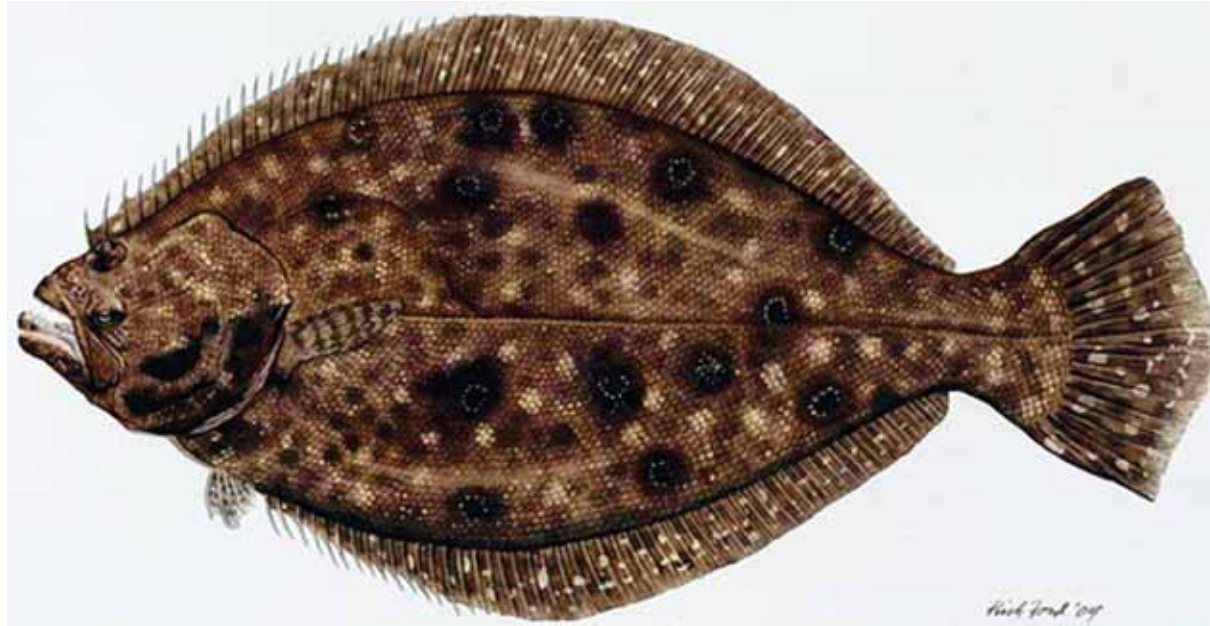


Optimization of Hook Size in the N.J. Summer Flounder, *Paralichthys dentatus*, hook and line fishery

James Salierno¹ & Carl Benson²

**¹Department of Biology and Allied Health Sciences
Fairleigh Dickinson University**

²New Jersey Resident Commercial Hook and Line Fishermen



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Background

- The recreational live discard rate in 2010 (94%) was the highest in the past 25 years. Recreational summer flounder discards have continued to increase since 2006.
- **There are no current actions to directly reduce the number of discards**
- 40% of the summer flounder TAL are assigned to the recreational sector, which are caught primarily by hook and line:
 - **One of the most common species caught and released in the Atlantic Coastal region, which results in discard mortality**
 - **Recreational fishers pay a 2,000,000 lb. reduction in landings for discarded summer flounder**
 - **One method to increase the survival of younger year classes is to reduce the live discard rates currently seen in the hook and line fishery.**



Background

- A 10% mean mortality rate has been estimated for summer flounder discards.
- It is believed that discard mortality estimates are low due to the exclusion of surface predation upon release.
- In response to discard mortality in the commercial sector, trawl gear was required to increase mesh size, which resulted in a significant reduction in discarded fish.

Regulations to decrease discard mortality in the recreational fishery have not been implemented.



NOAA
Bartholomew & Bohnsack (2005), Carmichael et al. (2008), Terceiro (2011)



www.messersmith.name

Gear size regulation for the summer flounder recreational fishery?

- **It has been demonstrated in several species that increased hook size lands larger fish while reducing the number of smaller fish caught.**
- **As a result, this increased size selection will increase the catch per unit effort (CPUE).**
- **One method to reduce discards, and potential mortality, is to ID hook sizes selective for legal sized fish, reducing the chance of potential discards ever reaching the boat.**
- **The current challenge is to determine appropriate hook size(s) for minimizing live discards, injury, and mortality of flounder while maximizing the capture efficiency.**

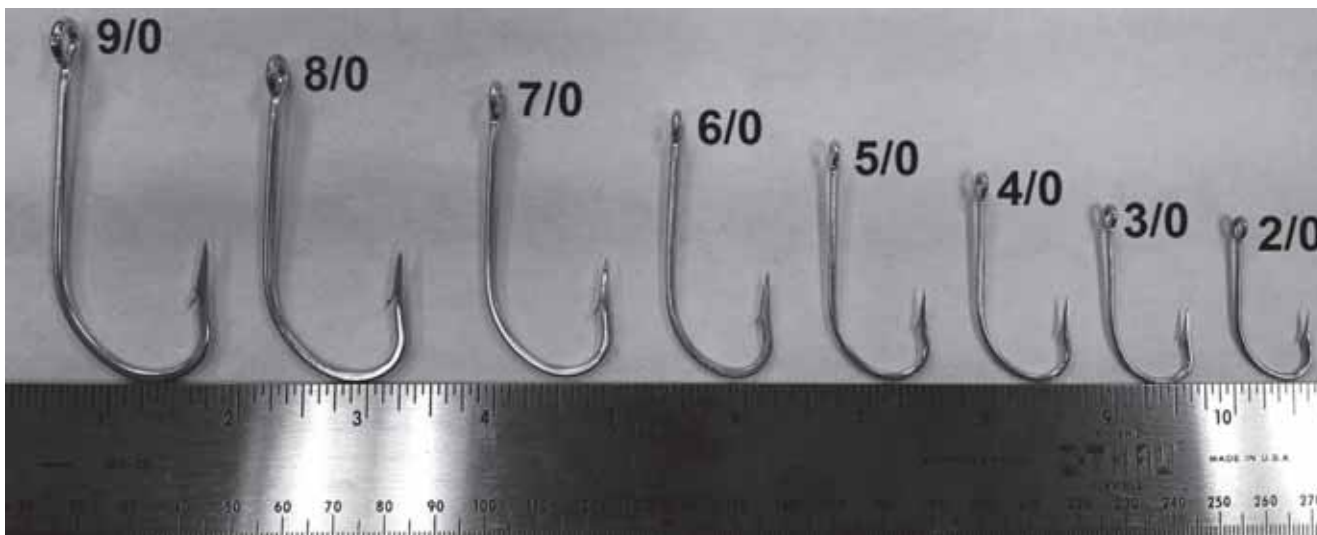
Project Objectives & Goals

- To quantitatively determine the optimal hook size(s) to land legal summer flounder while reducing the number of live discards;
- To reduce the incidence of deep hooking associated with catch and release;
- To reduce post-release mortality in recreational and commercial fisheries; and
- To facilitate development and implementation of innovative gear practices to agency managers
- Collaboration between FDU and the New Jersey commercial hook and line fisherman.



Methods

- Sampling trips conducted from May through September 2014.
- All fishing lines were outfitted with identical J-hooks (Eagle Claw), size classes 2/0-9/0.
- Hooks were paired for each trip as follows: 2/0-6/0; 3/0-7/0; 4/0-8/0; and 5/0-9/0.
- Vessels fished 1 of the 4 pairs of hooks on a given trip.
- Lines were randomly assigned to locations within the boat and fished side by side.



Methods

- Measured (TL) of all fish caught
- Hook set location: Lip, Mouth, Eye, Gill, Gut, Foul Vital, & Foul Other
- Non-fluke species recorded: Non-Target bycatch

Analyzed the following as a function of hook size:

Total length

Number of NJ legal fish (≥ 18 in.)

Number of NJ discards (< 18 in.)

NJ Legal: Discard ratio

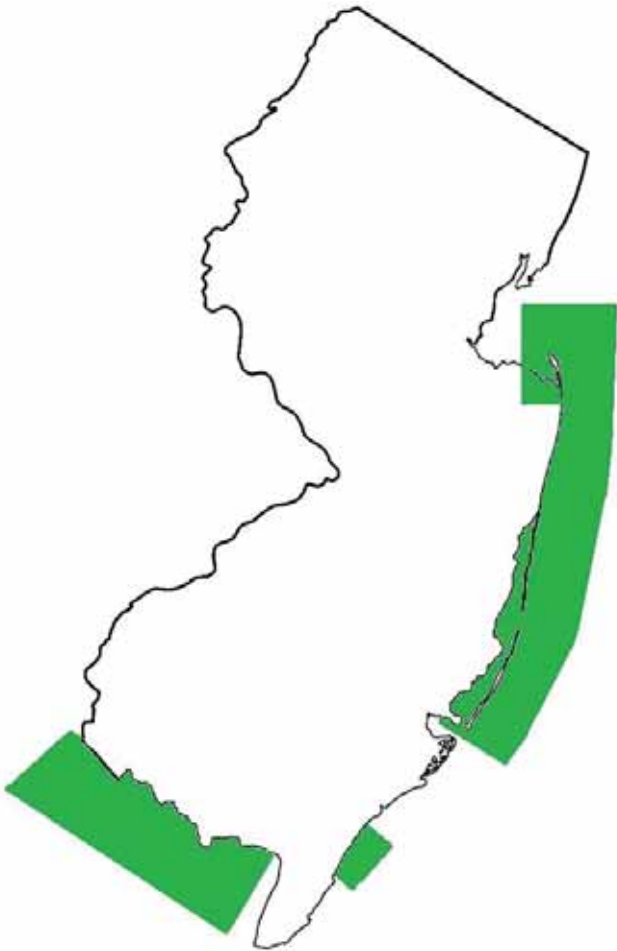
Mortality estimate

Hook set location



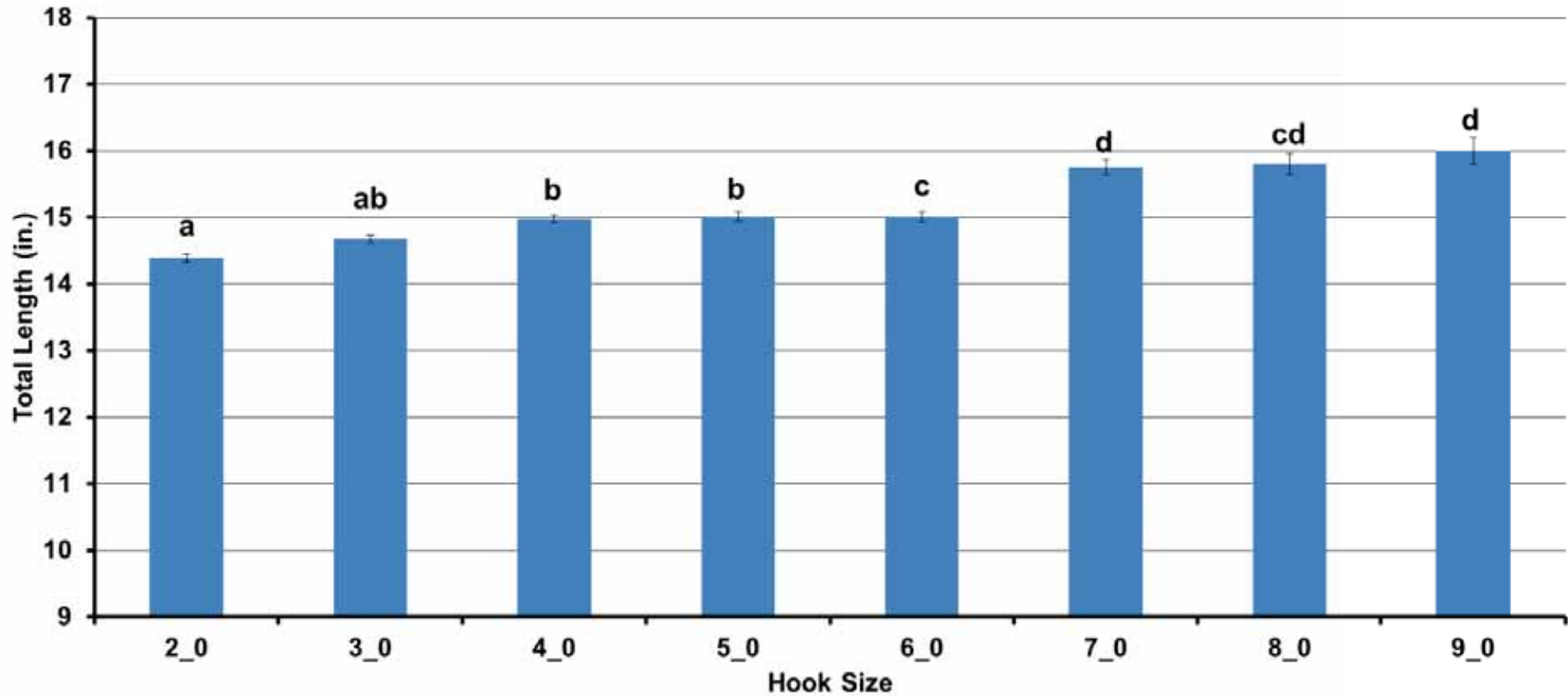
Results

- Commercial hook and line fisherman completed 160 collection trips from May through September
- 7764 summer flounder and 280 non target species caught



Results

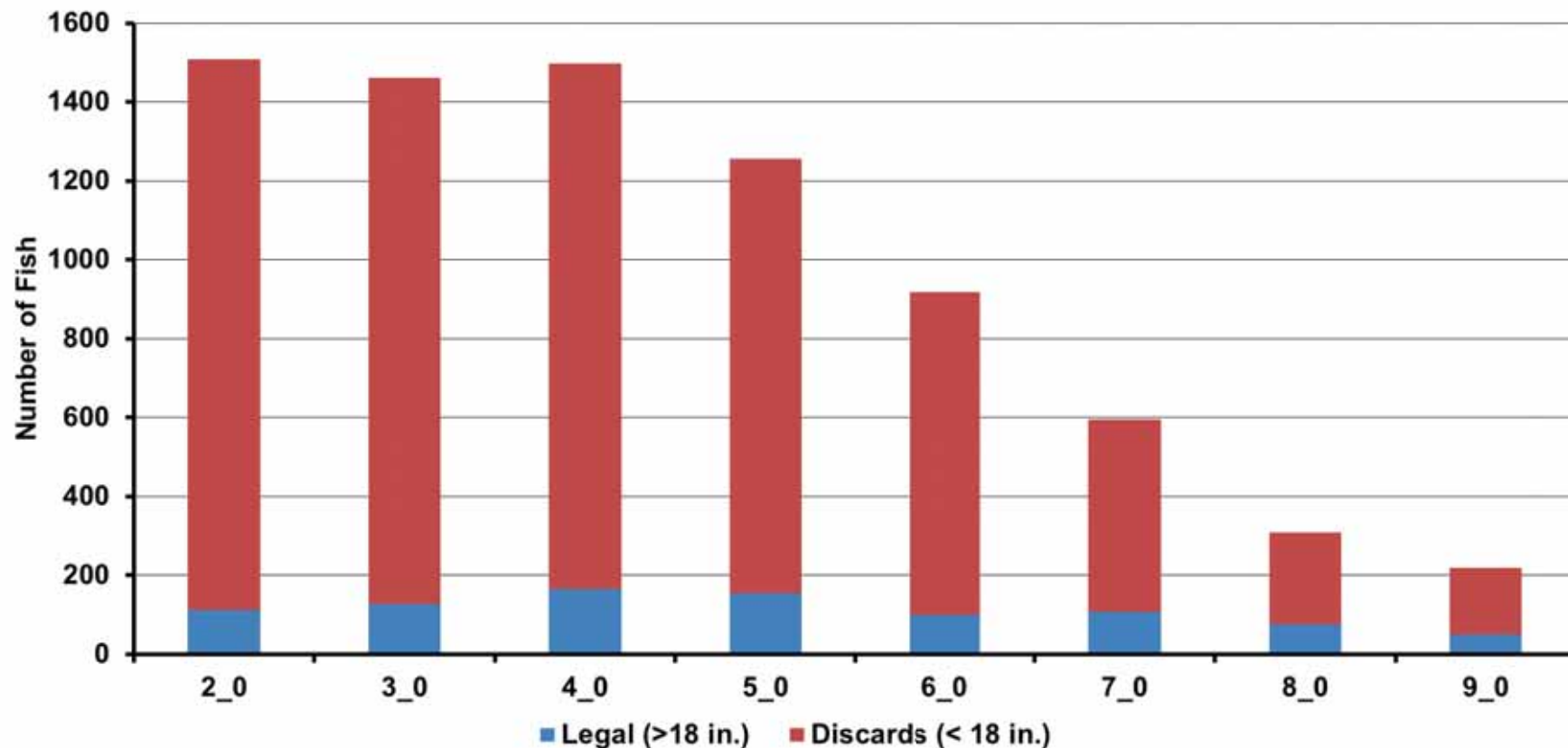
As hook size increases, mean length of flounder landed increases



Mean total flounder length (TL, inches) caught by hook size. Error bars represent standard error of the mean (\pm S.E.). Means with different letters are significantly different (ANOVA, $p < 0.05$)

Results, New Jersey

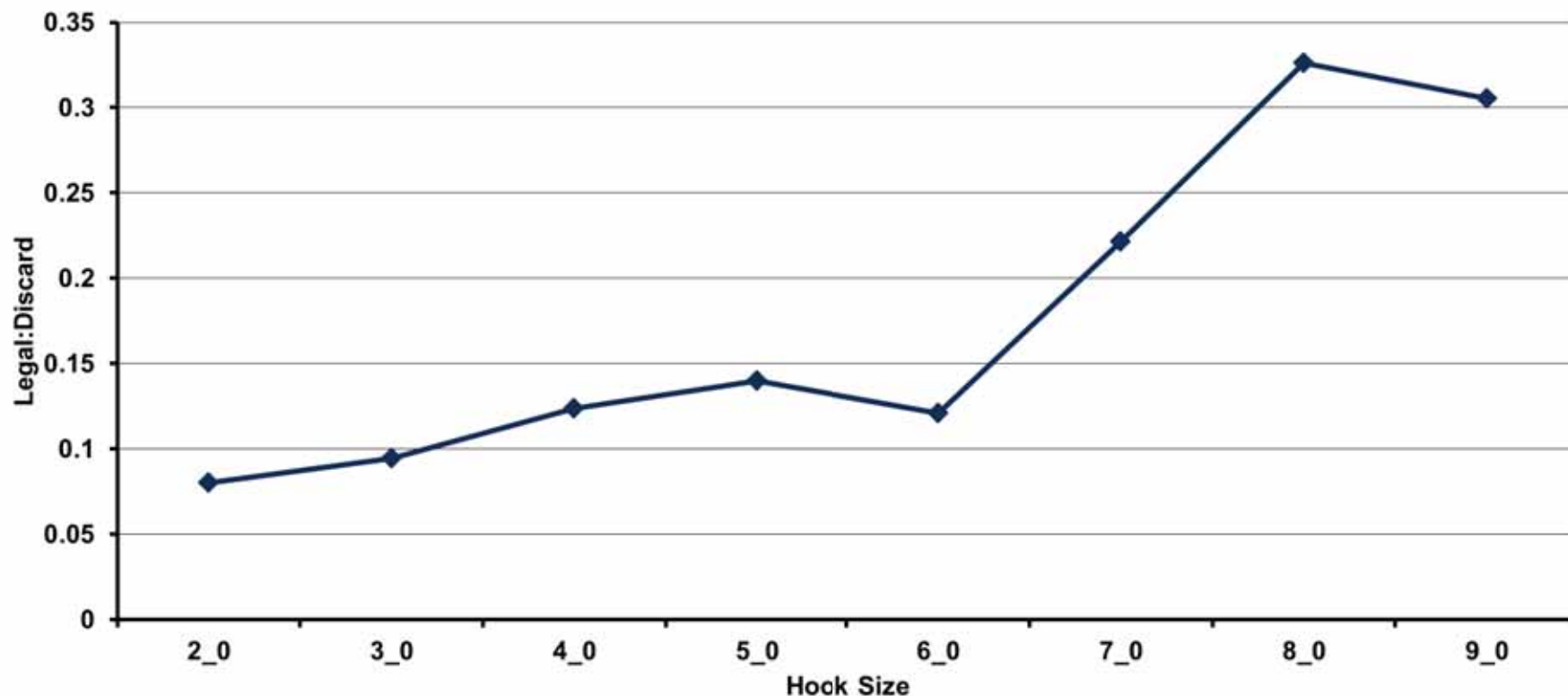
As hook size increases, number of total flounder caught decreases



The total number of NJ recreational legal flounder (blue, ≥ 18 in) and discards (red, < 18 in) as a function of hook size. $X^2 > 90$, $p < 0.005$

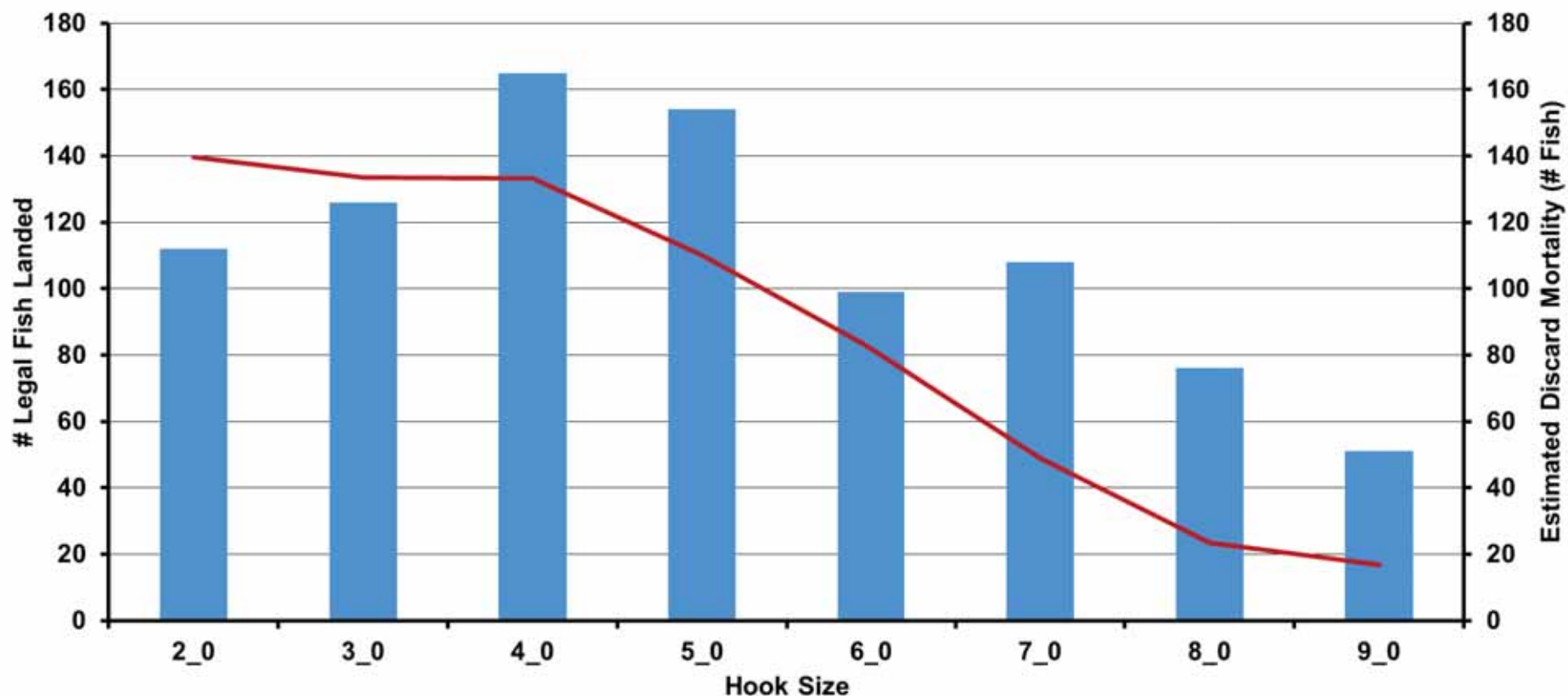
Results, New Jersey

As hook size increases, ratio of legally landed fish increases



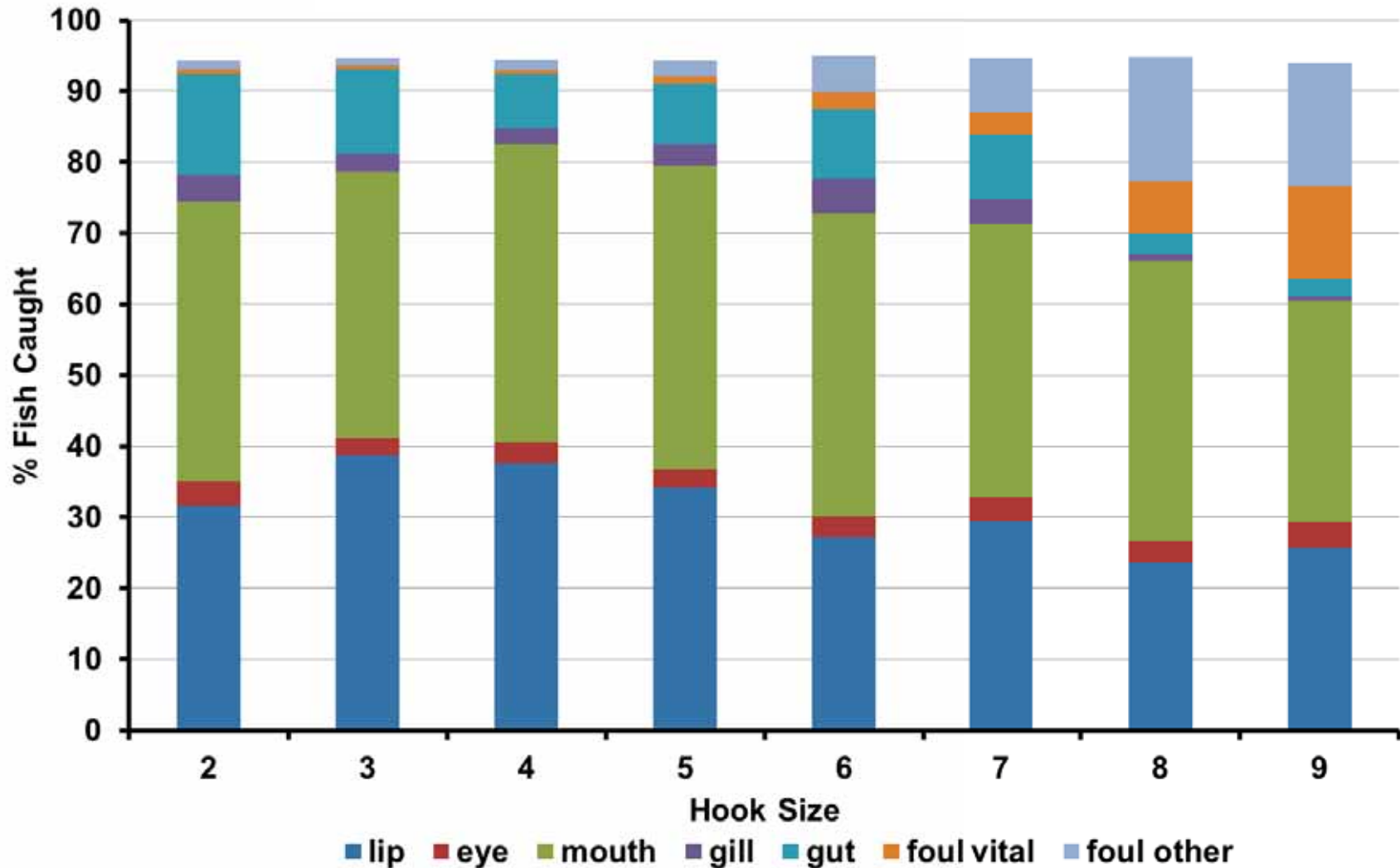
The ratio of recreational landed (≥ 18 in) to discarded flounder (< 18 in) by each hook size, $X^2 = 36$, $p < 0.005$

Results, New Jersey



The total number of recreationally legal harvested fish compared (blue bars) with the estimated discard mortality (red line # of fish) by hook size. Estimated discard mortality is calculated as 10% mortality rate of discarded fish (Terceiro, 2011).

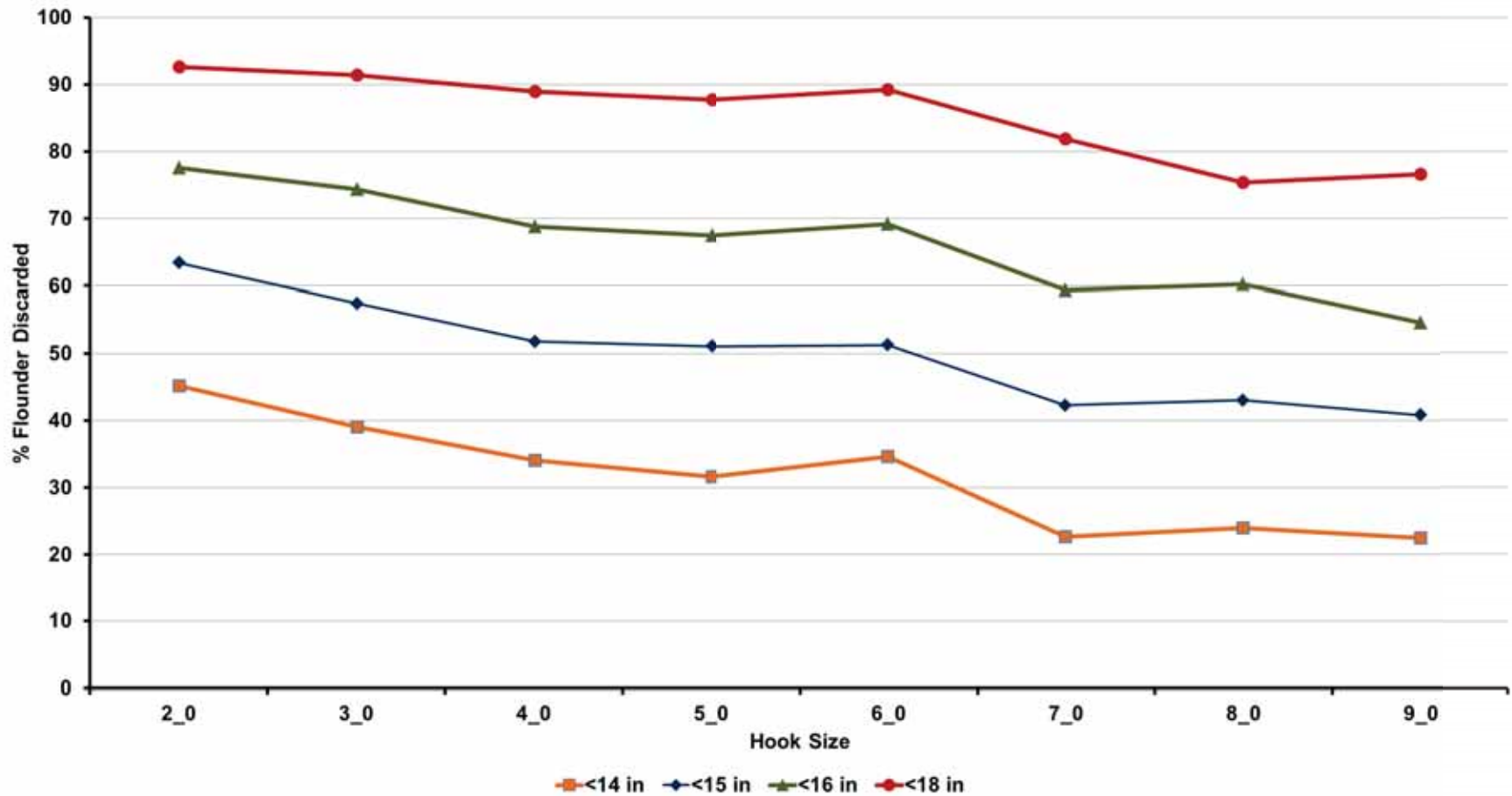
Results, New Jersey



Proportion of discarded flounder hooked at certain body locations by each hook size. Larger hooks significantly increased foul hooking ($X^2 > 30$, $p < 0.005$) and small hooks marginally increased gut hooking ($X^2 = 13.8$, $p < 0.1$), but had no effect on other locations ($X^2 < 6.8$, $p > 0.05$).

Results

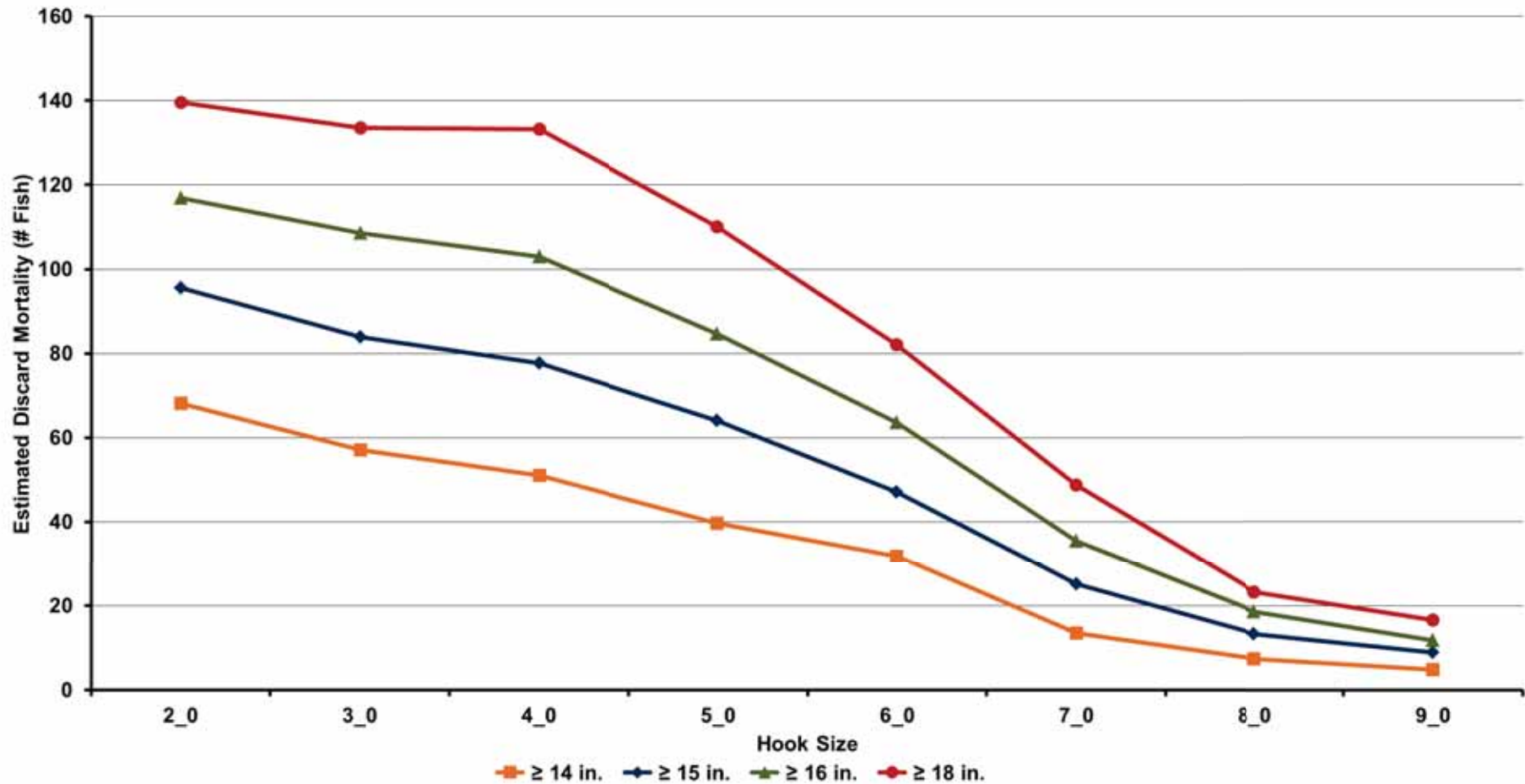
As hook size increases, % discard decreases



Percent discarded flounder (≥ 14 in., orange, ≥ 15 in., blue, ≥ 16 in., green, ≥ 18 in., red) by each hook size.

Results

As hook size increases, estimated discard mortality decreases



Estimated discard mortality (≥14 in., orange, ≥15 in., blue, ≥16 in., green & ≥ 18 in., red) by each hook size. Estimated discard mortality is calculated as 10% mortality rate of discarded fish (Terceiro, 2011).

Conclusions

- **Data concludes that 7/0 – 9/0 size hooks significantly outperform smaller gauges:**
 - **Catch significantly larger fish**
 - **Increases the ratio of legal fish landed to live discards**
 - **Significantly reduces estimated discard mortality**

Example of hook size impact on summer flounder catch

Switch hook from:	# of Discard fish	Legal:Discard	Est. Mortality
2/0-5/0	21% Reduction	74% Increase	21% Reduction
2/0-7/0	65% Reduction	175% Increase	65% Reduction

Conclusions & Recommendations

- Increased hook sizes lands larger fish while reducing overall discards and decreasing potential discard mortality.
- NJ recreational fishery; Recommend 7/0 hook with a 5/0 minimum.
- Great potential exists to increase recruitment and spawning stock biomass (SSB) simply through hook size guidelines.
- Future work to include Kahle (wide gap) hooks.
- With hook regulations in place:
 - Lower the NJ state minimum size while maintaining the same length of season and creel limit.
 - Discards become keepers, less discards, less discard mortality.



Acknowledgements

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- **FDU; Becton College, Grants and Sponsored Projects, Biology and Allied Health Department**



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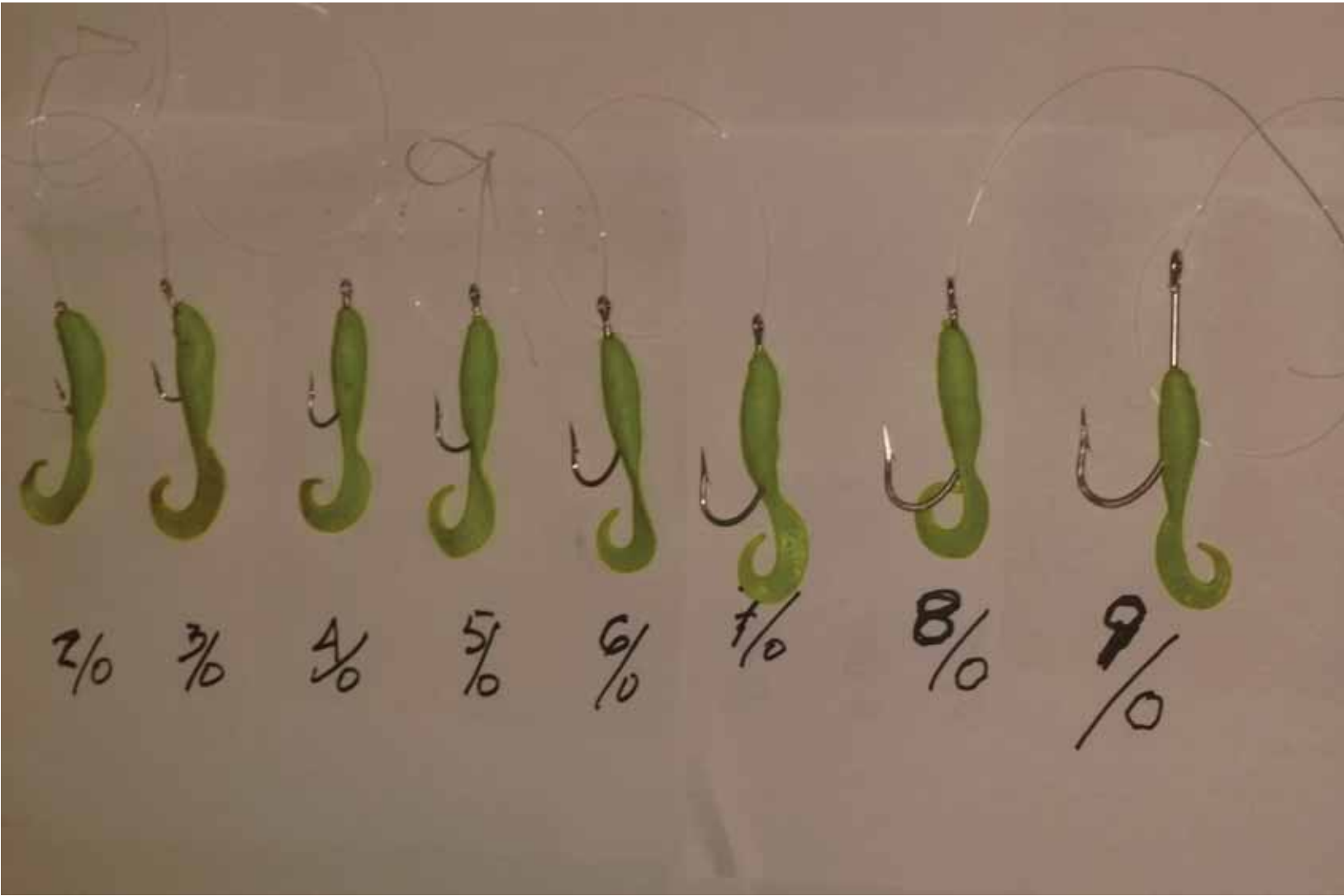


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2/0

3/0

4/0

5/0

6/0

7/0

8/0

9/0



2/0

3/0

4/0

5/0

6/0

7/0

8/0

1/0

Greater Atlantic Region Bulletin

Updated 2014 summer flounder quotas

- Recreational Catch Limit * 9.07
- Recreational Harvest Limit * 7.01

2015 Specifications

- Recreational Catch Limit * 9.44
- Recreational Harvest Limit * ^ 7.16

*=Million LBS ^= Less RSA GAR Bulletin 5/22/14

Fisher's Knowledge With Respect To Hook Size

- History: Family, friends and experience, ancient history; No minimum size, 13" Min., 14" Min., 15"...18" Min.
- Literature: Fishing magazine and newspapers fishing columnists
- Agency Research: RSA and BREP Reports
- Internet Sales: Manufacturers and Sellers

Number of Products Labeled as Fluke or Fluke/Flounder

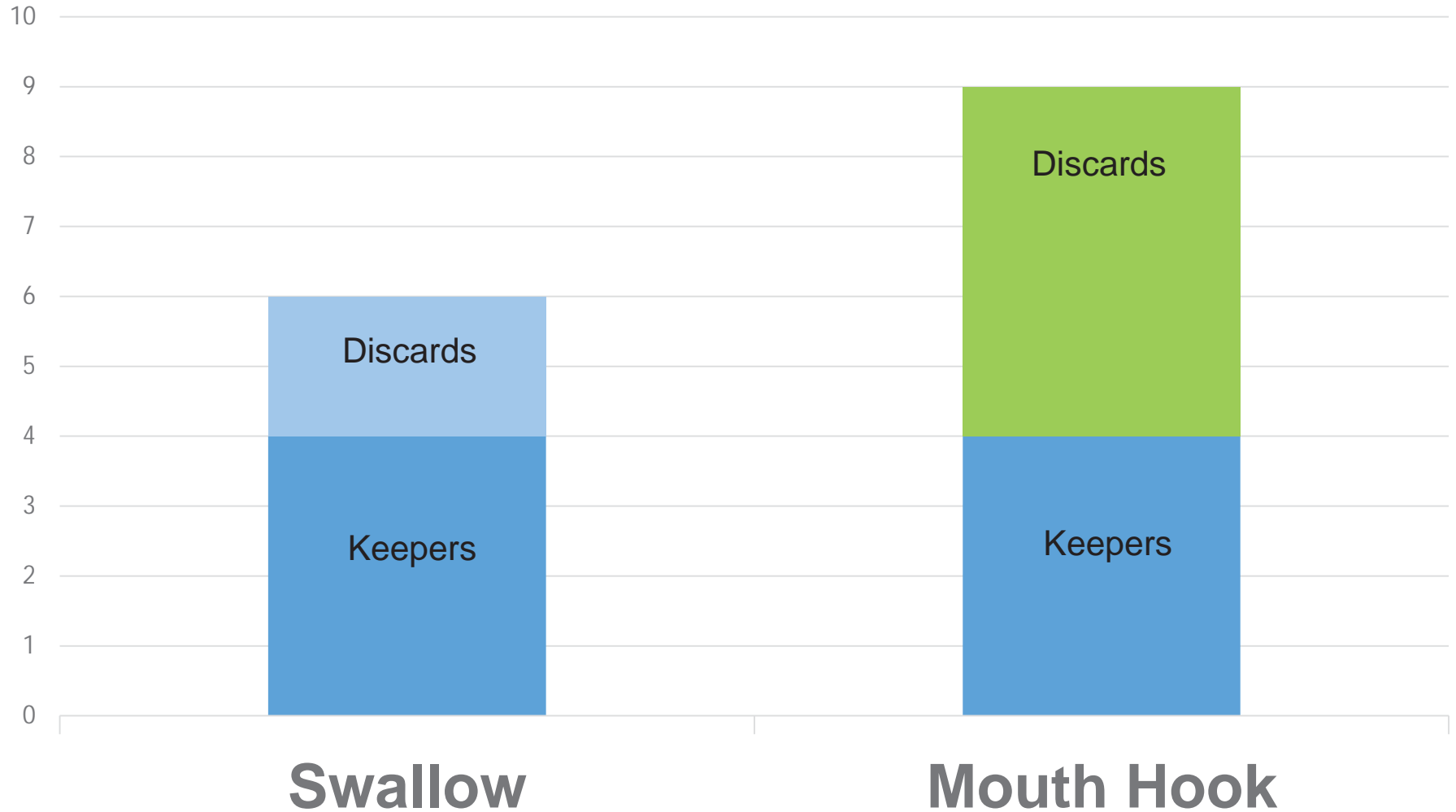
Hook Size	8	5	4	2	1	1/0	2/0	3/0	4/0
"J"	1	1	1	1	1	3	4	1	2
Wide gap			1	1	3	11	18	5	2
Circle								1	

- Manufacturers: Basstar, Betts, Boone, Creme, Eagle Claw, Fin Strike, Gamakatsu, Hurricane, Jeros, Marathon, Matsou, Mustad, Owner, Partridge of Redditch, Sea Striker, Shakespeare, South Bend, Rapala / VMC, Sohumi, Spro Jigs, Tide Rite, Tiemco / TMC and Tyrant.
- Sellers: Dicks, Wal-Mart, Sports Authority, Bass Pro, Cabela's, K-Mart, Ebay, Amazon, Gander Mountain and Folsom Corp.

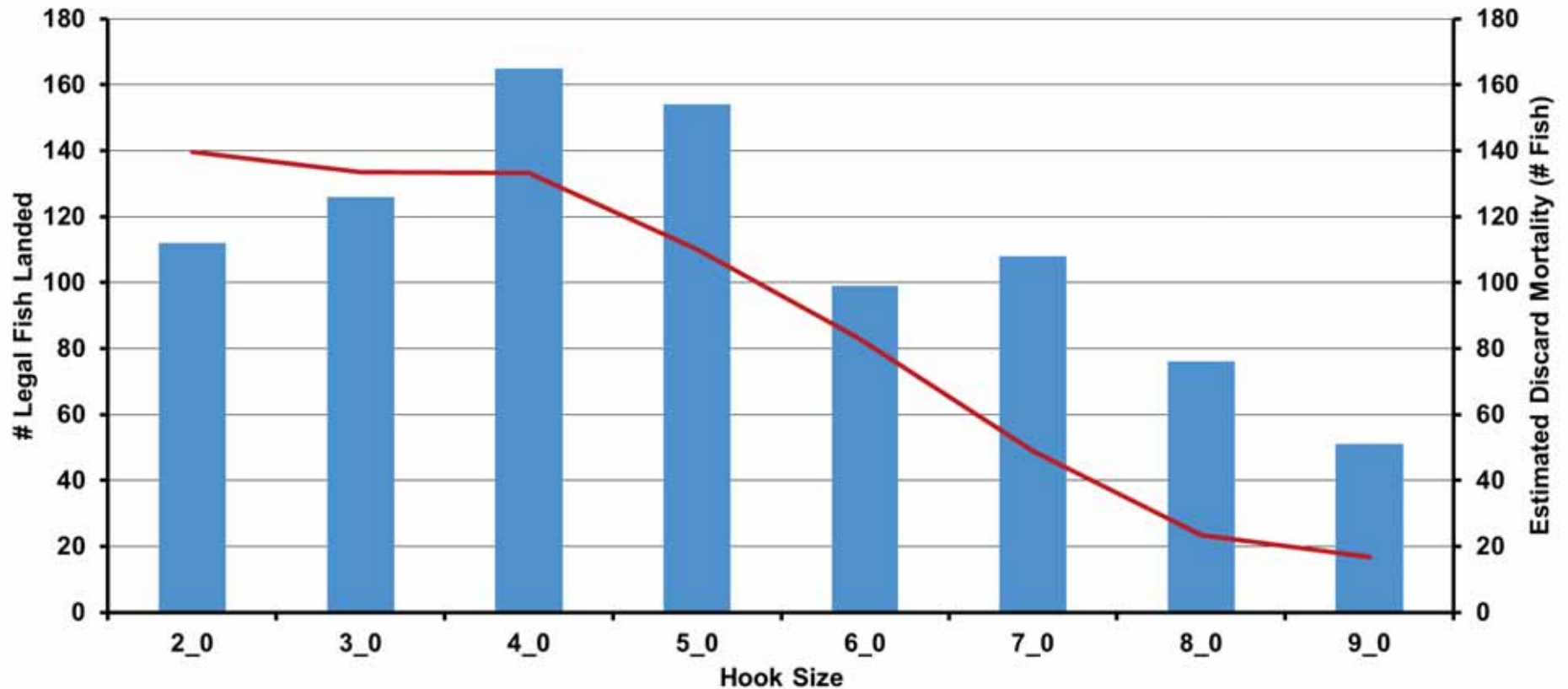
Questions

- What hook sizes do Fisher's currently use?
- What is the value of each component of discard mortality (stress, handling, wounding)?

Swallow Hook vs. Mouth Hook



Results, New Jersey



The total number of recreationally legal harvested fish compared (blue bars) with the estimated discard mortality (red line # of fish) by hook size. Estimated discard mortality is calculated as 10% mortality rate of discarded fish (Terceiro, 2011).

Ratio of Discards to Keepers

18"	12.5	10.6	8.1	7.2	8.3	4.5	3.1	3.3
17"	6.3	5.4	4.4	3.5	4.3	2.5	2.2	1.9
16"	3.5	2.9	2.2	2.1	2.3	1.5	1.5	1.2
15"	1.7	1.4	1.1	1.0	1.1	0.7	0.8	0.7
14"	0.8	0.6	0.5	0.5	0.5	0.3	0.3	0.3
Hook Size	2/0	3/0	4/0	5/0	6/0	7/0	8/0	9/0

Keeper's by Length and Hook Size

18"	112	126	165	154	99	108	76	51
17"	206	228	278	279	173	170	97	75
16"	339	375	468	408	283	242	123	99
15"	552	622	722	614	448	344	176	129
14"	827	890	988	858	601	461	235	169
Hook Size	2/0	3/0	4/0	5/0	6/0	7/0	8/0	9/0

RECOMMENDATIONS

Have MAFMC advisors propose changes to the process in order to lower discard mortality.

Improve discard mortality from estimates to hard numbers. Pareto principles can then be applied.

Indicate approval of Kahle wide gap study to compliment "J" hook study