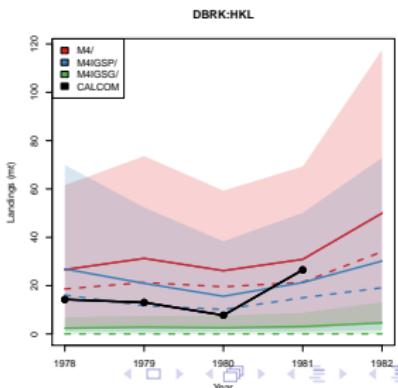
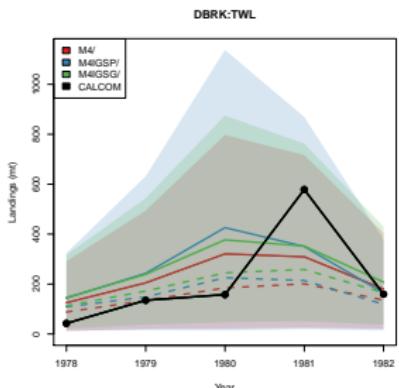
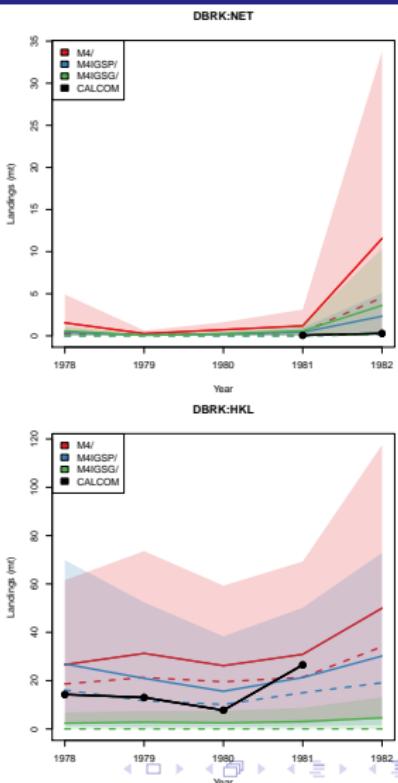
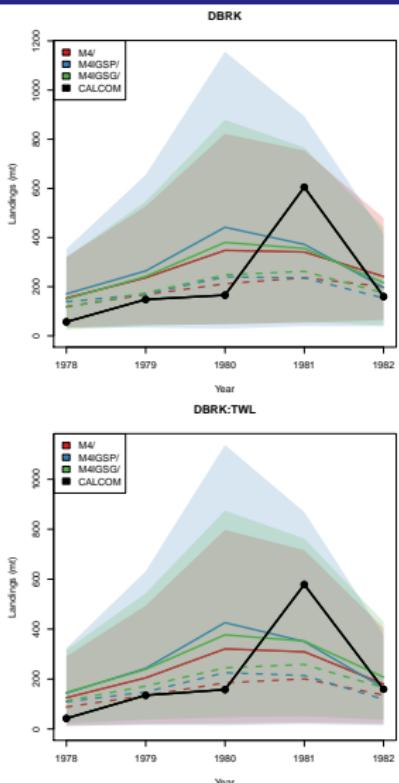
Landings Sensitivity

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Proofs

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Interaction Model



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Time Model

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Prior Model

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Interaction Model

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Time Block

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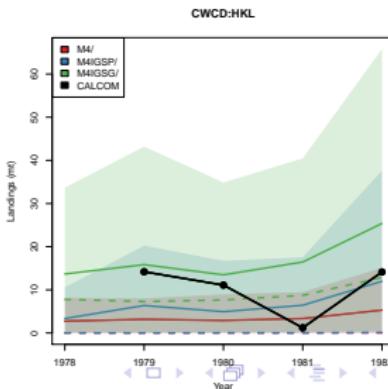
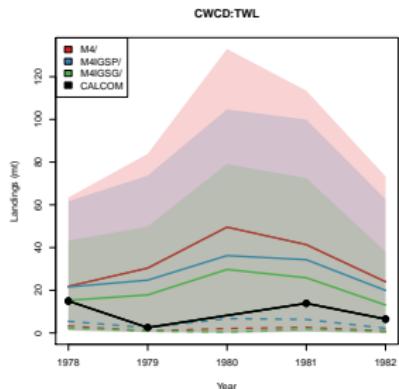
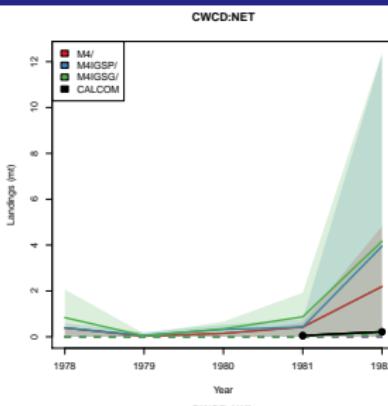
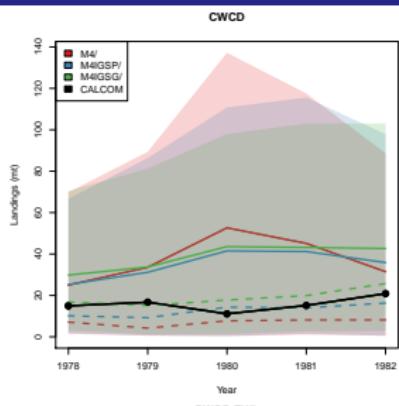
Landings Sensitivity

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Proofs

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Interaction Model



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Time Model

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Prior Model

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Interaction Model

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Time Block

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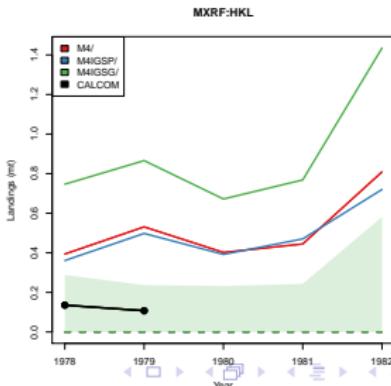
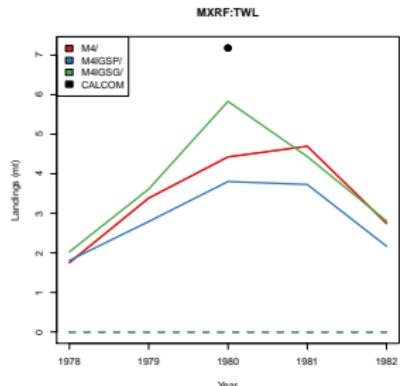
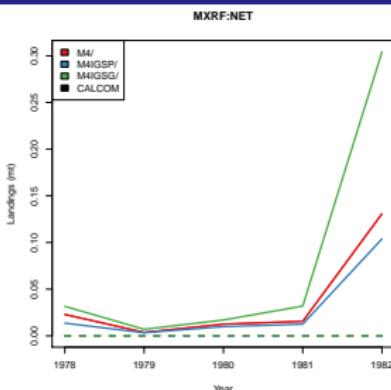
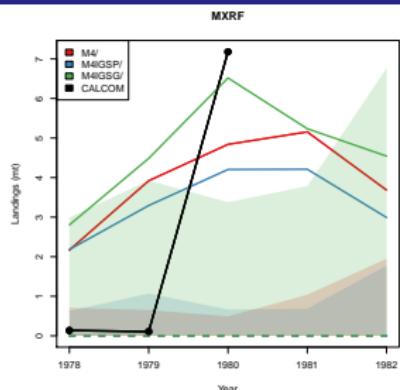
Landings Sensitivity

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Proofs

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Interaction Model



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Introduction	Time Model	Prior Model	Interaction Model	Time Block	Landings Sensitivity	Proofs
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Time Block

All Species

Introduction

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Time Model

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Prior Model

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Interaction Model

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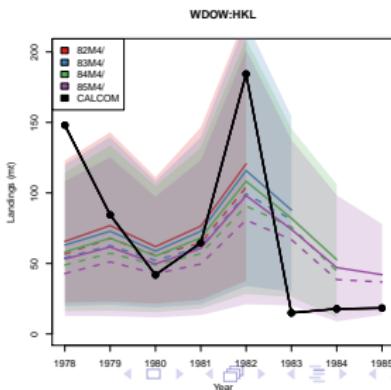
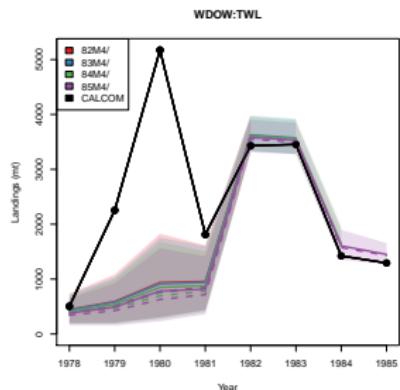
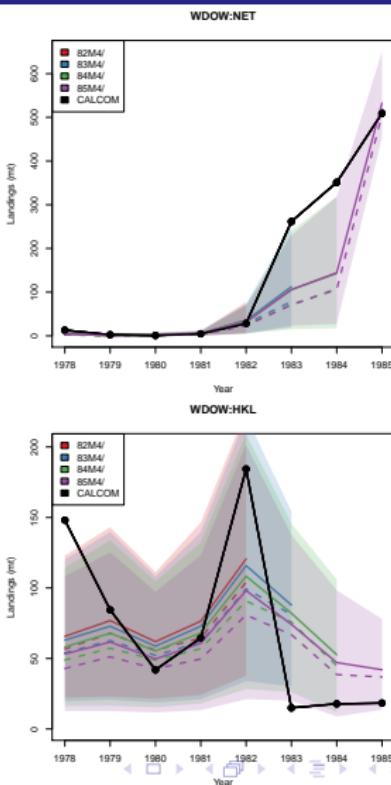
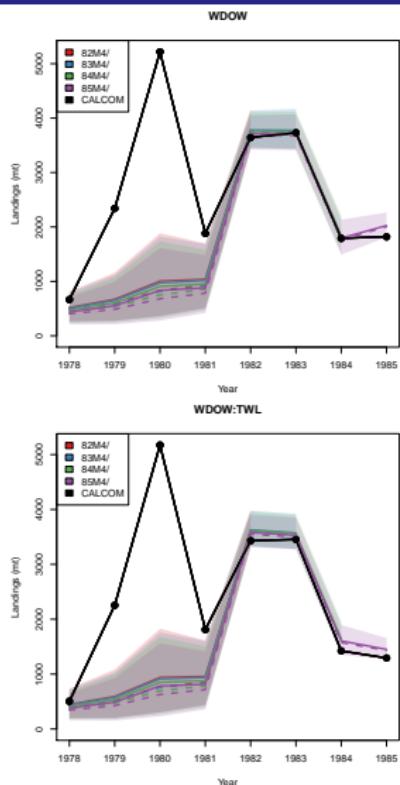
Landings Sensitivity

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Proofs

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Time Block



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Time Model

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Prior Model

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Interaction Model

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Time Block

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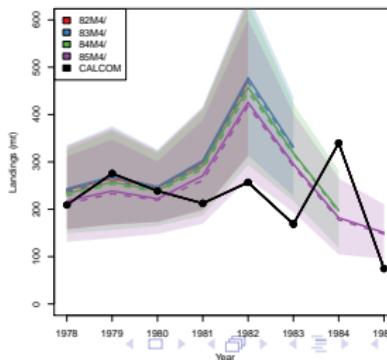
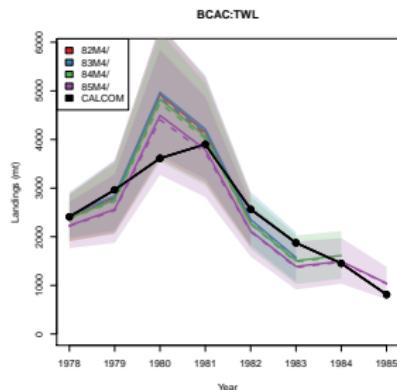
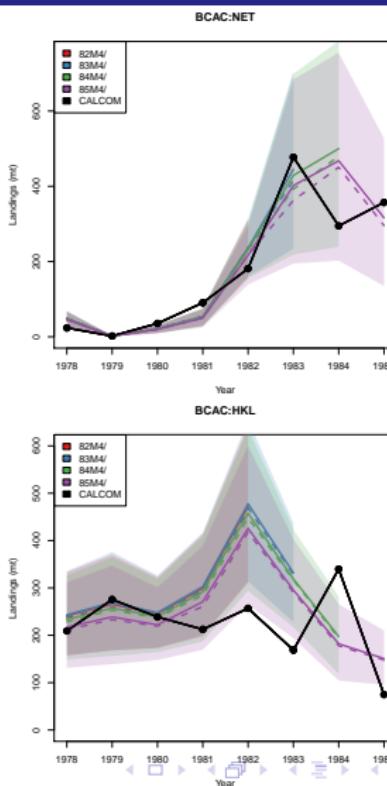
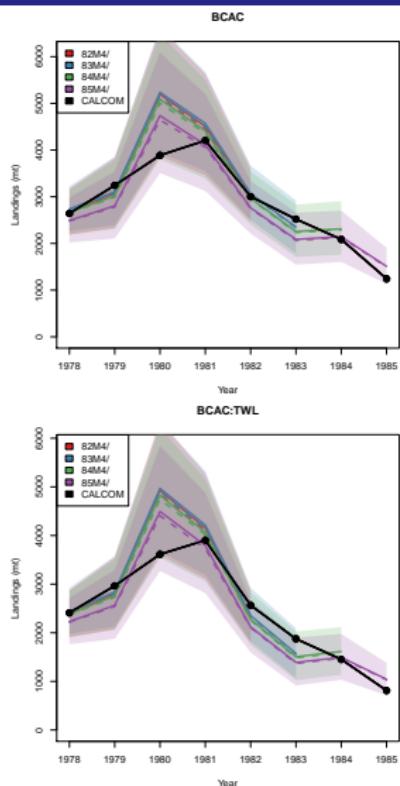
Landings Sensitivity

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Proofs

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Time Block



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Time Model

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Prior Model

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Interaction Model

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Time Block

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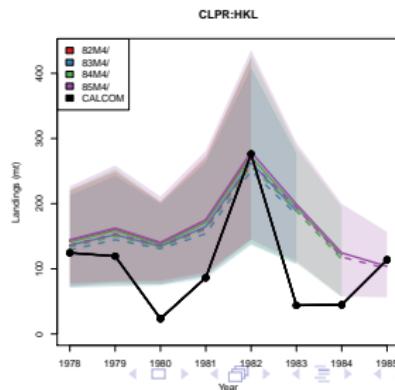
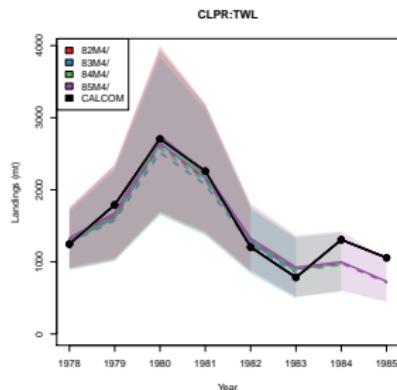
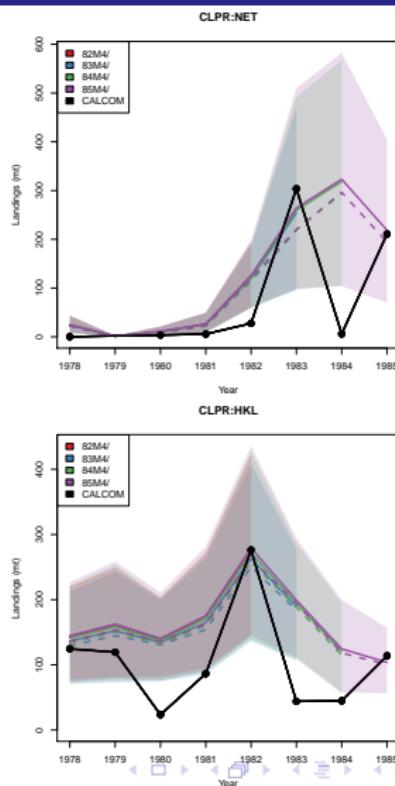
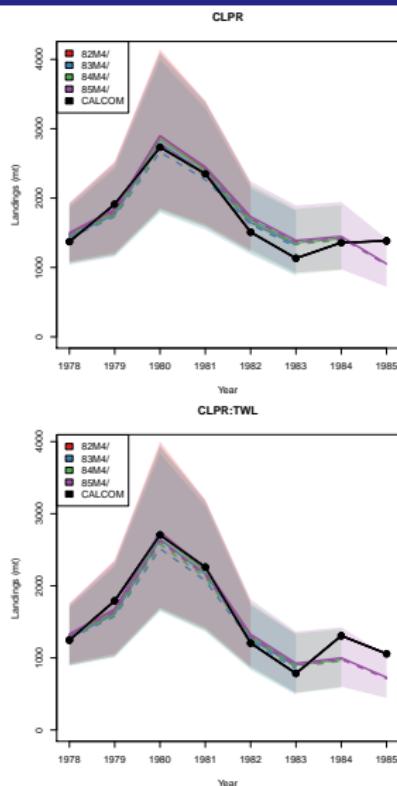
Landings Sensitivity

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Proofs

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Time Block



Nicholas Grunloh In Cooperation With: E.J. Dick, Don Pearson, John Field, Marc Mangel

Improving Catch Estimation Methods in Sparsely Sampled, Mixed Stock Fisheries.



Introduction

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Landings Sensitivity

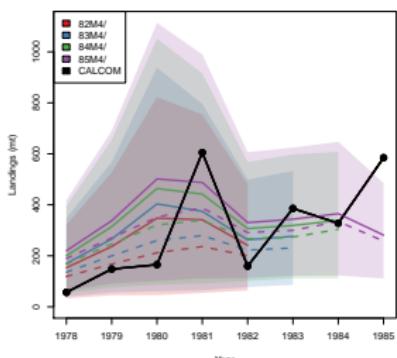
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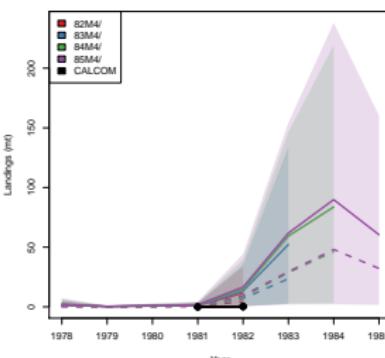
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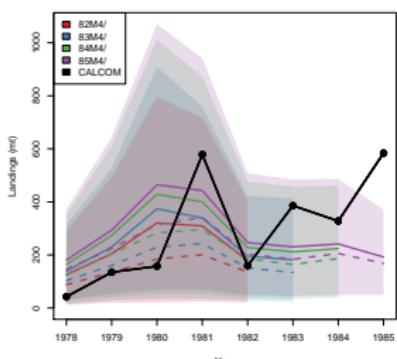
DBRK



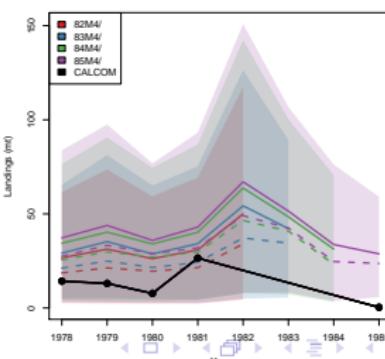
DBRK-NET



DBRK:TWL



DBRK:HKL



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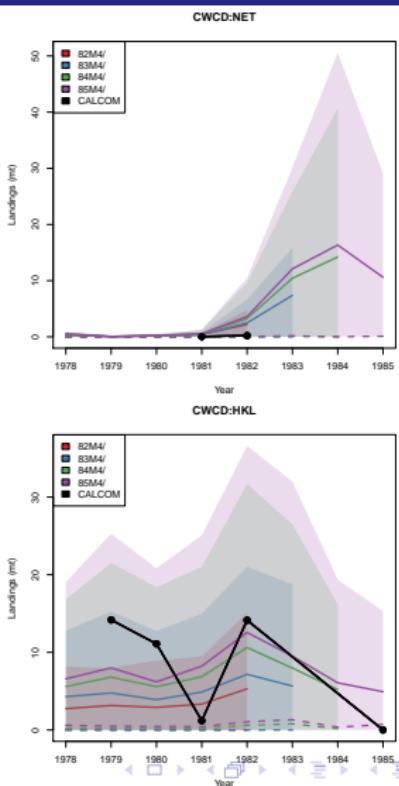
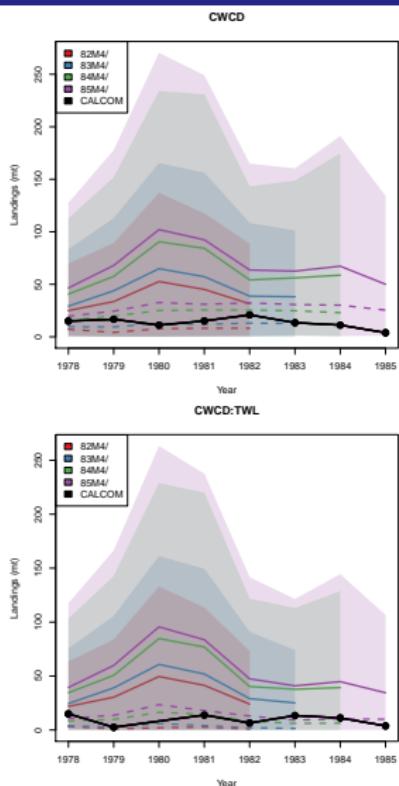
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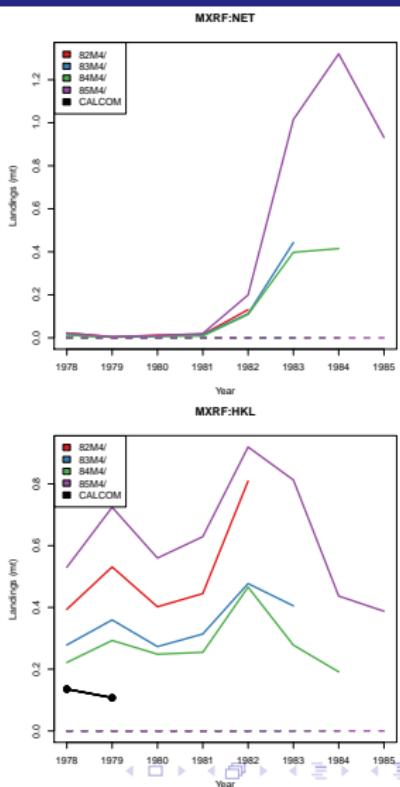
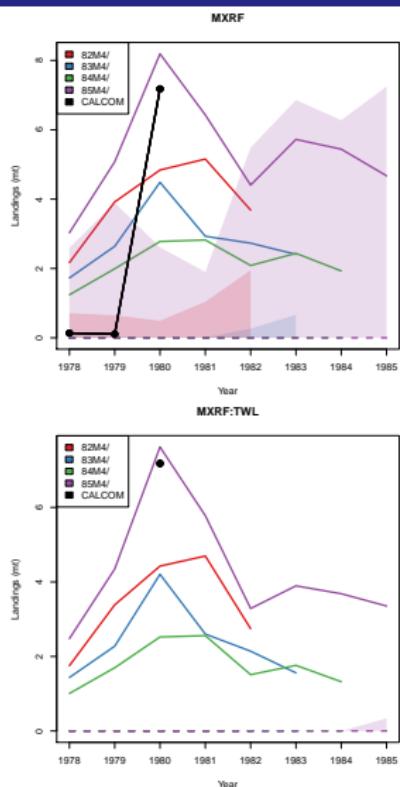
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Proof: Species Comps Sum to One... as do Their Means.

If y_{jk} is the k^{th} draw, $k \in \{1, \dots, K\}$, of the posterior predictive weight of species j in a particular stratum. Then,

$$\pi_{jk} = \frac{y_{jk}}{\sum_j y_{jk}} \quad \mathbf{y}_k \neq \mathbf{0}. \quad (1)$$

The predictive mean for species j is,

$$\hat{\pi}_j = \frac{\sum_k^K \pi_{jk}}{K}. \quad (2)$$

Summing $\hat{\pi}_j$ across species, it follows from (1) and (2) that,

$$\sum_j \hat{\pi}_j \stackrel{(2)}{=} \sum_j \frac{\sum_k^K \pi_{jk}}{K} = \frac{\sum_k^K \sum_j \pi_{jk}}{K} \stackrel{(1)}{=} \frac{\sum_k^K \sum_j \frac{y_{jk}}{\sum_j y_{jk}}}{K} = \frac{\sum_k^K 1}{K} = \frac{K}{K} = 1. \blacksquare$$

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Proof: Species Comps are Negatively Correlated.

Here we seek to show for any two species $I \neq m$, $\text{Corr}(\pi_I, \pi_m) < 0$.

Recall:

$$\text{Corr}(\pi_I, \pi_m) = \frac{\text{Cov}(\pi_I, \pi_m)}{\sigma_{\pi_I} \sigma_{\pi_m}} \quad \sigma_{\pi_I} \geq 0, \quad \sigma_{\pi_m} \geq 0$$

$$\text{Corr}(\pi_I, \pi_m) \leq 0 \iff \text{Cov}(\pi_I, \pi_m) \leq 0$$

$$\begin{aligned} \text{Cov}(\pi_I, \pi_m) &= \mathbb{E}[(\pi_I - \mathbb{E}[\pi_I])(\pi_m - \mathbb{E}[\pi_m])] \\ &= \mathbb{E}[\pi_I \pi_m] - \mathbb{E}[\pi_I] \mathbb{E}[\pi_m] \end{aligned}$$

$$\text{Cov}(\pi_I, \pi_m) \leq 0 \iff \mathbb{E}[\pi_I] \mathbb{E}[\pi_m] \geq \mathbb{E}[\pi_I \pi_m]$$



Proof: Species Comps are Negatively Correlated Cont.

Consider the strictly concave function:

$$f(\mathbf{x}) = \prod_i x_i : \mathbf{x} \in \left\{ \mathbf{y} \mid \sum_i y_i = 1, y_i \geq 0 \right\}$$

Jensen's Inequality for f is,

$$f(\mathbb{E}[\mathbf{x}]) \geq \mathbb{E}[f(\mathbf{x})]. \quad (3)$$

From the previous proof: $\sum_j \pi_j = 1$, $\pi_j \geq 0$ and $\sum_j \hat{\pi}_j = 1$, $\hat{\pi}_j \geq 0$.
 Thus applying (3) to π gives

$$\mathbb{E}[\pi_I] \mathbb{E}[\pi_m] \geq \mathbb{E}[\pi_I \pi_m] \quad (4)$$

with equality only if π is a constant. Since π is never a constant,

$$\mathbb{E}[\pi_I] \mathbb{E}[\pi_m] > \mathbb{E}[\pi_I \pi_m] \implies \text{Cov}(\pi_I, \pi_m) < 0 \implies \text{Corr}(\pi_I, \pi_m) < 0. \blacksquare$$