

Implications of bycatch, wastage, post-release survival and size-limits on MSY- and SPR-based reference points in the Pacific halibut fishery

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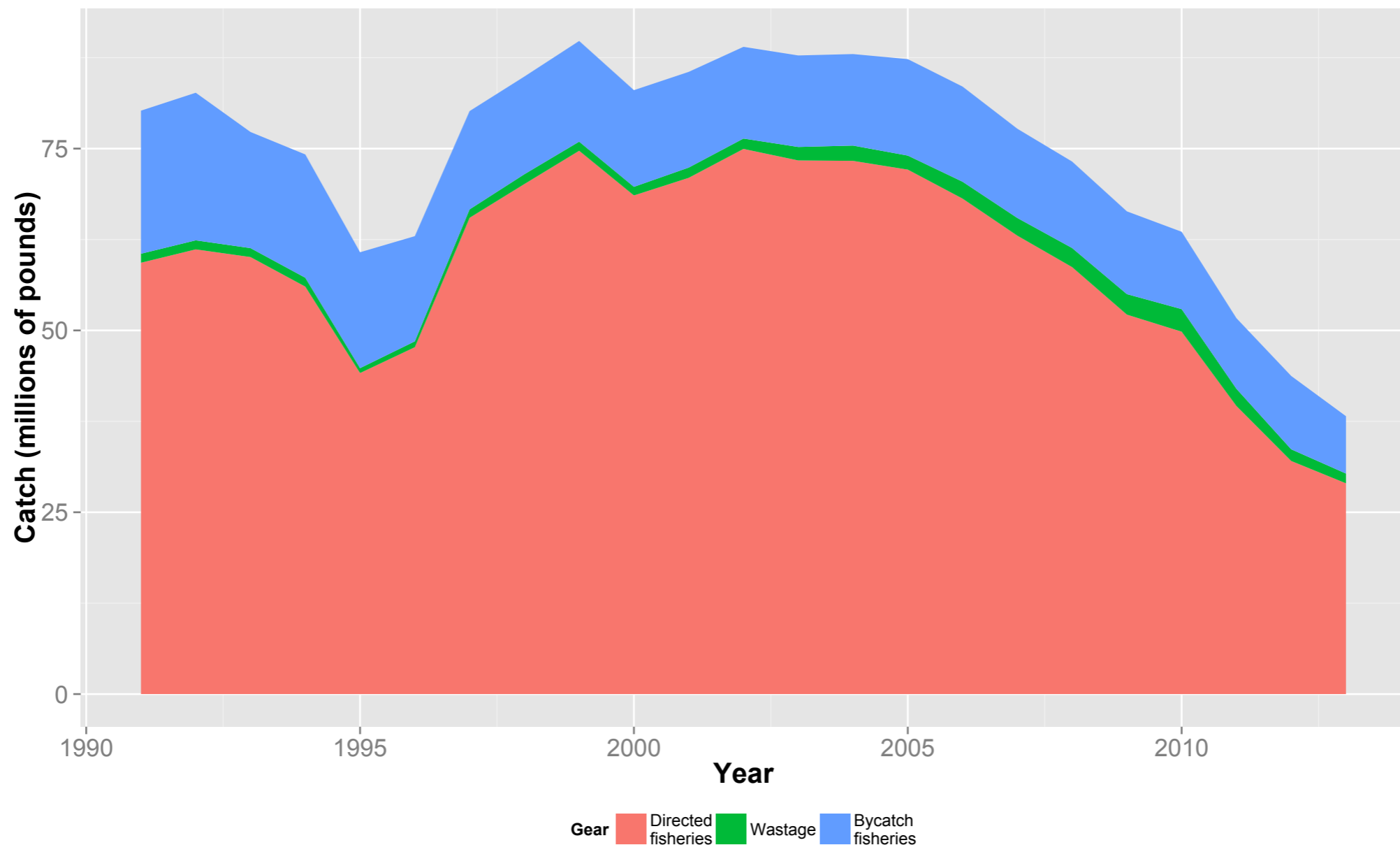
“It’s not bycatch if the trawlers are allowed to keep halibut.”

Jim Balsiger

Introduction

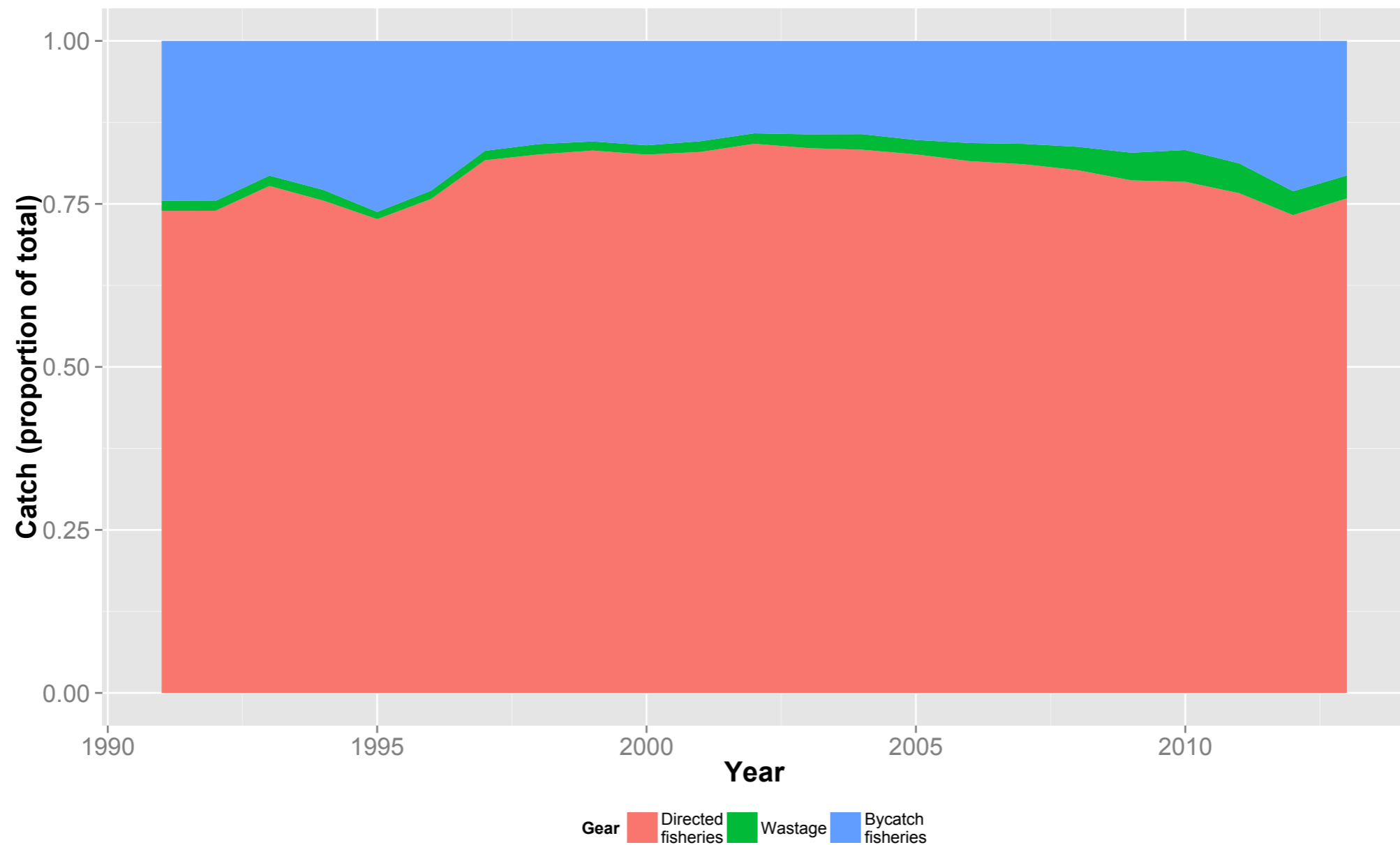
IPHC contends with two forms of bycatch:

1. Wastage -> directed fisheries (sub-legal & lost gear),
2. Bycatch -> all other fisheries where retention of halibut is prohibited.



Commercial Fishery Removals

Since 2002: Directed fisheries catch has declined by 61%, and bycatch has declined by 37%.



Bycatch & Wastage proportions

~ 1:4 pounds of commercially caught halibut are discarded, and since rationalization wastage has increased by 8.1% per year.

Overarching objective

- How do changes in ratios of catch:wastage and catch:bycatch impact the operational efficiency of the pacific halibut fishery?

Specific objectives

1. How do size-limits and discard mortality rates influence reference point calculations in the directed fisheries?
2. How does the ratio of catch:bycatch influence reference points in the directed fisheries?
3. What simple options are available to increase the operational efficiency of the halibut fishery?

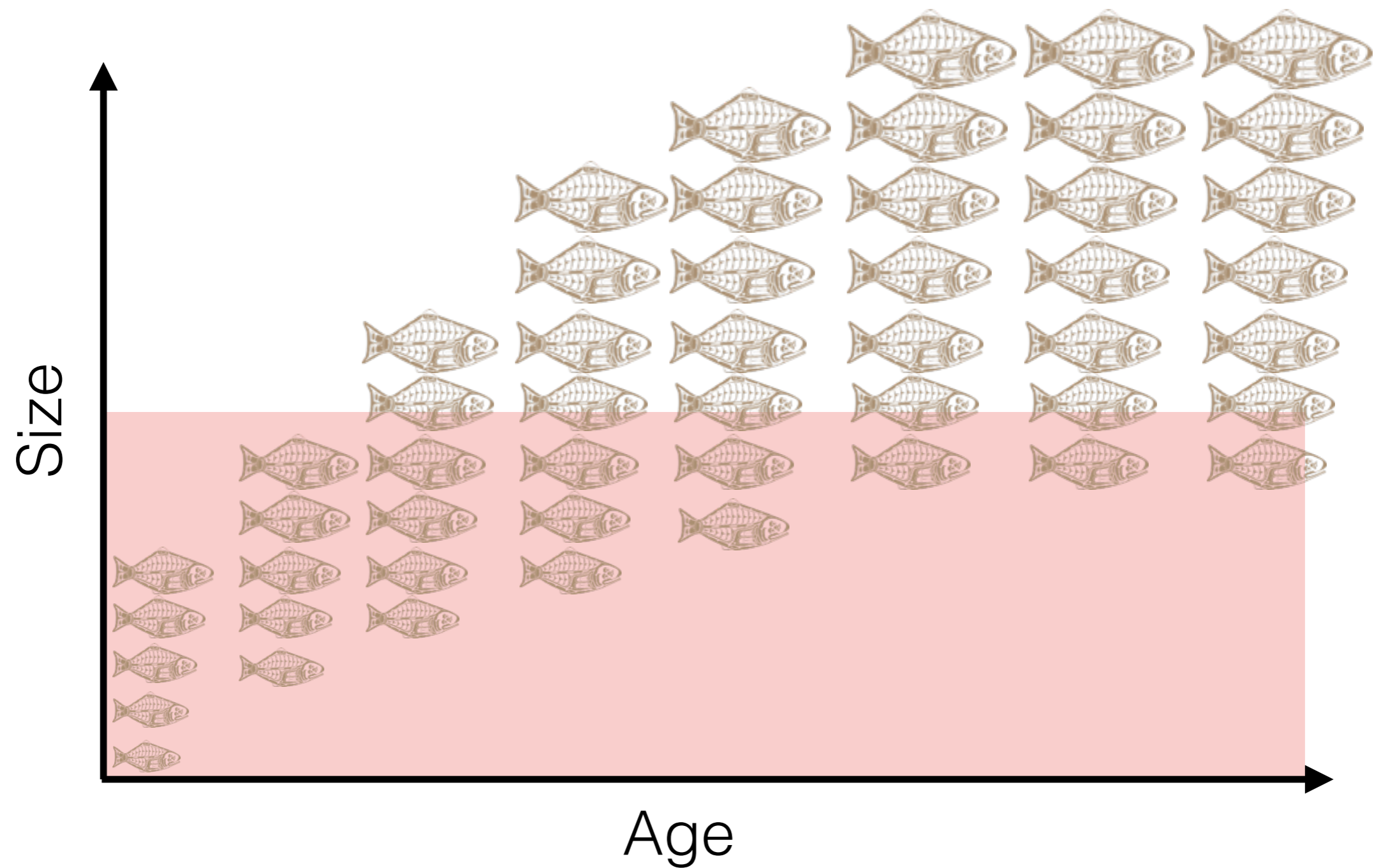
Equilibrium model

- To address these objectives we use an age-structured equilibrium model to examine the relationship between F and:
 - Yield, Discards, Wastage, Efficiency,
 - SPR, YPR, DPR, and average weight of the catch.
 - Landed value and value of waste and bycatch.

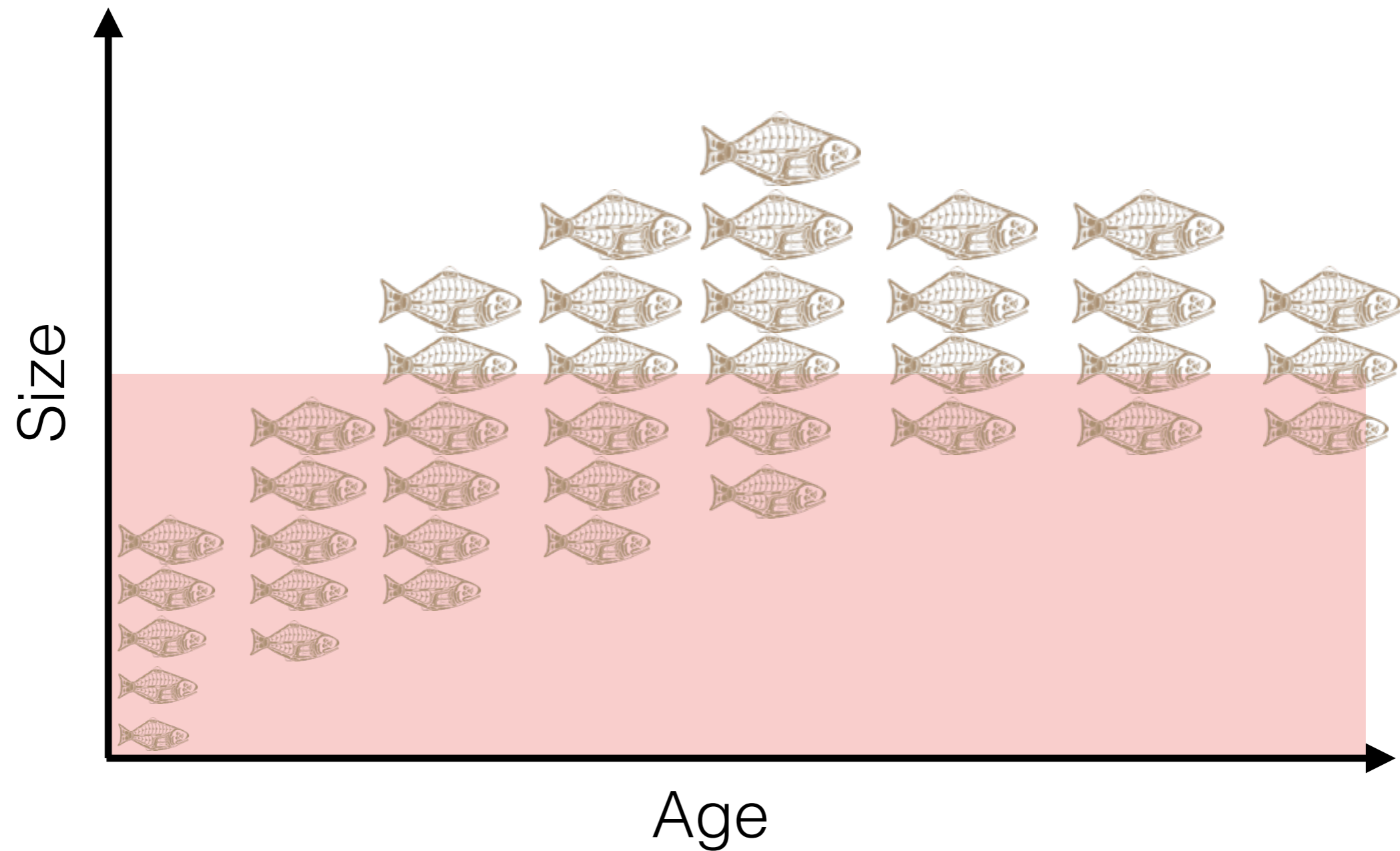
Two key model features

- Joint probability of dying do to minimum size-limit and discard mortality rate.
- Cumulative effects of size-selective fishing (fast growing fish have a higher total mortality).

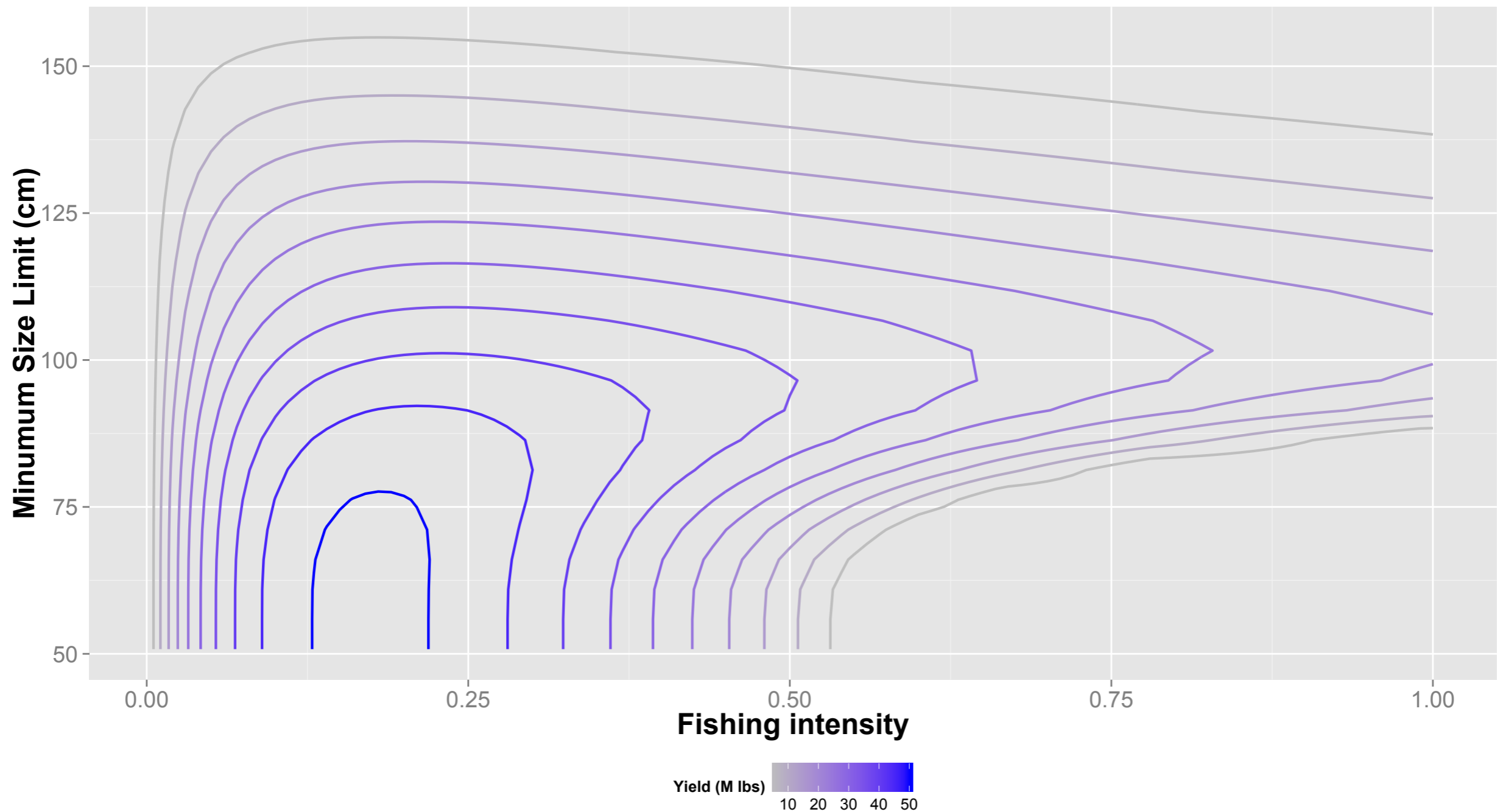
Unfished population



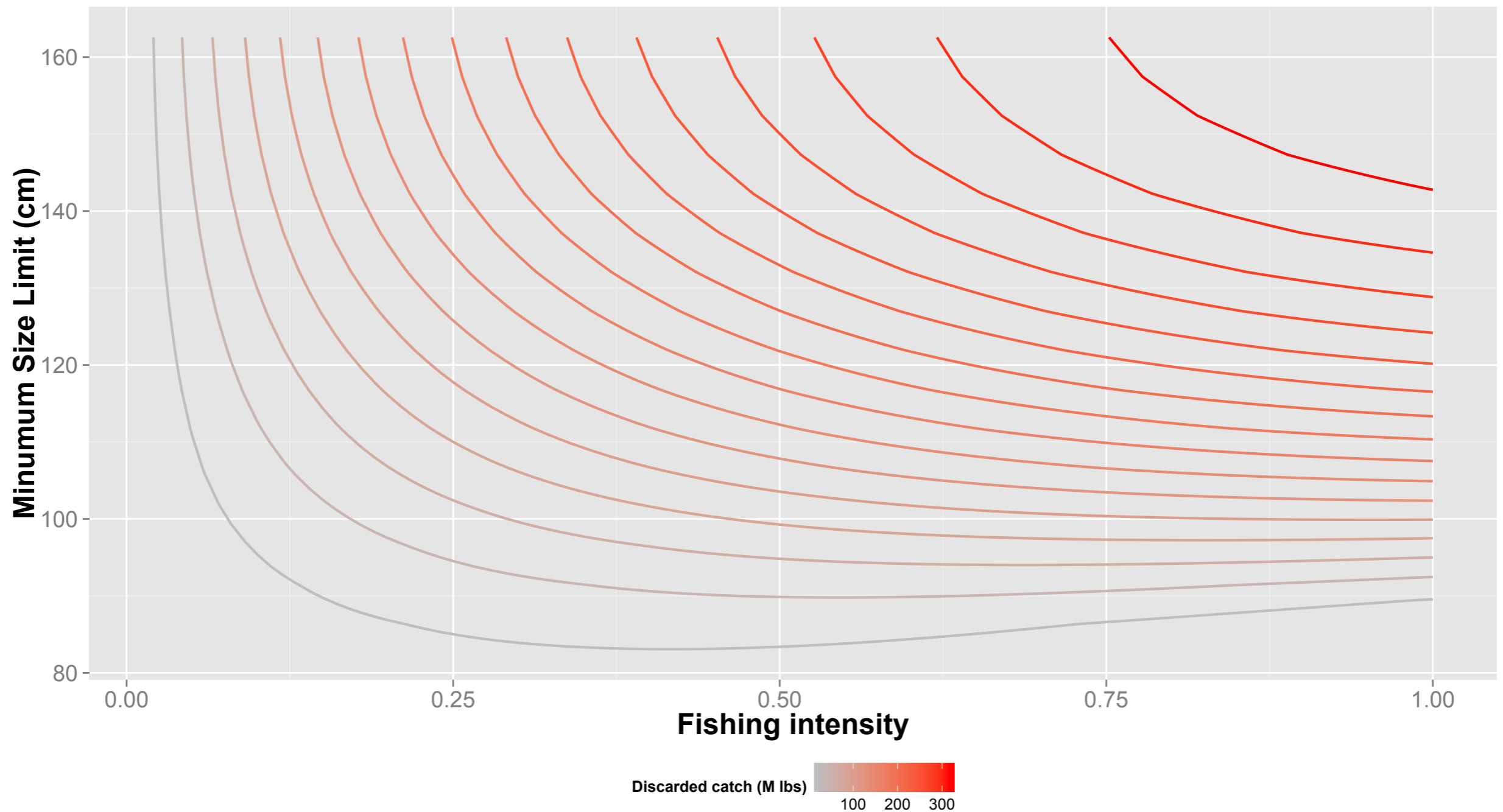
Fished population



Influence of size-limits & discard mortality rates on legal catch

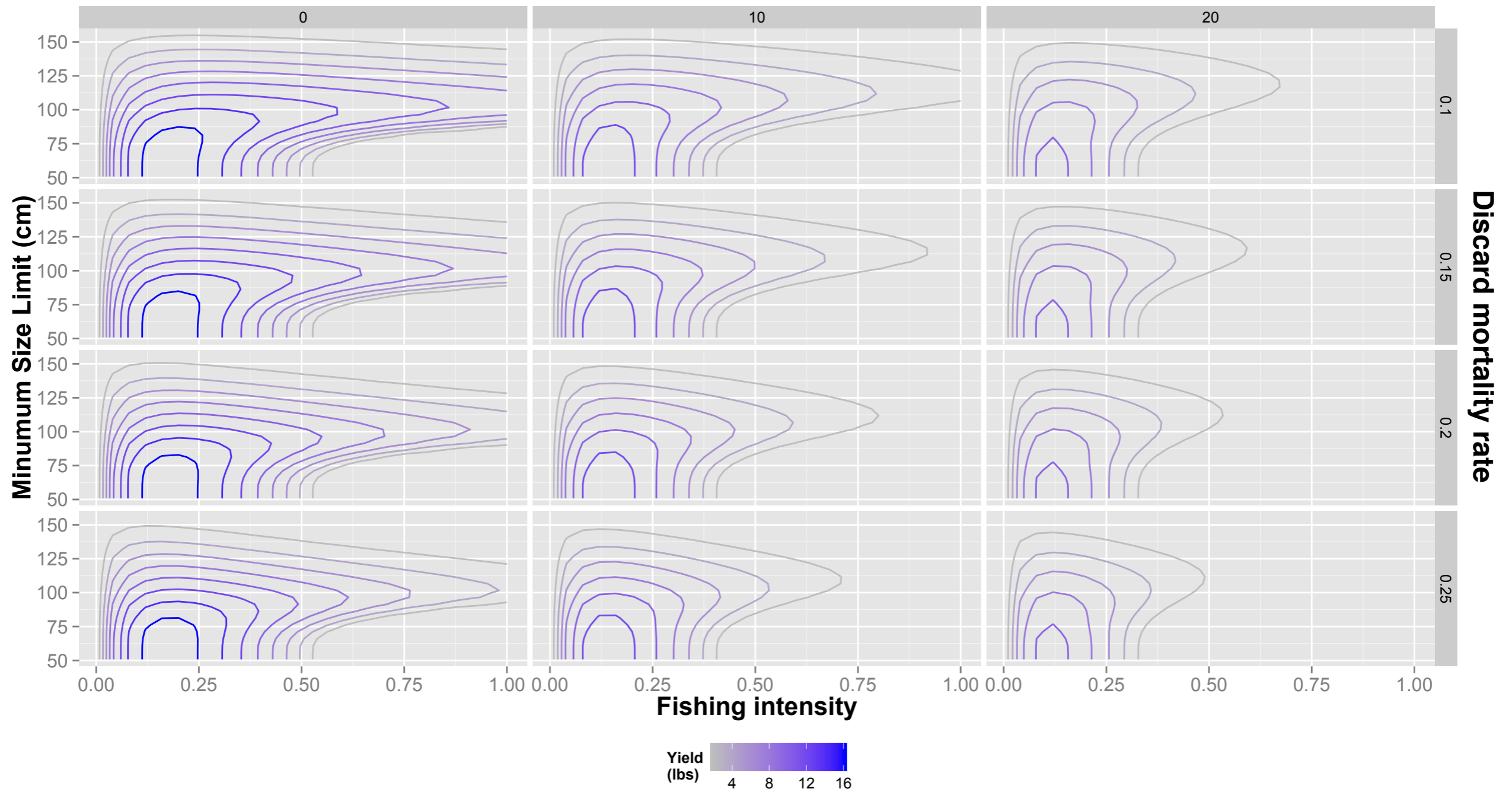


Influence of size-limits & discard mortality rates on discarded catch



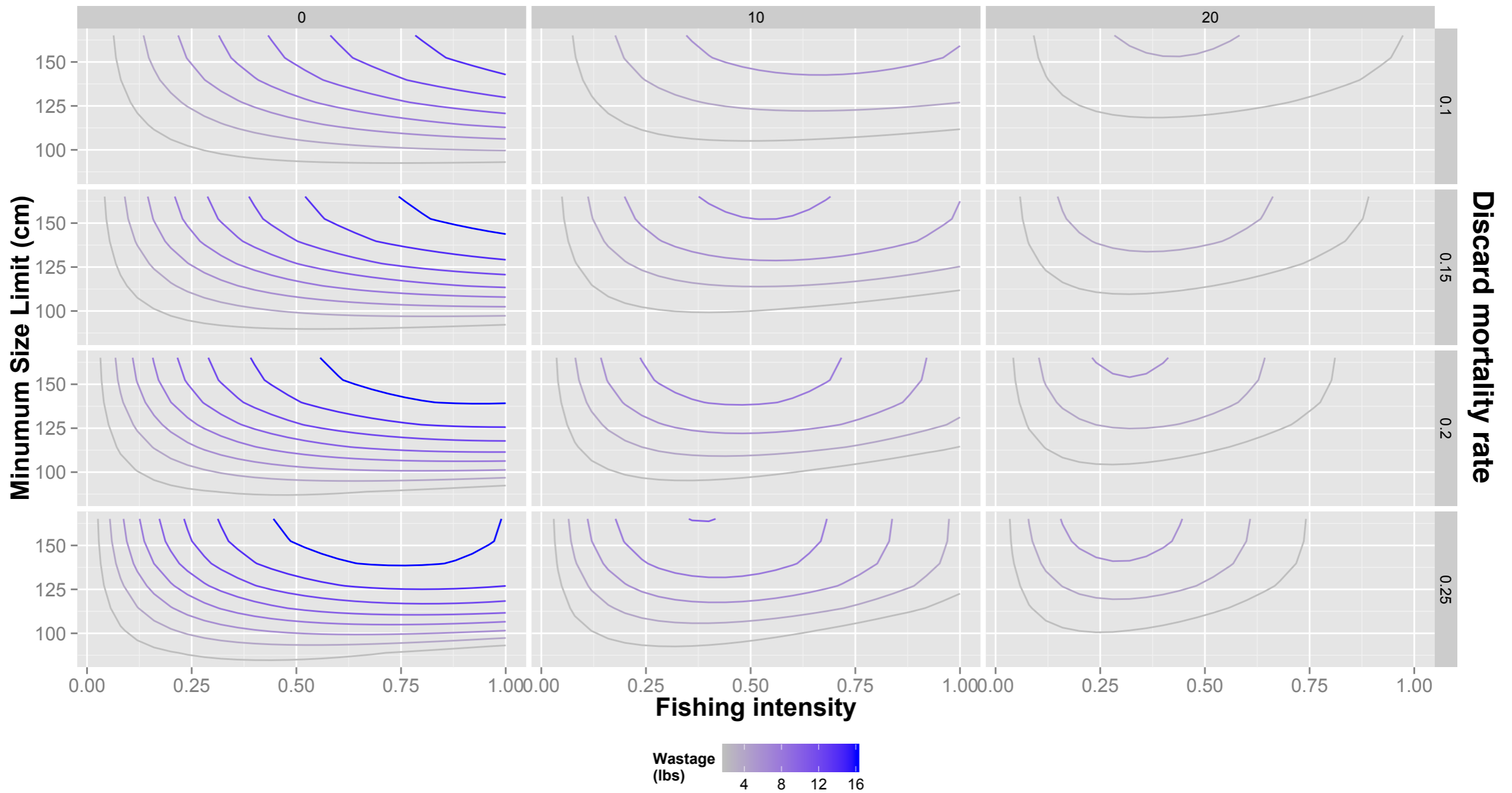
Yield vs Size limit vs Discard Mortality vs Bycatch

Bycatch (million lbs)



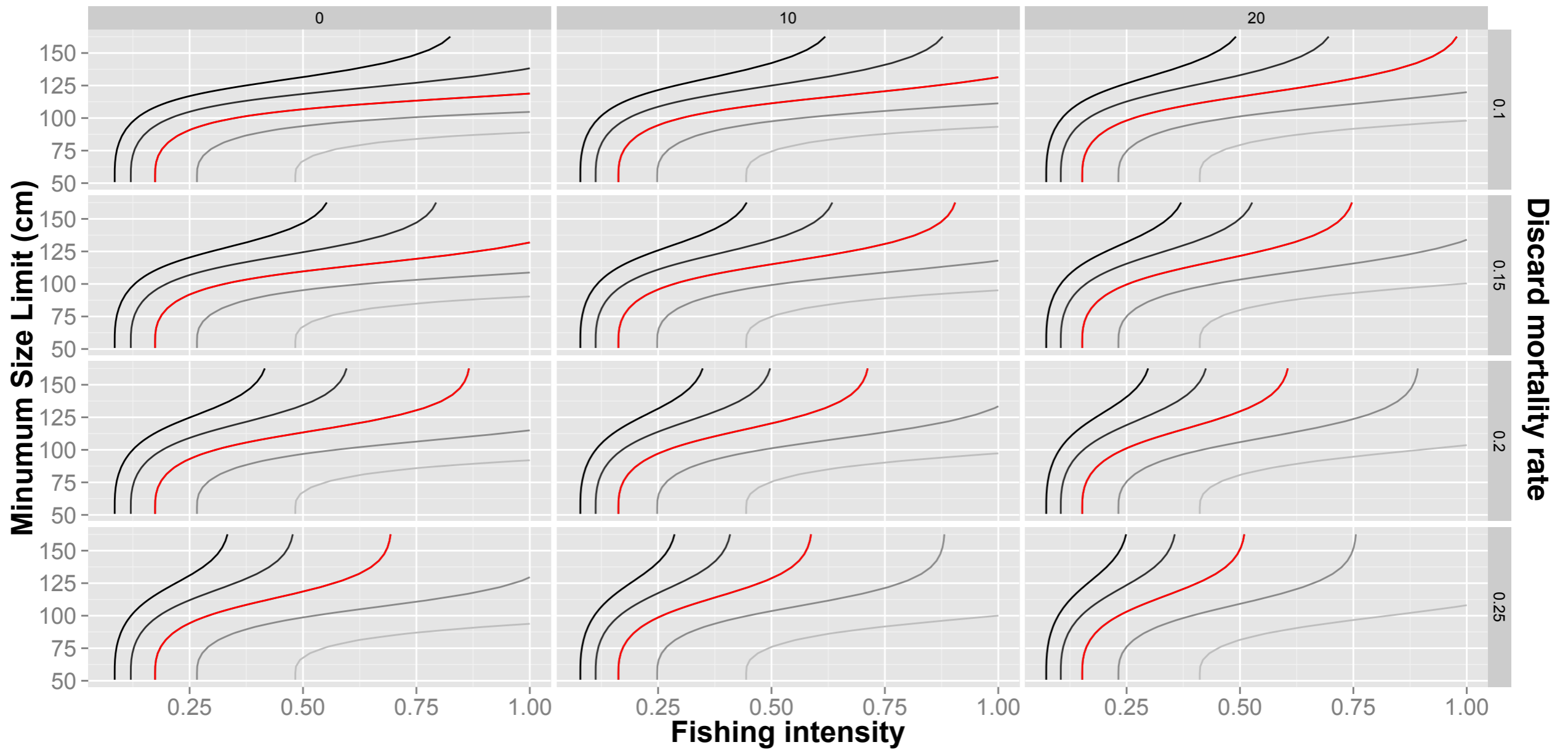
Wastage vs Size limit vs Discard Mortality vs Bycatch

Bycatch (million lbs)



Influence of bycatch and wastage on SPR

Bycatch (million lbs)

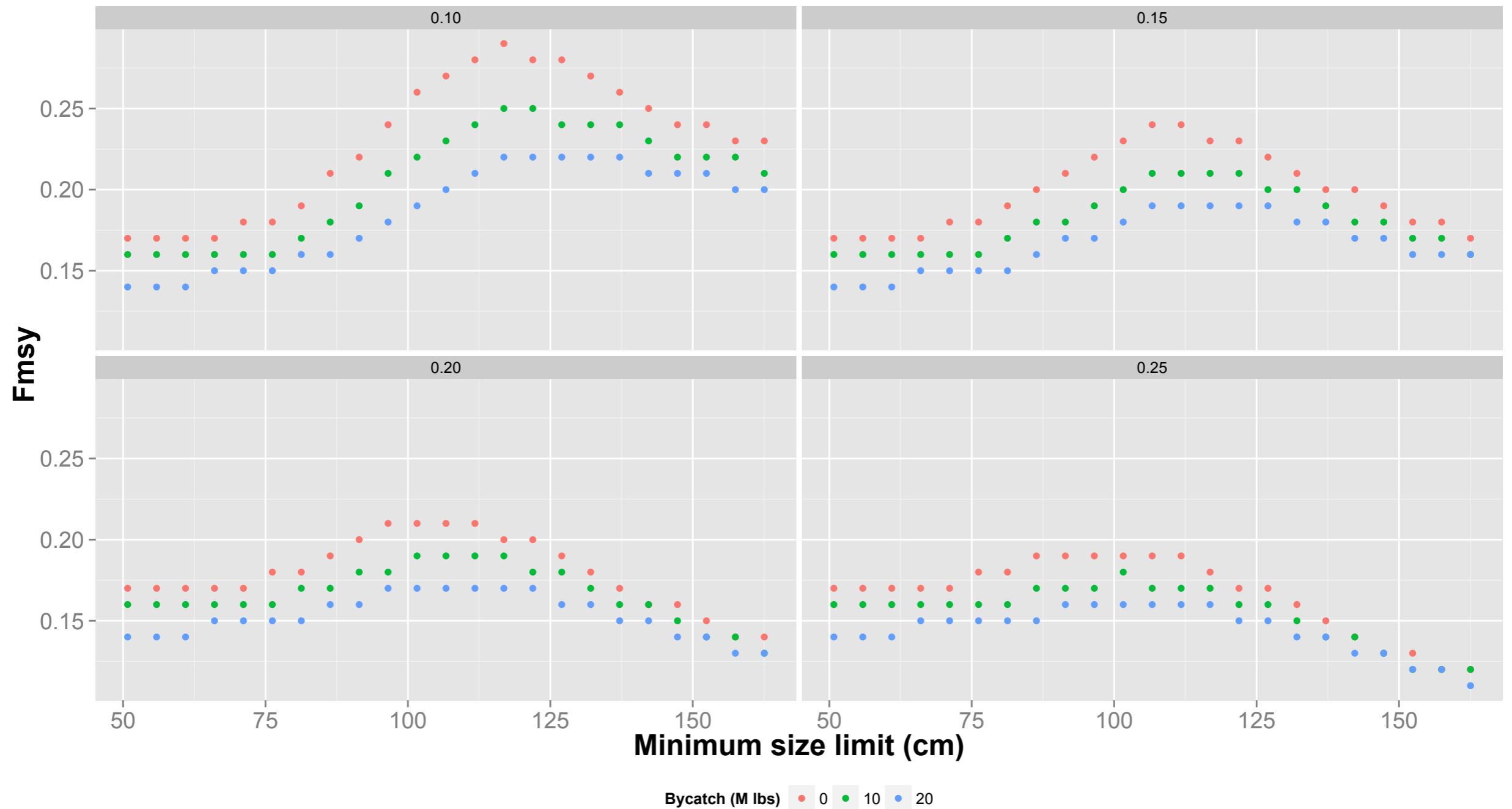


Discard mortality rate

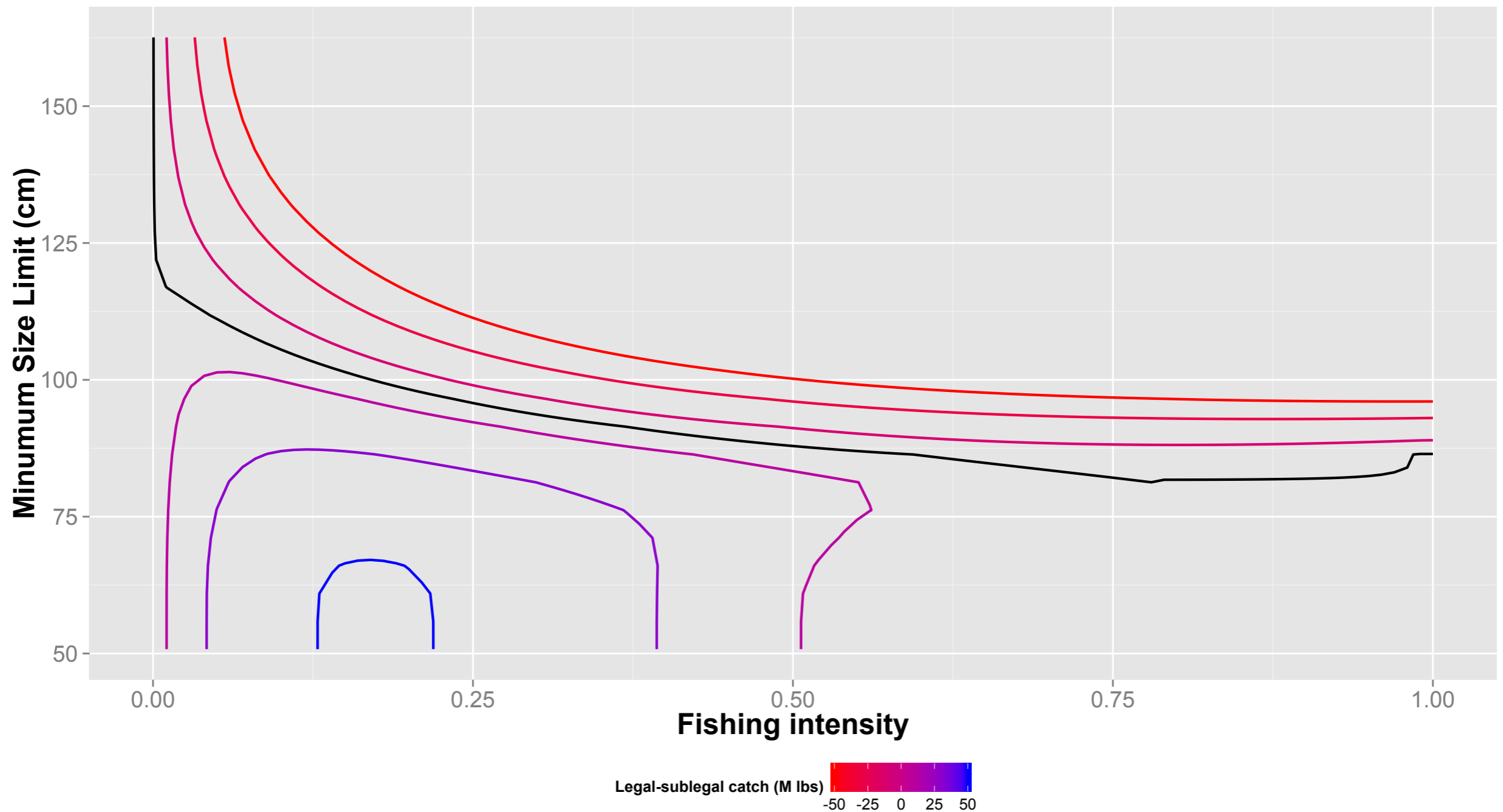
Spawning Potential Ratio

0.1 0.2 0.3 0.4 0.5

1. How do size-limits and discard mortality rates influence reference point calculations in the directed fisheries?



Legal catch - discarded catch



Effects of bycatch on estimated reference points (32" MSL).

Variable	No bycatch	10 million lbs	20 million lbs
Fmsy	0.19	0.17	0.15
MSY	49.19	44.60	40.72
SPR	0.31	0.32	0.33
YPR	3.86	3.46	3.12
DPR	0.91	0.77	0.65
Efficiency catch/(catch + discards)	81%	82%	83%
Average Wt. (lbs)	20.41	21.11	21.87

In the presence of bycatch, minimize Z to maximize YPR and average weight, and decrease DPR

Ecological Economics

Variable	No bycatch	10 million lbs	20 million lbs
Total catch	60.85	54.55	49.20
Landed catch	49.19	44.60	40.72
Landed value (millions)	\$345	\$314	\$288
Value of discards (millions)	\$14	\$11	\$9
Value of bycatch (millions)	0	\$4.8	\$8.3
Lost revenue due to wastage	(\$40)	(\$9)	\$17
Lost revenue due to bycatch (millions)	0	(\$31)	(\$57)

Earn more revenue with 32" size limit

Summary

- Size-restrictions increase SPR, but at the cost of increased fishing effort and bycatch in the directed halibut fishery.
- Continued declines in size-at-age are exacerbated with increased discard mortality rates; smaller size-at-age results in a less efficient fishery.
- Composition of the bycatch & amount of bycatch influence MSY-based and SPR-based reference points.
- Bycatch fisheries decrease YPR in directed fisheries via increased mortality & selecting smaller fish.

Tradeoffs

- Restrictive size-limits are good for conservation in the directed fishery, but require increased fishing effort to obtain the same yield.
 - Increased bycatch in the halibut fishery.
 - Increased cost and reduced profits in the halibut fishery.
- Halibut bycatch is a necessary evil to operate other, more valuable, groundfish trawl fisheries.
 - Retention of halibut with individual bycatch quotas could dramatically change the incentive landscape.

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“Thought experiment”

1. If retention were permitted in trawl fisheries, would trawlers target halibut, or avoid halibut?
2. Are there advantages to retention with respect to:
 - individual accountability?
 - more comprehensive catch accounting of all halibut?
3. In non-retention fisheries, who bears the majority costs of a declining stock and decreased total coast-wide catch?

Acknowledgments

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