PRE-PUBLICATION DRAFT

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A Report of the 58th Northeast Regional Stock Assessment Workshop

58th Northeast Regional Stock Assessment Workshop (58th SAW)

Assessment Summary Report for

Golden Tilefish

B. GOLDEN TILEFISH ASSESSMENT SUMMARY FOR 2014

State of Stock: The Golden Tilefish stock was not overfished and overfishing was not occurring in 2012 relative to the SARC 58 (2014) accepted biological reference points (Figure B1). A new model, ASAP, was used in this assessment to incorporate newly available length and age data and to better characterize the population dynamics of the stock. Based on the new model the stock was at high biomass and lightly exploited during the early 1970s. As the longline fishery developed during the late 1970s, fishing mortality rates increased and stock biomass decreased to a time series low by 1999. Since the implementation of constant landings quota of 905 mt in 2002, the stock has increased through 2012, and is near the accepted biomass target reference point (SSB_{MSY} proxy).

The fishing mortality rate was estimated to be 0.275 in 2012, below the accepted reference point F_{MSY} proxy = $F_{25\%}$ = 0.370. There is a 90% probability that the fishing mortality rate in 2012 was between 0.198 and 0.372 (Figure B2). SSB was estimated to be 5,229 mt in 2012, about 101% of the accepted biomass target reference point SSB_{MSY} proxy = $SSB_{25\%}$ = 5,153 mt (Figure B1). Therefore, based on the point estimates, the stock is considered rebuilt. There is a 90% chance that SSB in 2012 was between 3,275 and 7,244 mt (Figure B2). Average recruitment from 1971 to 2012 was 1.24 million fish at age 1. Recent large year classes occurred in 1998 (2.35 million), 1999 (2.39 million) and 2005 (1.85 million). Age-1 recruitment in 2009 was about 0.69 million fish (Figure B3).

Projections: The 2013 population estimates for ages 2-4 were adjusted in the projections to account for the apparent underestimation of recruitment in the most recent three years of the assessment model. This adjustment increased the estimated recruitment in years 2010-2012 to the geometric mean value during the assessment period. The projections are conditioned on the 2013 and 2014 Annual Catch Limit (ACL) landings being taken = 905 mt = 1.995 million lbs, and provide the following Overfishing Level (OFL) results:

OFL Landings, Fishing Mortality (F)
and Spawning Stock Biomass (SSB)
Catches and SSB in metric tons

Year	Landings	F	SSB	P(F>Fmsy)	P(SSB<SSBmsy/2)
2013	905	0.361	4,811	0.463	0.010
2014	905	0.366	4,914	0.489	0.013
2015	989	0.370	5,180	-	0.012
2016	1,027	0.370	5,246	-	0.010
2017	1,028	0.370	5,132	-	0.005

Additional projections were made assuming the current ACL landings (905 mt) are taken in all years.

Landings, Fishing Mortality (F)
and Spawning Stock Biomass (SSB)
Catches and SSB in metric tons

Year	Landings	F	SSB	P(F>Fmsy)	P(SSB<SSBmsy/2)
2013	905	0.361	4,811	0.463	0.010
2014	905	0.366	4,914	0.489	0.013
2015	905	0.335	5,219	0.371	0.017
2016	905	0.317	5,370	0.323	0.020
2017	905	0.309	5,392	0.273	0.025

Two scenarios were considered. In one, landings were determined by the F_{MSY} proxy starting in 2015. In the other, landings were held constant. In both cases, the probability of becoming overfished in any year up to 2017 is less than 3%. Under the constant landings projection, the probability of overfishing occurring in any year up to 2017 is less than 50%. The CV on the 2015 OFL is 30%.

Catch and Status Table: Golden Tilefish. Landings, SSB, Recruitment (age-1), and Fishing Mortality (F_{MULT}) (weights in '000 mt live, recruitment in millions)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Min[1]	Mean[1]	Max[1]
Commercial landings[2]	1.1	1.2	0.7	0.9	0.7	0.7	0.9	0.9	0.9	0.8	0.1	1.4	4.0
SSB	2.3	3.0	3.9	4.4	4.2	4.2	4.5	4.5	5.0	5.2	1.2	6.9	27.0
Recruitment	0.4	0.6	1.1	1.8	1.5	1.0	0.7	NA[3]	NA[3]	NA[3]	0.4	1.3	4.5
Fishing mortality	0.43	0.39	0.29	0.38	0.43	0.42	0.37	0.30	0.26	0.27	0.01	0.54	1.27

[1]Over period 1971-2012.
[2]Estimated discards since 1989 are less than 7 mt in most years with a maximum of 41 mt in 2001.
[3]NA:Not available due to the estimates being highly uncertain.Therefore, mean recruitment is for the period 1971-2009.

Stock Distribution and Identification: Golden Tilefish, *Lopholatilus chamaeleonticeps,* inhabit the outer continental shelf from Nova Scotia to South America and are relatively abundant in the Southern New England to Mid-Atlantic region at depths of 80 to 440 m. Tilefish have a relatively narrow temperature preference of 9 to 14 °C. The Virginia-North Carolina border defines the boundary between the northern and southern Golden tilefish management units.

Catch: Total commercial landings (live weight) increased from less than 125 metric tons (mt) during 1967-1972 to more than 3,900 mt in 1979 and 1980 during the development of the directed longline fishery (Figure B4). Landings prior to the mid 1960s were landed as a bycatch through the trawl fishery. Annual landings have ranged between 666 and 1,838 mt from 1988 to 1998. Landings from 1999 to 2002 were below 900 mt (ranging from 506 to 874 mt). An annual quota of 905 mt was implemented in November of 2001. Landings in 2003 and 2004 were slightly above the quota at 1,130 mt and 1,215 mt respectively. Landing from 2005 to 2009 have been at or below the quota. Landings in 2010 were slightly above the quota at 922 mt. Landings in 2011 and 2012 were 864 mt and 834 mt respectively. During the late 1970s and early 1980s Barnegat, NJ was the principal tilefish port; since the mid-1980s Montauk, NY has accounted for most of the landings. Approximately 95% of the commercial landings are taken by the directed longline fishery. Discards in the trawl and longline fishery are negligible. Recreational catches also appear to be a minor component of the total removals.

Data and Assessment: The surplus production model ASPIC was used in the previous three assessments. The availability of length and age data facilitated application of an age-structured assessment model (ASAP) which was used in this latest stock assessment.

There are no fishery independent surveys available for this stock, so commercial catch per unit effort is relied upon for indications of population abundance changes. Over the last fifteen years, the commercial length and more recent age data indicate that increases in fishery CPUE and model estimated biomass are predominantly due to the influence of strong year classes in 1999 and 2005 (Figures B5 and B6). The 2005 year class has now passed through the fishery, and recently fishery CPUE has started to decline.

Review of commercial fishery practices and markets justified the use of a dome-shaped selectivity pattern in the assessment model.

The SCALE model was explored as a bridge between the ASPIC and the ASAP models. The ASAP model has the ability to estimate recruitment, incorporate annual fishery age compositions directly, estimate uncertainty, and model dome-shaped fishery selectivity.

Biological Reference Points (BRPs): Golden Tilefish are estimated to live about 40 years, and this information along with likelihood profiles of the ASAP model indicates that a value for instantaneous natural mortality (M) of 0.15 is appropriate. The long life span and relatively low M would suggest that a fishing mortality rate BRP of $F_{40\%}$ or higher %MSP would be appropriate. Under a management regime using a constant landings quota of 905 mt since 2002, with actual landings close to the quota each year, the stock has increased to 5,229 mt. Fishing mortality rates have averaged 0.367 since 2002, and the new yield per recruit analysis shows that this fishing rate corresponds to about $F_{25\%}$. Given these factors, the new accepted BRPs proxies are $F_{25\%}$ = 0.37 (overfishing threshold), the corresponding $SSB_{25\%}$ = 5,153 mt (biomass target), one-half $SSB_{25\%}$ = 2,577 mt (biomass threshold), and $MSY_{25\%}$ = 1,029 mt.

The reference points from the previous 2009 SAW 48 assessment are based on the ASPIC surplus production model and cannot be compared to the current assessment ASAP model results and reference points.

Fishing Mortality:

Fishing mortality on the fully selected age class (age 5) (F_{MULT}) increased with the development of the directed longline fishing from near zero in 1971 to 1.2 in 1987 (Figure B1). Fishing mortality was relatively high but fluctuated from 0.3 to 1.3 from 1987 to 1997. Fishing mortality has been decreasing since 1997 to 0.26 in 2011 and 0.275 in 2012. F_{MULT} 90% confidence intervals were 0.20 – 0.37 in 2012 (Figure B2).

Spawning Stock Biomass*:*

Spawning stock biomass declined substantially early in the time series from 27,044 mt in 1974 to 1,221 mt in 1999, lowest in the time series (Figure B1). Thereafter, SSB has increased to 5,229 mt in 2012. Spawning stock biomass 90% confidence intervals were 3,275 mt to 7,244 mt in 2012 (Figure B2).

Recruitment:

Average recruitment from 1971 to 2009 was 1.3 million fish. 2009 is the last year recruitment can be estimated accurately, with 0.69 million fish at age-1. Recent large year classes have occurred in 1998 (2.35 million), 1999 (2.39 million) and 2005 (1.85 million) (Figure B3). In the absence of empirical information to validate the uncertain estimates of recruitment in years 2010-2012, due to low selectivity for ages 1-3, estimates of these cohorts were increased in the projections. The 2013 population estimates for ages 2-4 were adjusted in the projections to account for the apparent underestimation of recruitment in the last three years of the assessment. This adjustment increased the estimated recruitment in years 2010-2012 to the geometric mean of 1.1 million fish during the assessment period.

Special Comments:

The use of fishery dependent CPUE remains a concern but is lessened by the use of age data which indicates cohort tracking and justifies the use of the dome-shaped selectivity pattern. The age data corroborate the strong year classes seen in the CPUE time series.

The current tilefish fishery is conducted by a relatively small (<10) number of vessels. A few of those vessels (<6) contribute information to the VTR CPUE index of stock biomass. Even though they account for >75% of the tilefish landings, there is concern that the small scale of the fleet may not provide a synoptic index of abundance for tilefish due to the limited spatial coverage of tilefish habitat.

Through the working group process, industry members noted an increase in the 2013 landings of small fish, data that were not available during the meeting. Industry members also noted concerns with consistency in market category reporting in the dealer reports.

References:

Mid-Atlantic Fishery Management Council. 2000. Tilefish fishery management plan. NOAA award No. NA57FC0002.

Nitschke, P., G. Shepherd, and M. Terceiro. 1998. Assessment of tilefish in the middle Atlantic – southern New England region. NEFSC. 1-12.

NEFSC. 2005. Northeast Regional Stock Assessment Workshop (41st SAW). 41st SAW Assessment Report. U.S. Dept. Commerce, Northeast Fisheries Science Center Ref. Doc. 05-14; 237 p.

NEFSC. 2009. Northeast Regional Stock Assessment Workshop (48st SAW). 48st SAW Assessment Report. U.S. Dept. Commerce, Northeast Fisheries Science Center Ref. Doc. 09-15; 834 p.

Turner, S.C. 1986. Population dynamics of and, impact of fishing on tilefish, *Lopholatilus chamaeleonticeps*, in the Middle Atlantic-Southern New England region during the 1970's and early 1980's. New Brunswick, N.J.: Rutgers University. Ph.D. dissertation.

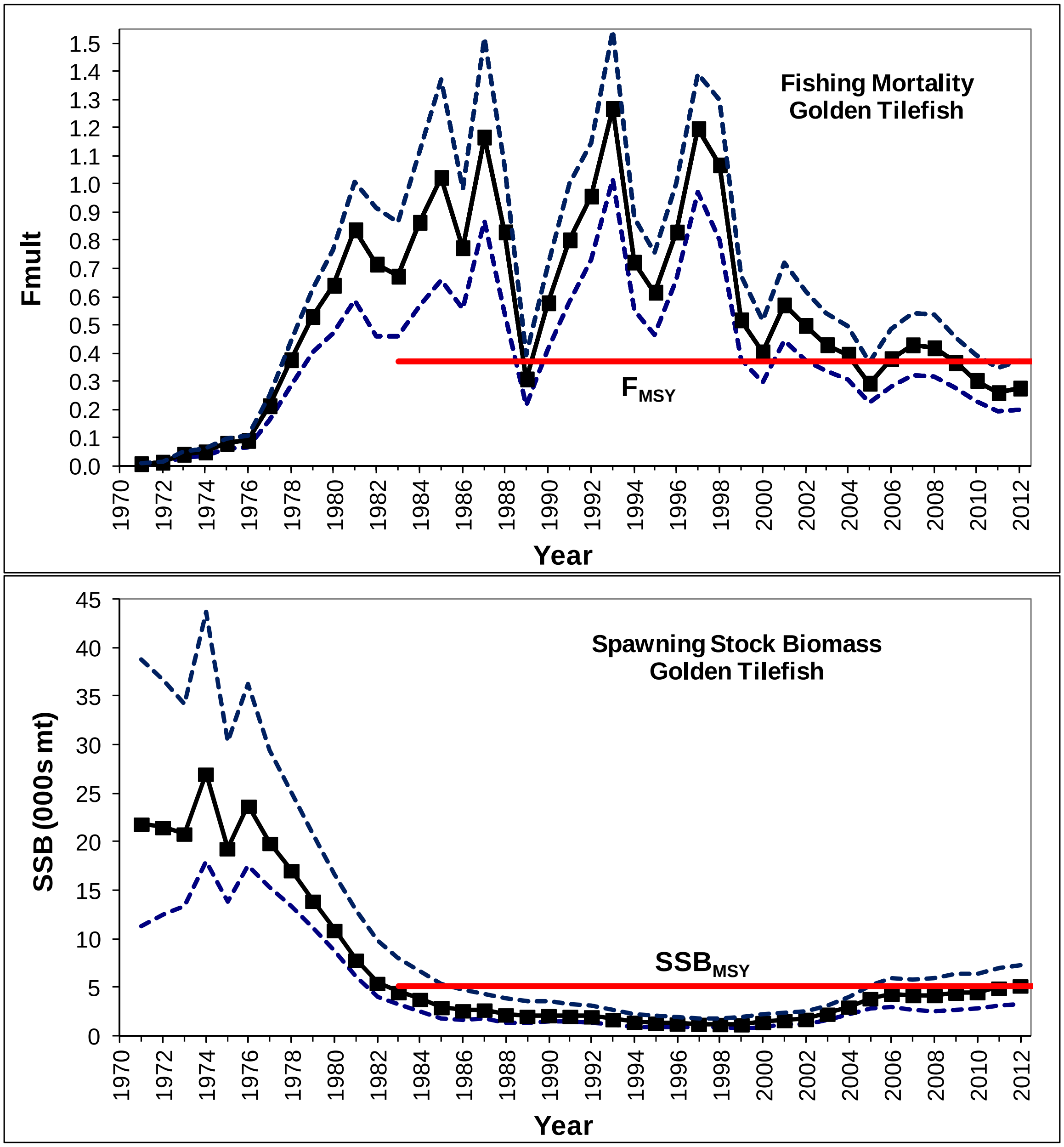

Figure B1. Tilefish. ASAP model estimated fishing mortality (F_{MULT}) and SSB with MCMC estimated 90% confidence intervals. F_{MSY} and SSB_{MSY} are shown for 1983-2012 (i.e., the second selectivity block).

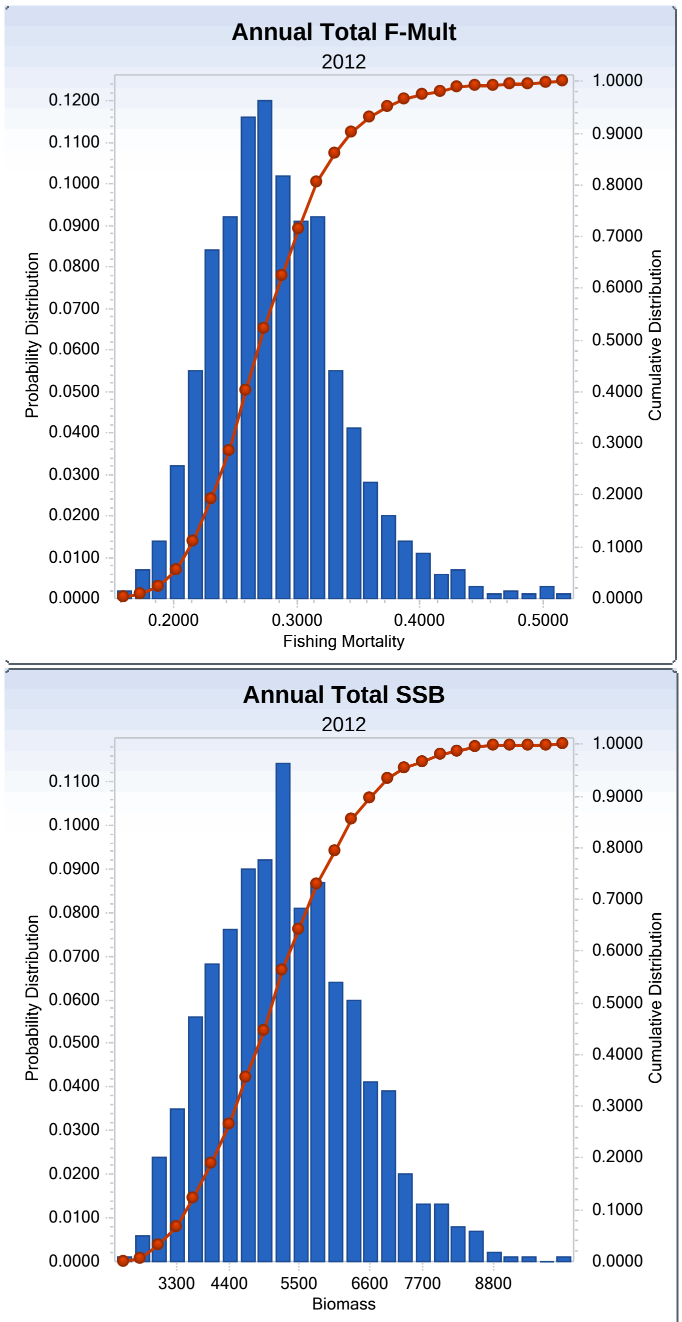

Figure B2. MCMC 2012 distributions for fishing mortality (F_{MULT}) and SSB for Golden tilefish. The percent confidence intervals can be taken from the cumulative frequency. The 2012 point estimate of fishing mortality = 0.275 and SSB = 5,229 mt.

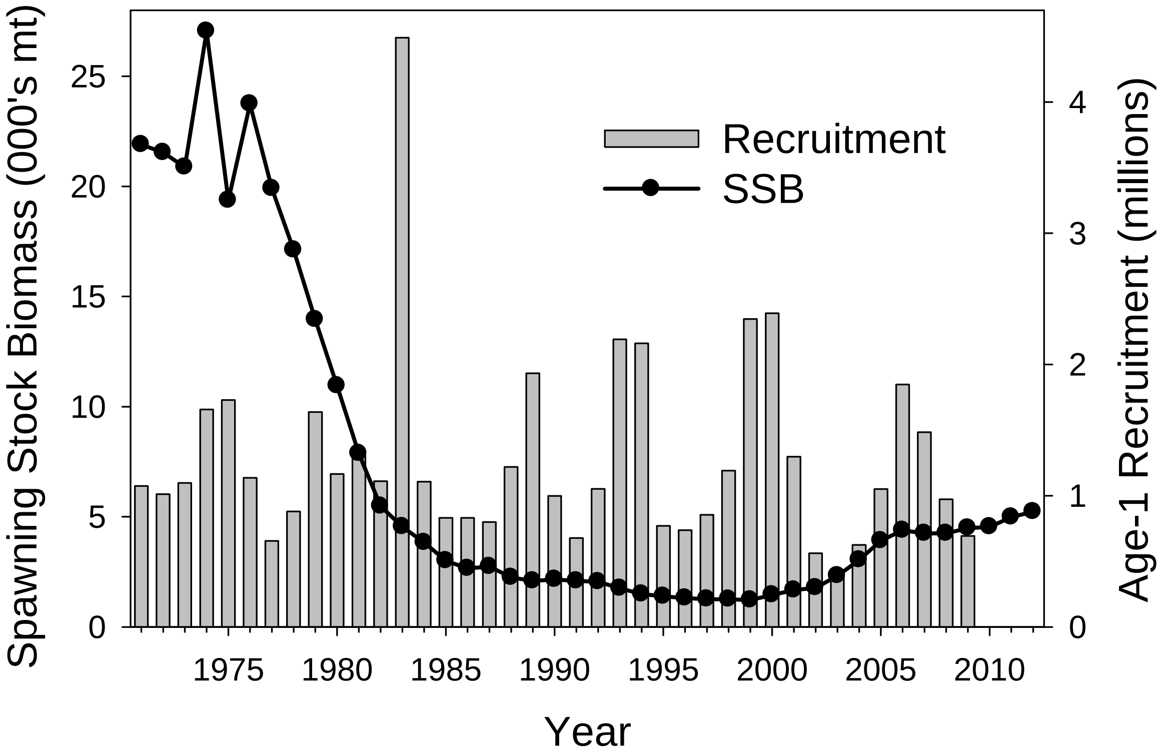

Figure B3. Comparison of age-1 recruitment and SSB for Golden tilefish from 1971-2012. Recruitments for years 2010-2012 are not shown because estimates are highly uncertain.

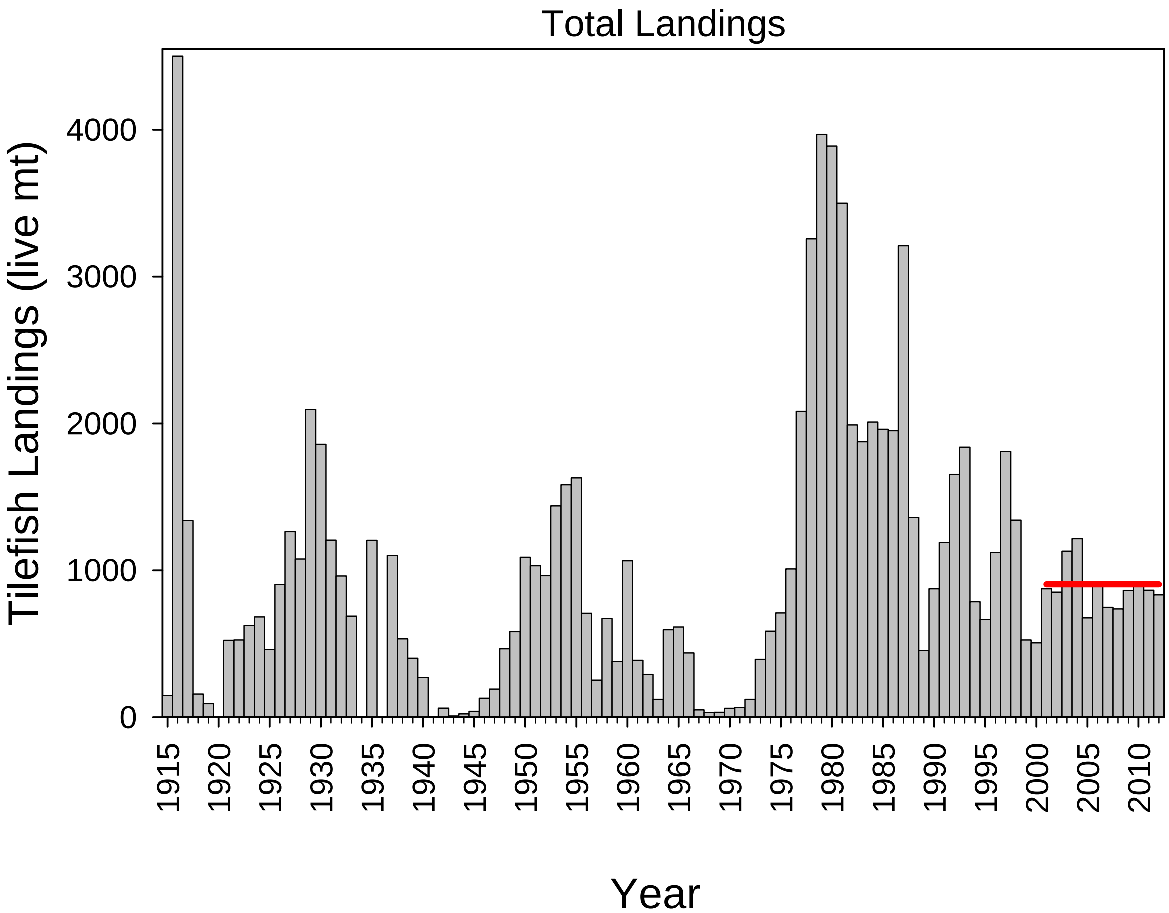

Figure B4. Landings of tilefish in metric tons from 1915-2012. Landings in 1915-1972 are from Freeman and Turner (1977), 1973-1989 are from the general canvas data, 1990-1993 are from the Weighout system, 1994-2003 are from the dealer reported data, and 2004-2012 is from dealer electronic reporting. Red line is the 905 mt quota implemented in November 2001.

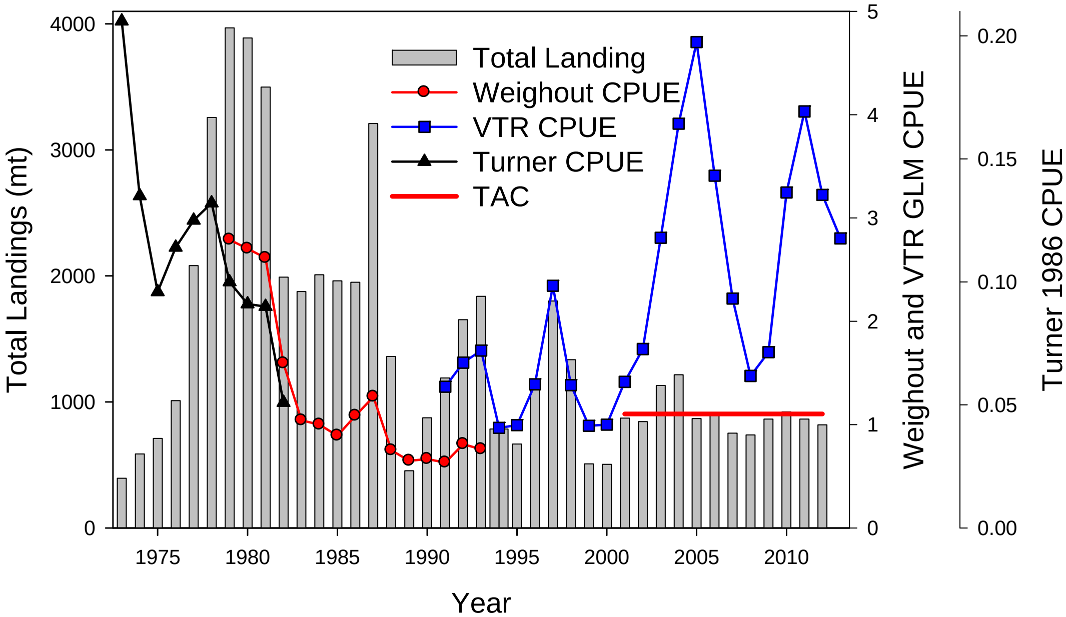

Figure B5. Tilefish. GLM CPUE for the Weighout and VTR data split into two series with additional New York logbook CPUE data from three vessels (1991-1994) added to the VTR series. Four years of overlap between Turner's and the Weighout CPUE series can be seen. Total landings are also shown. Landings in 2005 were taken from the IVR system. Fluctuations in the VTR CPUE series seem to correspond to year class effects.

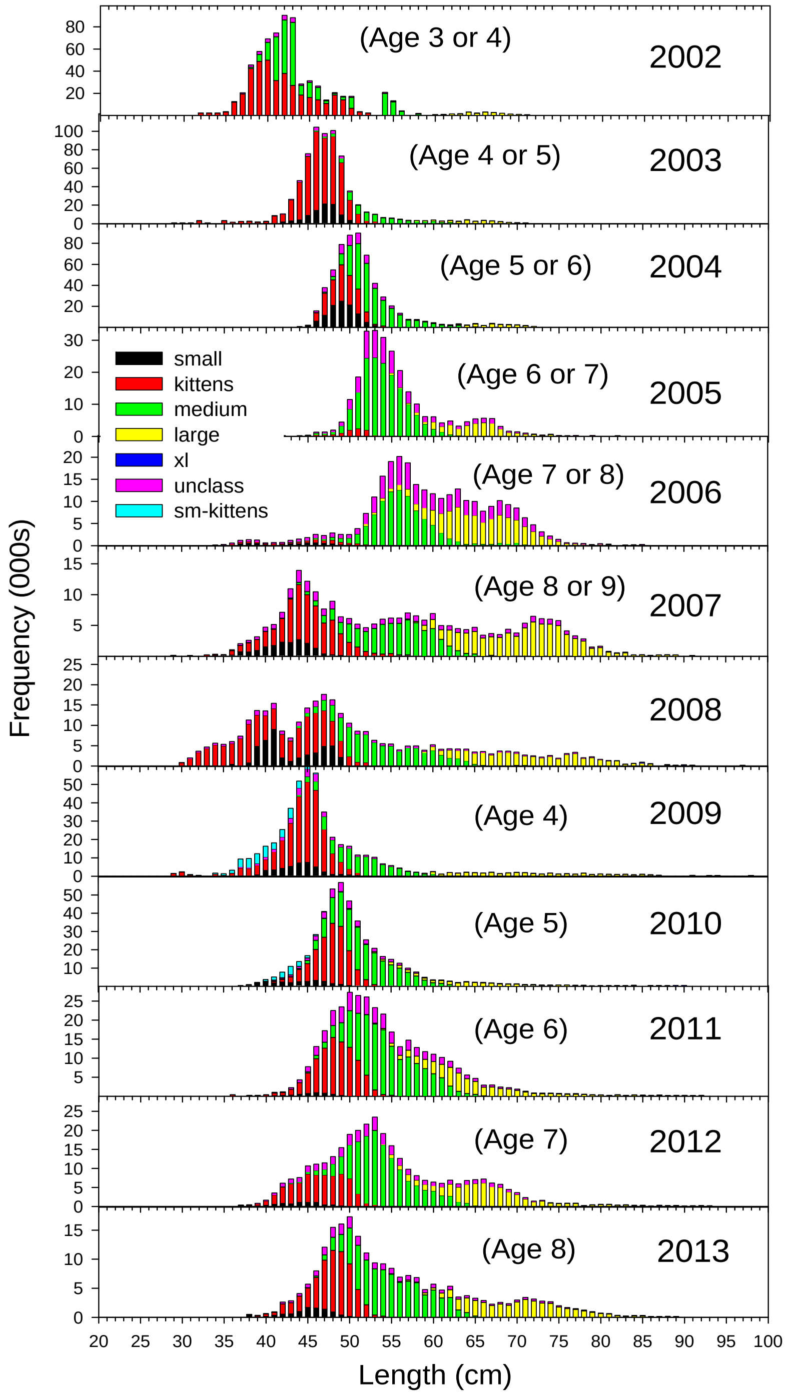

Figure B6. Expanded commercial catch length frequency distributions by year, in numbers of tilefish. Y-axis is allowed to rescale. A strong 1998 and/or 1999 and a 2005 year class can be seen tracking through the market categories and the landings at length. Sm-kittens are < 2 lbs, small & kittens = 2-2.4 lbs, medium = 3.5-5 lbs, large = 7-24 lbs, extra large > 24 lbs.

Appendix: Stock Assessment Terms of Reference for SAW/SARC58, January 27-31, 2014
(To be carried out by SAW Working Groups) (v. 8/2/2013)

A. Butterfish

1. Characterize the commercial catch including landings, effort and discards by gear type. Describe the magnitude of uncertainty in these sources of data.

2. Characterize the survey data that are being used in the assessment. Describe the magnitude of uncertainty in these sources of data.

3. Characterize oceanographic and habitat data as it pertains to butterfish distribution and availability. If possible, integrate the results into the stock assessment (TOR-5).

4. Evaluate consumptive removals of butterfish by its predators. If possible, integrate results into the stock assessment (TOR-5).

5. Use assessment models to estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Include a comparison with previous assessment results and previous projections.

6. State the existing stock status definitions for "overfished" and "overfishing". Given that the stock status is currently unknown, update or redefine biological reference points (BRPs; point estimates for B_{MSY}, $B_{THRESHOLD}$, F_{MSY} and MSY, or their proxies) and provide estimates of their uncertainty. Consider effects of environmental factors on stability of reference points and implications for stock status.

7. Evaluate stock status with respect to a newly proposed model and with respect to "new" BRPs and their estimates (from TOR-6). Evaluate whether the stock is rebuilt.

8. Develop approaches and apply them to conduct stock projections and to compute the statistical distribution (e.g., probability density function) of the OFL (overfishing level) and candidate ABCs (Acceptable Biological Catch; see Appendix to the SAW TORs).
    a. Provide numerical annual projections (2 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment). Comment on which projections seem most realistic.
    b. Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.

9. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in most recent SARC reviewed assessment and review panel reports. Identify new research recommendations.

B. Tilefish

1. Estimate catch from all sources including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the magnitude of uncertainty in these sources of data.

2. Characterize commercial LPUE as a measure of relative abundance. Consider the utility of recreational data for this purpose. Characterize the uncertainty and any bias in these sources of data.

3. For the depth zone occupied by tilefish, examine the relationship between bottom temperature, tilefish distribution and thermal tolerance.

4. Use assessment models to estimate annual fishing mortality and stock size for the time series, and estimate their uncertainty. Include a historical retrospective to allow a comparison with previous assessment results.

5. State the existing stock status definitions for "overfished" and "overfishing". Then update or redefine biological reference points (BRPs; point estimates for B_{MSY}, $B_{THRESHOLD}$, F_{MSY} and MSY or for their proxies) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.

6. Evaluate stock status with respect to the existing ASPIC model (from previous peer reviewed accepted assessment) and with respect to a new model developed for this peer review. In both cases, evaluate whether the stock is rebuilt.
   a. When working with the existing model, update it with new data and evaluate stock status (overfished and overfishing) with respect to the existing BRP estimates.
   b. Then use the newly proposed model and evaluate stock status with respect to "new" BRPs and their estimates (from TOR-4).

7. Develop approaches and apply them to conduct stock projections and to compute the statistical distribution (e.g., probability density function) of the OFL (overfishing level) and candidate ABCs (Acceptable Biological Catch; see Appendix to the SAW TORs).
   a. Provide numerical annual projections (2-3 years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. Use a sensitivity analysis approach in which a range of assumptions about the most important uncertainties in the assessment are considered (e.g., terminal year abundance, variability in recruitment).
   b. Comment on which projections seem most realistic. Consider the major uncertainties in the assessment as well as sensitivity of the projections to various assumptions.
   c. Describe this stock's vulnerability (see "Appendix to the SAW TORs") to becoming overfished, and how this could affect the choice of ABC.

8. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in most recent SARC reviewed assessment and review panel reports. Identify new research recommendations.

C. Northern shrimp

1. Present the Gulf of Maine northern shrimp landings, discards, effort, and fishery-independent data used in the assessment. Characterize the precision and accuracy of the data and justify inclusion or elimination of data sources.

2. Estimate population parameters (fishing mortality, biomass, and abundance) using assessment models. Evaluate model performance and stability through sensitivity analyses and retrospective analysis, including alternative natural mortality (M) scenarios. Include consideration of environmental effects where possible. Discuss the effects of data strengths and weaknesses on model results and performance.

3. Update or redefine biological reference points (BRPs; point estimates or proxies for B_{MSY}, SSB_{MSY}, F_{MSY}, MSY). Evaluate stock status based on BRPs.

4. Characterize uncertainty of model estimates of fishing mortality, biomass and recruitment, and biological reference points.

5. Review the methods used to calculate the annual target catch and characterize uncertainty of target catch estimates.

6. Develop detailed short and long-term prioritized lists of recommendations for future research, data collection, and assessment methodology. Highlight improvements to be made before the next benchmark assessment.

7. Based on the biology of species, and potential scientific advances, comment on the appropriate timing of the next benchmark assessment and intermediate updates.

Appendix to the SAW Assessment TORs:

Clarification of Terms
used in the SAW Terms of Reference

On "Acceptable Biological Catch" (DOC Nat. Stand. Guidel. Fed. Reg., v. 74, no. 11, 1-16-2009):

Acceptable biological catch (ABC) is a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of [overfishing limit] OFL and any other scientific uncertainty…" *(p. 3208) [In other words, OFL ≥ ABC.]*

ABC for overfished stocks. For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan. *(p. 3209)*

NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. (p. 3180)

ABC refers to a level of ''catch'' that is ''acceptable'' given the ''biological'' characteristics of the stock or stock complex. As such, [optimal yield] OY does not equate with ABC. The specification of OY is required to consider a variety of factors, including social and economic factors, and the protection of marine ecosystems, which are not part of the ABC concept. (p. 3189)

On "Vulnerability" (DOC Natl. Stand. Guidelines. Fed. Reg., v. 74, no. 11, 1-16-2009):

"Vulnerability. A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality)." (p. 3205)

Rules of Engagement among members of a SAW Assessment Working Group:

Anyone participating in SAW assessment working group meetings that will be running or presenting results from an assessment model is expected to supply the source code, a compiled executable, an input file with the proposed configuration, and a detailed model description in advance of the model meeting. Source code for NOAA Toolbox programs is available on request. These measures allow transparency and a fair evaluation of differences that emerge between models.

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