***Atlantic States Marine Fisheries Commission***
1444 Eye Street, N.W., Sixth Floor
Washington, D.C.   20005
(202) 289-6400 phone
(202) 289-6051 fax
www.asmfc.org

**MEMORANDUM**

April 17, 2009

To:      Summer Flounder, Scup, and Black Sea Bass Management Board
From:   Summer Flounder, Scup, and Black Sea Bass Technical Committee
RE:      Slot Limit management for recreational summer flounder fishery

**Background**
In 2008, the Technical Committee began examining the effects of slot limits on recreational harvest of summer flounder.  From that first analysis, it was clear that harvest would be greatly increased under slot limits (*viz.* 16-18") due to the immense availability of fish caught at sub-legal sizes.  Slot limits would also greatly increase coastwide recreational quotas (in numbers of fish) with the shift in harvest towards smaller fish.  The age distribution of the suddenly inflated harvest would be shifted toward younger fish.  Modeling showed little benefit to spawning stock biomass due to the partial (40%) influence of the recreational fishery relative to the total (commercial and recreational) fishery harvest.

The current study analyzes the effects of slot *and bag* limits on recreational harvest of summer flounder.  Its purpose is to illustrate how 2008 harvest would have been affected by various slot limit implementations.  The data used in this analysis contain both spatial and temporal limitations.   Special care should be taken to avoid over-interpreting the results of this study.

**Data**
Size and frequency of all summer flounder caught (harvested or released) in fishing trips are required information for this analysis.  Therefore, the analysis was limited to only one type of fishing (for-hire fishing) occurring in the most-recent year (2008).  Specifically, the data consisted of for-hire (party boat) mode, 2008 waves 1-4 MRFSS intercept samples[1].  Data were limited to for-hire mode samples because MRFSS does not record size information of discarded catch in other modes.

**Method**
A size and possession limit analysis was conducted on the MRFSS data[2].  For each sampled trip, harvest was calculated by tallying all summer flounder within specified lower and upper size bins.  The trip harvest was simultaneously truncated by the specified possession limit.  This trip harvest was then expanded by the known effort divided by the number of samples observed in each area, wave, mode stratum[3] (in order to properly weight the MRFSS sampling to the known

---

[1] Data were subset to single angler intercepts to eliminate ambiguity in possession limits.
[2] In collaboration with Robert Andrews of NOAA Fisheries Statistics and Economics Division.
[3] Fishing effort was estimated externally from the MRFSS telephone survey.

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

1

M 09-039

angler effort across the coast).  The analysis assumes that all fish within the specified slot and bag limits are kept.

**Results**
The observed harvest (from existing regulations in 2008) in the for-hire mode through wave 4 were 52,760 fish in this analysis.  The predicted harvest (in the for-hire mode through wave 4) given various slot and bag limit combinations are shown in Table 1.  The predicted harvest resulting from discrete trophy classes are shown in Table 2.  Table 3 shows the percentage increase or decrease in harvest resulting from various slot and bag limits with a one fish trophy class (26"+).  The 26" minimum size was selected since it reflected most state's minimum size requirements for citation awards.  Tables assume that all state-specific seasons remain the same. Any adjustment to seasons will affect the predicted outcomes from the tables.

Table 1.  Predicted 2008 harvest in the for-hire mode through wave 4 given various slot and bag limit combinations

| Slot | 1 Bag | 2 Bag | 3 Bag | 4 Bag | 5 Bag | 6 Bag | 7 Bag | 8 Bag |
|---|---|---|---|---|---|---|---|---|
| 14-16 | 100,440 | 149,622 | 171,524 | 184,055 | 192,884 | 197,381 | 200,010 | 201,327 |
| 14-17 | 121,977 | 192,335 | 232,319 | 256,282 | 271,525 | 279,145 | 283,397 | 286,143 |
| 14-18 | 128,099 | 207,365 | 253,182 | 284,029 | 301,436 | 310,782 | 316,322 | 320,248 |
| 15-16 | 63,435 | 82,932 | 89,293 | 91,745 | 93,312 | 94,422 | 95,111 | 95,367 |
| 15-18 | 106,207 | 161,850 | 190,677 | 206,220 | 212,411 | 215,287 | 217,263 | 218,192 |
| 16-17 | 59,274 | 78,886 | 86,620 | 88,913 | 88,959 | 89,005 | 89,051 | 89,098 |
| 16-18 | 73,307 | 105,007 | 117,152 | 122,827 | 124,297 | 124,790 | 124,882 | 124,928 |
| 16-19 | 81,509 | 120,610 | 138,848 | 147,522 | 150,951 | 151,994 | 152,846 | 152,938 |
| 16.5-19 | 64,191 | 86,595 | 97,743 | 102,600 | 104,490 | 104,968 | 105,353 | 105,399 |
| 17-18 | 29,057 | 33,786 | 35,729 | 36,307 | 36,353 | 36,399 | 36,445 | 36,445 |
| 17-19 | 44,932 | 57,415 | 61,629 | 63,879 | 64,357 | 64,743 | 65,128 | 65,175 |
| 18-20 | 36,267 | 44,408 | 45,661 | 46,185 | 46,663 | 47,002 | 47,341 | 47,341 |

Table 2.  Trophy class harvest that would have occurred in the for-hire mode through wave 4 in 2008.

| min size | 22 | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|
| 1 Bag | 7,322 | 4,443 | 3,326 | 1,655 | 1,079 | 900 |

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

2

M 09-039

Table 3. Percentage increase or decrease in for-hire harvest through wave 4 resulting from combined slot and bag limits and one trophy fish 26"+ or greater. The shaded cells indicate slot harvests that are >13% less than the observed 2008 coastwide for-hire harvest. These slot, bag, trophy combinations would have ostensibly resulted in harvest at/near the coastwide limit in 2008. (Observed 2008 harvest exceeded the quota by 13.5%.)

| Slot | 1 Bag | 2 Bag | 3 Bag | 4 Bag | 5 Bag | 6 Bag | 7 Bag | 8 Bag |
|---|---|---|---|---|---|---|---|---|
| 14-16 | 92% | 186% | 227% | 251% | 268% | 276% | 281% | 284% |
| 14-17 | 133% | 267% | 342% | 388% | 417% | 431% | 439% | 444% |
| 14-18 | 145% | 295% | 382% | 440% | 473% | 491% | 502% | 509% |
| 15-16 | 22% | 59% | 71% | 76% | 79% | 81% | 82% | 83% |
| 15-18 | 103% | 209% | 263% | 293% | 305% | 310% | 314% | 316% |
| 16-17 | 14% | 52% | 66% | 71% | 71% | 71% | 71% | 71% |
| 16-18 | 41% | 101% | 124% | 135% | 138% | 139% | 139% | 139% |
| 16-19 | 57% | 131% | 165% | 182% | 188% | 190% | 192% | 192% |
| 16.5-19 | 24% | 66% | 87% | 97% | 100% | 101% | 102% | 102% |
| 17-18 | -43% | -34% | -30% | -29% | -29% | -29% | -29% | -29% |
| 17-19 | -13% | 11% | 19% | 23% | 24% | 25% | 25% | 26% |
| 18-20 | -29% | -14% | -11% | -10% | -10% | -9% | -8% | -8% |

**Discussion**

The results of this analysis provide useful predictions of harvests resulting from various slot, bag and trophy combinations in 2008 using the for-hire (party boat) mode as a model for the entire fishery. All modes other than the for-hire mode are disregarded. For reference, the for-hire mode accounted for 2.5% of the total yearly harvest and 2.7% of the yearly catch in 2008. In any case, the slot options in this analysis will certainly result in greatly increased numbers of fish harvested.

Our prior examination of volunteer angler data indicated that the ratio of discards to kept summer flounder was considerably higher in shore versus boat modes (Figure 1). The lower discard ratio in boat modes is an important caveat to consider, as it could result in higher harvest than predicted in this study.
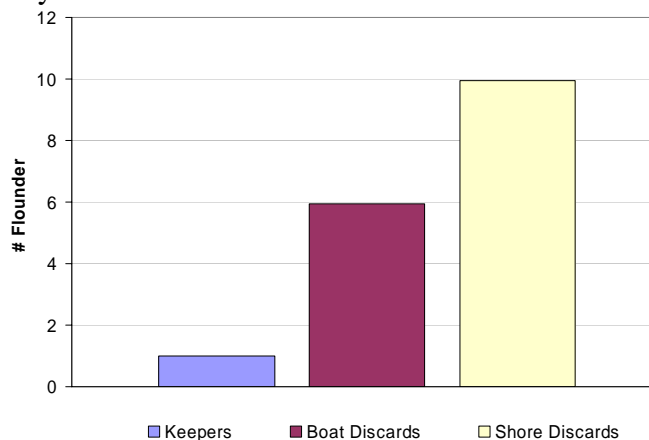


Figure 1. Average number of fluke discards per keeper between boat and shore modes. Results are averages across years 2003-2007 from the CT VAS (2003-2007) and NJ VAS (2007).

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

3

M 09-039

Higher availability of smaller flounder to shore anglers points to a probable change in harvest distribution once a slot limit is implemented. Currently, the vast majority (97%) of harvest occurs from boat modes. Given smaller size regulations from a slot limit, we expect that the current harvest distribution would shift towards shore modes (to some unknown yet not trivial degree). It would not be surprising if effort and total catch also increased in shore modes after a slot limit is implemented. Larger-size slot options (>18") would assuredly shift the coastwide harvest towards certain states with large coastal fisheries or high availability of large fish and penalize states with primarily inside, bay fisheries with smaller fish (e.g. MD, NC).

As we saw in the 2008 analysis, the implementation of slot limits will substantially increase the harvest of smaller, younger fish at the benefit of reducing some harvest on larger, older fish (Figure 2). As such, increased regulatory discarding of larger, older fish would occur from the slot limit. We suspect that non-compliance could increase as anglers are faced with releasing very large flounder. High-grading (discarding legal fish for larger sizes) within the slot would also be an important issue, particularly since there will be high availability of fish within the presumably narrow slot and bag limits.

For a given coastwide recreational TAL in weight, a larger coastwide quota in numbers of fish can be harvested with decreasing size limits. For example, in 2008, the 6.31 million lb recreational TAL was converted into a 2.06 million fish quota. The slot options in this study would have resulted in coastwide quotas reaching over 5 million fish (Table 4). This dramatic increase in harvest numbers would raise the fishing mortality rate on the stock significantly.
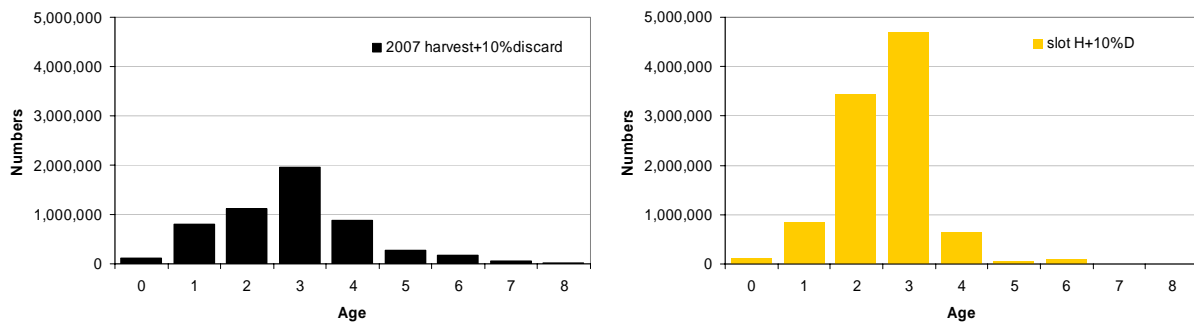


Figure 2. Comparison of the observed 2007 recreational harvest age distribution to the theoretical distribution of a 16-18" slot limit harvest.

Another perceived benefit to slot management is the reduction in the magnitude of discard mortalities. While it is true the numbers of discards decline with smaller slot limits, the numbers of total removals (harvest + discard mortalities) actually increase substantially (Table 4). The greater number of total removals would, again, contribute to higher fishing mortality rates.

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.   4

M 09-039

Table 4.  Coastwide quotas, discards, discard mortalities, and total removals expected in 2008 associated with given slot limit options.  Average weights were calculated from the NEFSC length-weight relationship (Wigley et al. 2003).  Quota = 2008 recreational TAL / ave wt.  (The recr. TAL in 2008 was 6.31 M lb.)  Discards = observed 2008 total catch (a+b1+b2) – quota.  (Total catch in 2008 was 24,514,524.)  Discard mortalities = 10% mortality rate * discards.  Total removals = quota + discard mortalities.

| Slot | Average Wt | 2008 Harvest Target | 2008 Discards | Discard Mortalities | Total Removals |
|---|---|---|---|---|---|
| 14-16 | 1.24 | 5,088,710 | 19,425,814 | 1,942,581 | 7,031,291 |
| 14-17 | 1.37 | 4,605,839 | 19,908,685 | 1,990,868 | 6,596,708 |
| 14-18 | 1.52 | 4,151,316 | 20,363,208 | 2,036,321 | 6,187,637 |
| 15-16 | 1.37 | 4,605,839 | 19,908,685 | 1,990,868 | 6,596,708 |
| 15-18 | 1.68 | 3,755,952 | 20,758,572 | 2,075,857 | 5,831,810 |
| 16-17 | 1.68 | 3,755,952 | 20,758,572 | 2,075,857 | 5,831,810 |
| 16-18 | 1.85 | 3,410,811 | 21,103,713 | 2,110,371 | 5,521,182 |
| 16-19 | 2.03 | 3,108,374 | 21,406,150 | 2,140,615 | 5,248,989 |
| 16.5-19 | 2.12 | 2,976,415 | 21,538,109 | 2,153,811 | 5,130,226 |
| 17-18 | 2.03 | 3,108,374 | 21,406,150 | 2,140,615 | 5,248,989 |
| 17-19 | 2.22 | 2,842,342 | 21,672,182 | 2,167,218 | 5,009,561 |
| 18-20 | 2.64 | 2,390,152 | 22,124,372 | 2,212,437 | 4,602,589 |
| @2008 | 3.07 | 2,055,375 | 22,459,149 | 2,245,915 | 4,301,290 |

Given the larger quotas with smaller slot limits (above), we examined the hypothetical quota performances of slot, bag, 26"+ trophy options in 2008 (Table 5).  The predicted slot harvest was increased by 3% to account for the missing waves 5 and 6 estimates.  (Although waves 5 and 6 data were not available for this size/bag analysis, the MRFSS has reported the 2008 estimated harvest in these waves.)  As you can see, many of the quota-achieving options contain either a very narrow slot or one fish bag limit.   Because of expected issues related to angler satisfaction, non-compliance, and enforcement, the TC recommended avoiding very narrow slot ranges.

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

5

M 09-039

Table 5. Hypothetical quota performance in 2008 given various slot, bag, 26"+ trophy combinations. Performance was measured as (slot quota-harvest)/slot quota. Calculated for-hire harvest was expanded by 3% to account for missing waves 5 and 6. Shaded cells show options that achieve the quota target.

| Slot | 1 Bag | 2 Bag | 3 Bag | 4 Bag | 5 Bag | 6 Bag | 7 Bag | 8 Bag |
|---|---|---|---|---|---|---|---|---|
| 14-16 | -18% | 22% | 40% | 50% | 57% | 61% | 63% | 64% |
| 14-17 | 10% | 73% | 109% | 130% | 144% | 151% | 154% | 157% |
| 14-18 | 28% | 107% | 152% | 183% | 200% | 209% | 215% | 219% |
| 15-16 | -42% | -25% | -19% | -17% | -16% | -15% | -14% | -14% |
| 15-18 | 18% | 79% | 110% | 127% | 134% | 137% | 139% | 141% |
| 16-17 | -34% | -12% | -4% | -1% | -1% | -1% | -1% | -1% |
| 16-18 | -10% | 28% | 43% | 50% | 51% | 52% | 52% | 52% |
| 16-19 | 9% | 61% | 85% | 97% | 101% | 103% | 104% | 104% |
| 16.5-19 | -10% | 21% | 37% | 44% | 46% | 47% | 47% | 47% |
| 17-18 | -60% | -54% | -51% | -50% | -50% | -50% | -50% | -50% |
| 17-19 | -33% | -15% | -9% | -6% | -5% | -5% | -4% | -4% |
| 18-20 | -36% | -22% | -19% | -19% | -18% | -17% | -17% | -17% |

Initial forays into yield per recruit and spawning stock biomass per recruit modeling showed a slight decline in overall fishery yield with a marginal benefit to spawning stock biomass. Most of the expected spawning stock benefit from the slot limit was diminished since commercial fishery selectivity (with a minimum size limit) remained unchanged, while accounting for 60% of the total harvest. Furthermore, the only marginal benefit to SSB that did exist was observed from modeling a recreational slot limit fishery without a trophy class. With little to nil benefit to spawning stock biomass expected from modeling a slot limit recreational fishery *with* a trophy class, the spawning based reference points ($F_{35}$ and $F_{40}$) would probably not change greatly.

We expect an increase in fishing mortality rate resulting from much larger quotas and higher numbers of total removals from slot limit management. Fishing mortality rates have only recently declined, 2007 being the first year that overfishing has not occurred since 1982. Accelerating F in relation to reference points would be contrary to 2012 rebuilding efforts.

**The TC recommends that experimentation with slot management wait until rebuilding goals and data needs are met.**

**Summary**
1. The results of this analysis provide harvest outcomes resulting from various slot and bag and trophy combinations in 2008 using the for-hire (party boat) mode as a model for the entire fishery. All modes other than the for-hire mode are disregarded.
2. The data used in this analysis contain both spatial and temporal limitations. Special care should be taken to avoid over-interpreting the results of this study.
3. Data caveats
   a. Analysis disregards all modes other than for-hire (party boat) fishing

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

6

M 09-039

b. Previous VAS analyses suggest that more discards per landed fish (higher discard ratio) occur in shore based modes than boat modes. This would tend to underestimate (bias) the harvest predicted in the given slot sizes.
   c. Analysis assumes all fish caught in slot will be retained.
   d. Analysis assumes all season closures are maintained.
   e. State or regional level analyses could suffer from insufficient sample sizes.
4. Results
   a. Smaller slot limits result in very large increases in harvest.
   b. The larger slot options (>18") would keep harvest at or below current levels.
5. Different slot options would affect the distribution of the coastwide harvest differently.
   a. Smaller-size slot limits would redistribute harvest into shore modes.
   b. Larger-size slot limits will redistribute the harvest to states with better availability of large fish (i.e MA, CT, RI, NY, and VA).
6. Narrow (1 inch) slot bins are probably infeasible to implement.
7. Regulatory discarding of larger fish will increase.
8. High-grading within the slot is expected given the very high availability of legal sized fish.
9. Decreasing size limits vastly increase quota sizes (in numbers of fish) for a given TAL (pounds).
10. Total removals (harvest and discarded mortalities) increase substantially with declining size limits.
11. Fishing mortality would rise due to the considerable increase in harvest, quotas, and total removals expected from slot limit implementation.
12. Reference points will not change considerably.
13. The TC recommends that slot experimentation wait until the stock has rebuilt given the risks associated with accelerating F and data limitations.

**References**

Wigley, S.E., McBride, H.M., and N.J.McHugh. 2003. Length-weight relationships for 74 fish species collected during NEFSC research vessel bottom trawl surveys, 1992-99.

The TC would like to thank the TC Chair, Rich Wong, for his work in the data analysis to support this document and for composing the majority of this memo.

ASMFC Vision Statement: Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

7

M 09-039