Testing the Robustness of the Current PBR framework (Continued)

Andre Punt, Paula Moreno, John Brandon & M. Mathews

Going case-specific?

Parameter	Humpback whale	Bottlenosed dolphin	Bowhead whale	"Generic" marine mammals*
Age-at-first parturition	11 yr	7 yr	18 yr	1 yr
Calf survival	0.90	0.70	0.944	0.90
Non-calf survival	0.95	0.951	0.990	0.95
Selectivity	Age 1+	Age 1+	Age 1+	Age 1+
Plus-group	Age 15	Age 10	Age 25	Age 5

Included to mimic the production model on which the analyses of Wade (1998) were based

Case-specific analysis-I

The main design:

- Four species (humpback, bottlenose dolphin; bowhead, “generic”)
- Five carrying capacities (1000, 10000, …, 10000000)

Other factors:

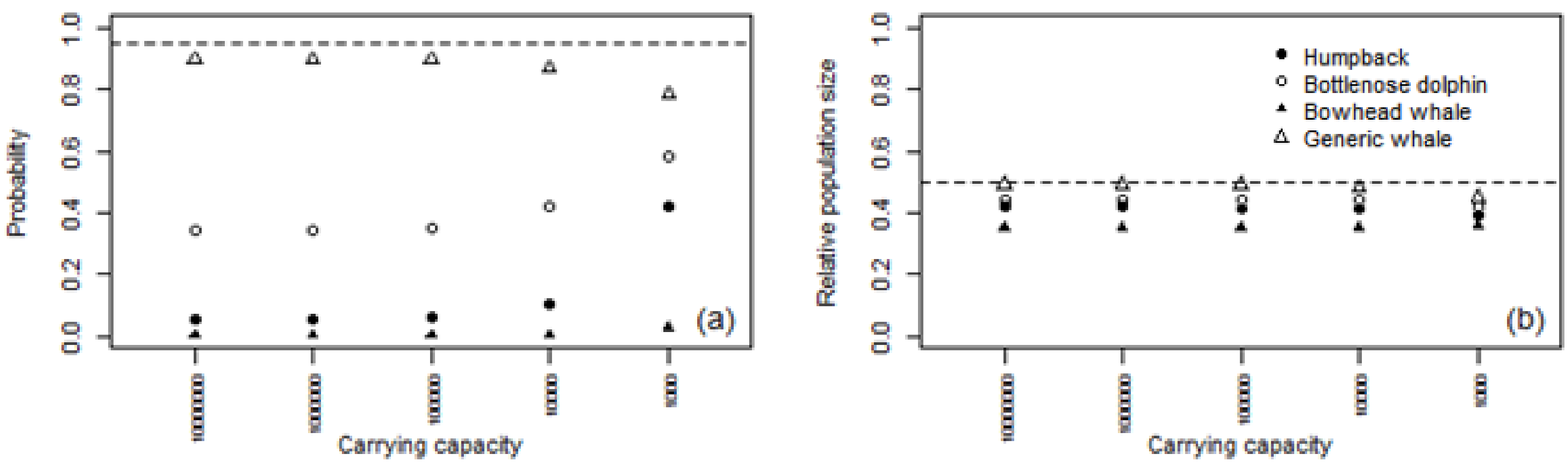
- Initial depletion = 0.3
- 4-year abundance surveys with CVs of 0.2
- MSI CV = 0.3

Performance metrics:

- Probability of being above MNPL
- Lower 5th percentile of the final depletion distribution

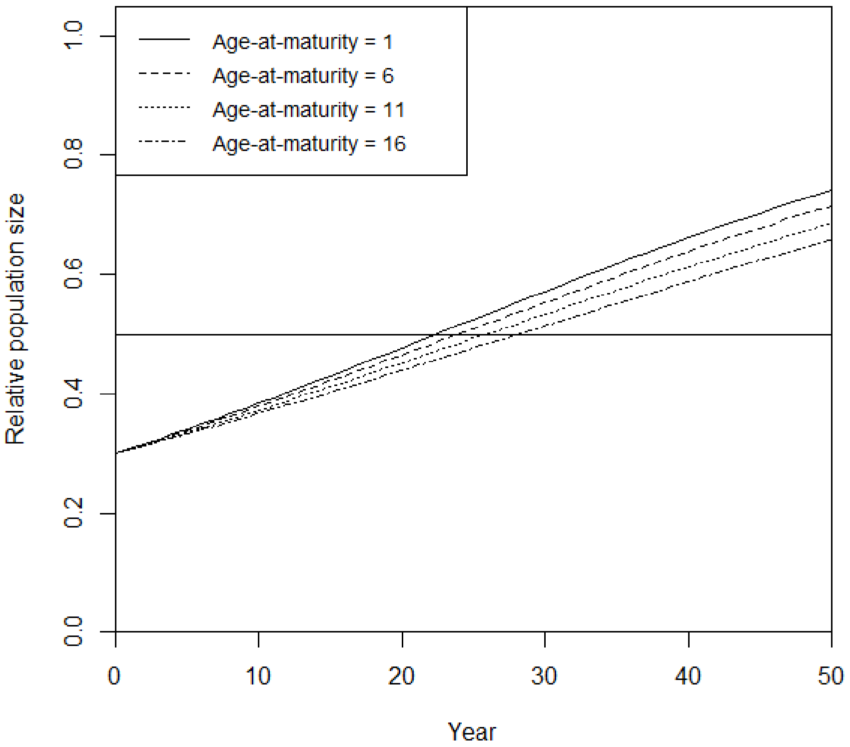
Case-specific analysis-II

- Final population size depends on species and carrying capacity
- Bowheads are the least optimistic in terms of recovery rate while the “generic” whale recovers quickest.



Case-specific analysis-III

Sensitivity of the rate of increase to the assumed age-at-maturity



Take Home Messages

- The ability to satisfy the management conservation goals are dependent on the biological characteristics of the species being managed. **Most MSEs are case-specific.**
- The "generic" whale has no time-lags and this leads to more optimistic results in terms of recovery times and rates.
- The probability of recovery also depends on the size of the population because of the impacts of demographic uncertainty – the original MSE corresponds to "infinite" population size.
- **Future simulations should be tailored more to "real" species, which could impact values for F_R, the recovery factor.**

How robust is the current approach for setting limits to fisheries-caused mortality of marine mammals in U.S. waters? (Continued)

Paula Moreno, Andre Punt, John Brandon & M. Mathews

Question: How do changes related to the stock (life history) and management strategies (e.g. survey effort) influence the ability to achieve the conservation goal when more than one fishery causes incidental mortality (bycatch)?

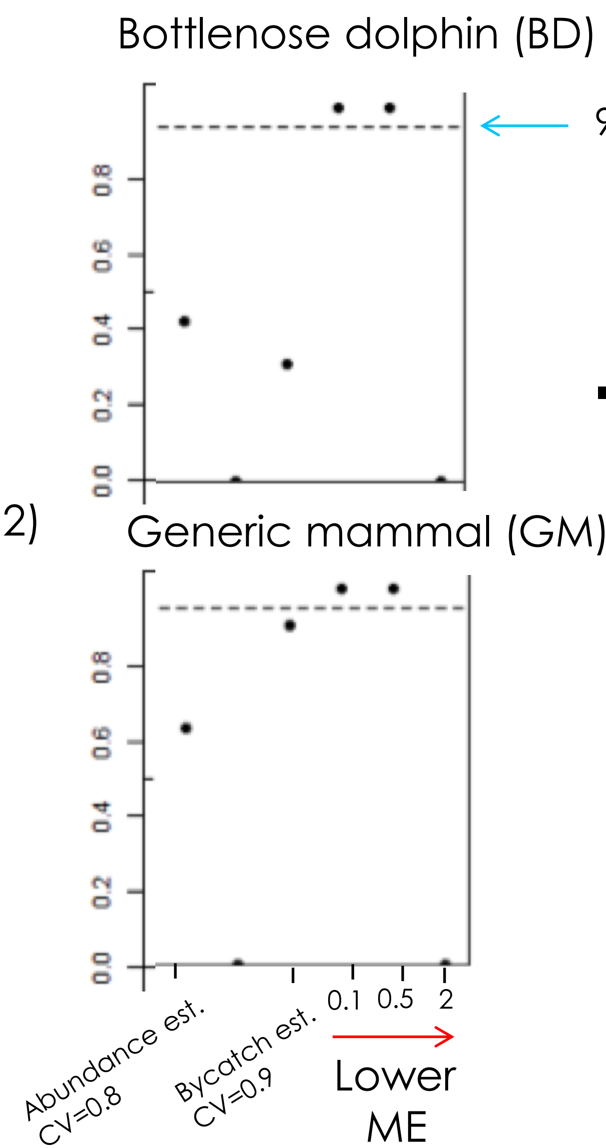
Changes relative to Wade model (1998):

+ Non-generic species
+ Abundance estimate CV (0.8)
+ Bycatch CV (0.9)
+ Management Efficiency (0.1, 0.5, 2)

Management Efficiency (ME):
Expected (Bycatch/PBR)
e.g., ZMRG = 0.1

+ More fisheries (3)

Punt et al (2018)



95% P(rebuild stock to MNPL)

Results

- BD recovery less likely than GM at low precision of abundance and bycatch estimates
- BD and GM recovery is equally likely at these ME levels and stock not likely to rebuild to MNPL when expected bycatch is 2x PBR

More questions

As the precision of estimates of

- Abundance and
- Bycatch

changes and **multiple fisheries** interact with the stock, how well can we classify fisheries (categories I, II, III) and achieve the conservation goal?

Photo: NOAA

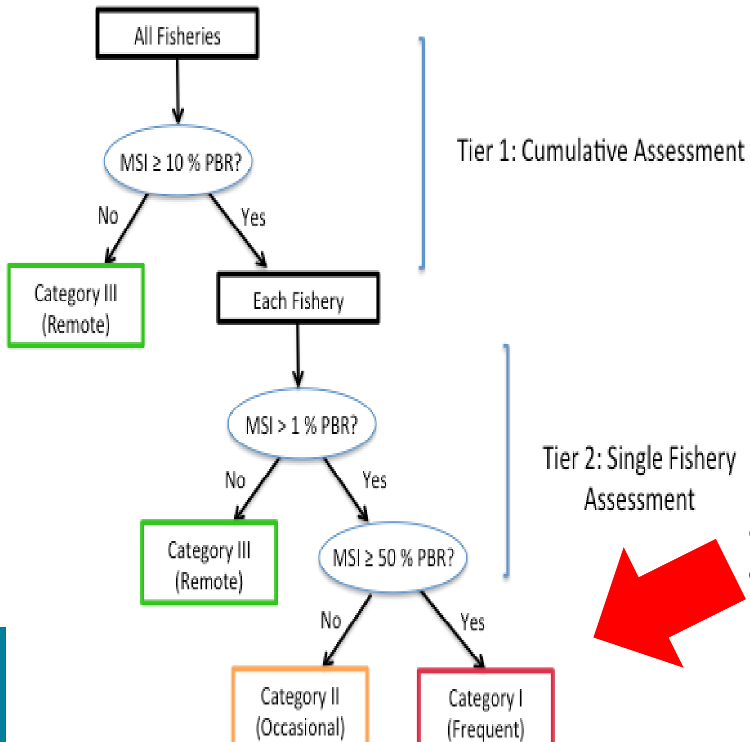
Classification of Fisheries

- Fisheries are classified as Categories I, II and III based on the level of bycatch and managed accordingly

Category I : MSI ≥ 50% PBR
Category II : 50% PBR > MSI > 1% PBR
Category III : MSI ≤ 1% PBR

→ Management action E(bycatch) = PBR

- - → No management action



Scenario	Fishery-type		
	1	2	3
A	0.70	+ 0.25	+ 0.05
B	0.40	0.40	0.20
C	0.33	0.33	0.33
D	0.50	0.49	0.01
E	0.90	0.05	0.05

Expected (bycatch) = PBR

Q: How often are these classifications correct given uncertainty ?

Classification of Fisheries (cont.)

Over-classify a fishery: Higher impact assessed than actual impact

Under-classify a fishery: Lower impact assessed than actual impact

Bycatch is random => If E(bycatch) is 0.7 PBR, the actual bycatch may be above or below 0.7 PBR

Category I : MSI ≥ 50% PBR

Category II : 50% PBR > MSI > 1% PBR

Category III : MSI ≤ 1% PBR

Management action E(bycatch) = PBR

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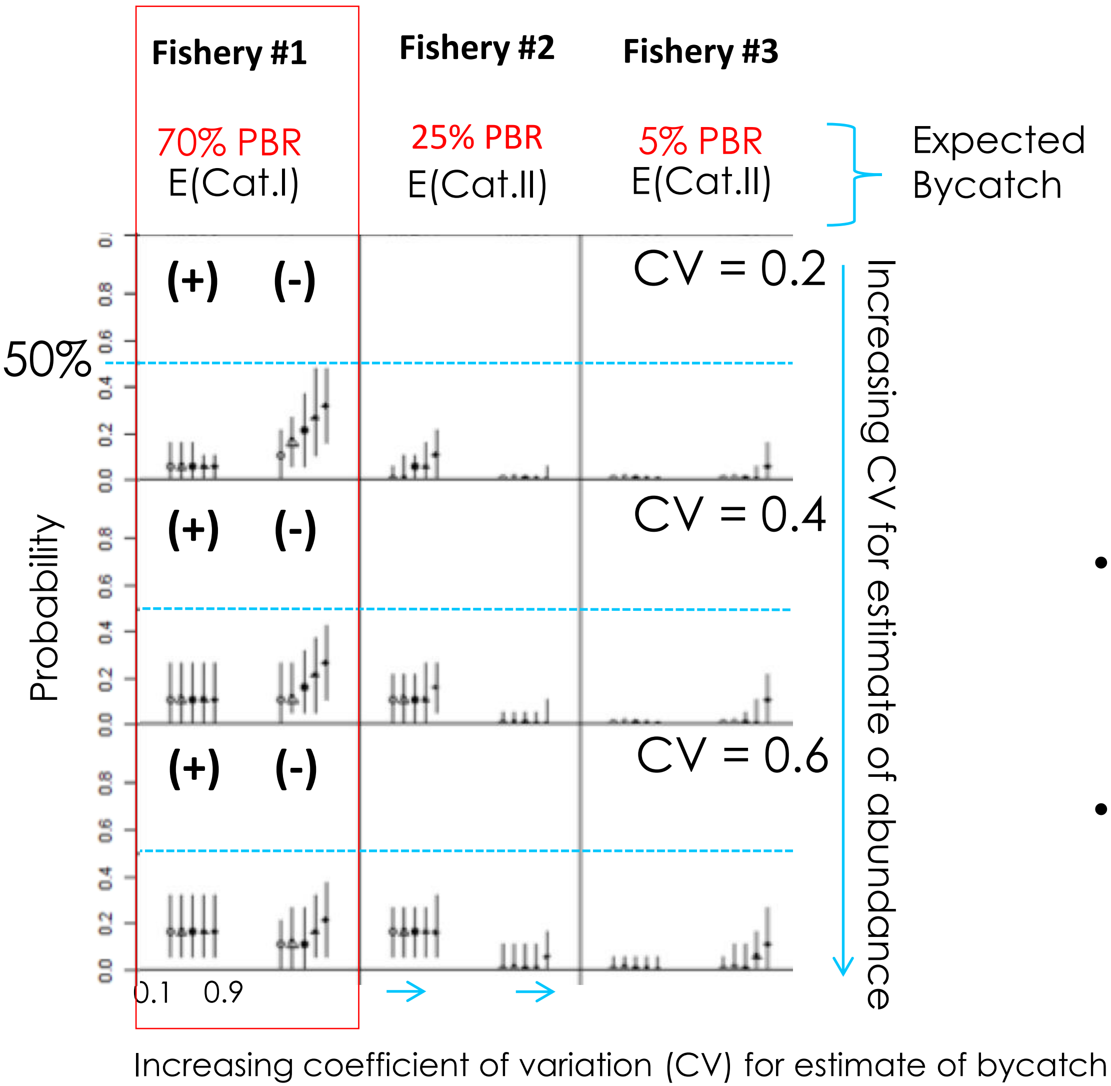
D	0.50	0.49	0.01
E	0.90	0.05	0.05

=> Expected (bycatch) = PBR

Distinctive Cases

Sp = Humpback; Carrying capacity = High (10 million)

- Each simulation runs for 100 years (1,000x)



(+) => **Over-classify** a fishery (Higher impact assessed than actual impact)

(-) => **Under-classify** a fishery (Lower impact assessed than actual impact)

Results

- **Over-classification (+)** increases as precision of **abundance estimates** decreases
- **Under-classification (-)** tends to increase as precision of **bycatch estimates** decreases

Take-Home Message

This MSE framework is a useful tool to examine the ability to achieve the OSP conservation goal for MM populations under a broad range of plausible scenarios.

In the cases presented, we learned that:

- The ability to achieve the conservation goal depends on the **demographics** of the species being managed => future simulations to guide stock assessments should be tailored more to "real" species.
- **Precision of estimates of bycatch and abundance** influences ability to correctly classify fisheries (higher risk of over-classifying as precision of abundance decreases; higher risk of under-classifying as precision of bycatch decreases).

Next Steps

- Evaluate the effect of observer coverage (effort) on achieving the conservation goal and correctly classifying fisheries
- Focus on scenarios that better capture Category III (Remote) vs. Category II (Frequent) and III (Occasional)
- Expand simulations to lower [more conservative] Recovery Factor (F_r) values