Atlantic States Marine Fisheries Commission

Winter Flounder Advisory Panel Call

Draft Agenda

Thursday January 14th, 2021

1:00 – 2:00 p.m.

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

Webinar URL: https://www.gotomeet.me/ASMFCStaff2/winter-flounder-advisory-panel-meeting
You can also dial in using your phone.
Phone: +1 (646) 749-3122 **Access Code**: 679-624-269

1) **Welcome/Review draft agenda** *(D. Colson*) 1:00-1:05 p.m.

2) **Staff Presentation** (*D. Colson*) 1:05-1:20 p.m.
   - Updated assessment information for Gulf of Maine and Southern New England/Mid-Atlantic stocks
   - Commercial and recreational fishery performance
   - New England Fishery Management Council state sub-component specifications
   - Winter Flounder Technical Committee recommendations for 2021 fishing year commercial and recreational specifications

3) **Panel Discussion of Current Management Issues** 1:20-1:50 p.m.

4) **Public Comment** 1:50-1:55 p.m.

5) **Adjourn/other business** 1:55-2:00 p.m.

draft working paper for peer review only

Gulf of Maine winter flounder

2020 Assessment Update Report

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

Compiled August 2020

This assessment of the Gulf of Maine winter flounder (Pseudopleuronectes americanus) stock is a management track assessment of the existing 2017 area-swept operational assessment (NEFSC 2017). Based on the previous assessment the biomass status is unknown but overfishing was not occurring. This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, and the area-swept estimates of 30+ cm biomass based on the fall NEFSC, MDMF, and MENH surveys.

State of Stock: Based on this updated assessment, the Gulf of Maine winter flounder (*Pseudopleuronectes americanus*) stock biomass status is unknown and overfishing is not occurring (Figures 1-2). Retrospective adjustments were not made to the model results. Biomass (30+ cm mt) in 2019 was estimated to be 2,862 mt (Figure 1). The 2019 30+ cm exploitation rate was estimated to be 0.052 which is 23% of the overfishing exploitation threshold proxy (E_{MSY} *proxy* = 0.23; Figure 2).

Table 1: Catch and status table for Gulf of Maine winter flounder. All weights are in (mt) and E_{Full} is the exploitation rate on 30+ cm fish. Biomass is estimated from survey area-swept for non-overlaping strata from three different fall surveys (MENH, MDMF, NEFSC) using an updated q estimate of 0.71 on the wing spread from the sweep study (Miller et al., 2020).

	2014	2015	2016	2017	2018	2019
Data						
Recreational discards	5	5	11	5	2	2
Recreational landings	89	85	41	161	80	42
Commercial discards	5	2	3	3	3	4
Commercial landings	215	179	185	210	158	102
Catch for Assessment	315	271	241	378	244	150
Model Results						
30+ cm Biomass	3,924	2,815	3,156	3,380	2,898	2,862
E_{Full}	0.08	0.096	0.076	0.112	0.084	0.052

Table 2: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $E_{40\%}$ exploitation rate proxy was used for the overfishing threshold and was based on a length based yield per recruit model from the 2011 SARC 52 benchmark assessment.

	2017	2020
E_{MSY} *proxy*	0.23	0.23
B_{MSY}	Unknown	Unknown
MSY (mt)	Unknown	Unknown
Overfishing	No	No
Overfished	Unknown	Unknown

Projections: Projections are not possible with area-swept based assessments. Catch advice was based on 75% of $E_{40\%}$(75% E_{MSY} *proxy*) using the terminal year fall area-swept estimate assuming q=0.71 on the wing spread which was updated using the average efficiency from 2009-2019 from the sweep experiment (Miller et al., 2020). Updated 2019 fall 30+ cm area-swept biomass (2,862 mt) implies an OFL of 658 mt based on the E_{MSY} *proxy* and a catch of 494 mt for 75% of the E_{MSY} *proxy*. Alternatively, using the average updated 2018 and 2019 fall 30+ cm area-swept biomass (2,880 mt) implies an OFL of 662 mt based on the E_{MSY} *proxy* and a catch of 497 mt for 75% of the E_{MSY} *proxy*.

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).
  The largest source of uncertainty with the direct estimates of stock biomass from survey area-swept estimates originates from the survey gear catchability (q). Biomass and exploitation rate estimates are sensitive to the survey q assumption. However this 2020 update does incorporate the use of a re-estimated q through an average estimate of efficiency from 2009-2019 (q=0.71) from the sweep study for the NEFSC survey. This updated q assumption (0.71) results in a higher estimate of 30+ biomass (2,862 mt) relative to the 2017 estimate q=0.87 assumption (2,343 mt) from the updated fall surveys. Another major source of uncertainty with this method is that biomass based reference points cannot be determined and overfished status is unknown.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}
  The model used to determine status of this stock does not allow estimation of a retrospective pattern. An analytical stock assessment model does not exist for Gulf of Maine winter flounder. An analytical model was no longer used for stock status determination at SARC 52 (2011) due to concerns with a strong retrospective pattern. Models have difficulty with the apparent lack of a relationship between a large decrease in the catch with little change in the indices and age and/or size structure over time.

- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?
  Population projections for Gulf of Maine winter flounder do not exist for area-swept assessments and stock biomass status is unknown. Catch advice from area-swept estimates tend to vary with interannual variability in the surveys. Consideration should be given to using multiple surveys to stabilze the biomass estimates and catch advice.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.
  The assumption on q changed from 0.87 to 0.71 using information from the updated sweep experiment (Miller et al., 2020) and incorporation of new survey data were made to this Gulf of Maine winter flounder management track assessment. The new MRIP calibrated catch time series was also updated in this assessment. In addition there were some changes with updated commercial landings data with the switch to using Stockeff data which are mostly due to the changes in the proration with regards to unknown areas from Massachusetts

state landings of winter flounder. However, Changes in total removals will not affect the biomass or catch advice and total removals still remain far below the overfishing definition.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The overfishing status of Gulf of Maine winter flounder has not changed.

- Provide qualitative statements describing the condition of the stock that relate to stock status.

  The Gulf of Maine winter flounder has relatively flat survey indices with little change in the size structure over time. There have been large declines in the commercial and recreational removals since the 1980s. However, this large decline over the time series does not appear to have resulted in a response in the stock's size structure within the catch and surveys nor has it resulted in a change in the survey indices of abundance.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Direct area-swept assessments could be improved with additional studies on state survey gear efficiency. Quantifying the degree of herding between the doors and escapement under the footrope and/or above the headrope for state surveys is needed to improve the area-swept biomass estimates. Studies quantifying winter flounder abundance and distribution among habitat types and within estuaries could improve the biomass estimate.

- Are there other important issues?

  The general lack of a response in survey indices and age/size structure are the primary sources of concern with catches remaining far below the overfishing level.

References:

Northeast Fisheries Science Center. 2017. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 17-17; Commer, Northeast Fish Sci Cent Ref Doc. 17-17; 259 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. https://repository.library.noaa.gov/view/noaa/16091

Northeast Fisheries Science Center. 2011. 52^{nd} Northeast Regional Stock Assessment Workshop (52^{nd} SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 11-17; 962 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. CRD11-17

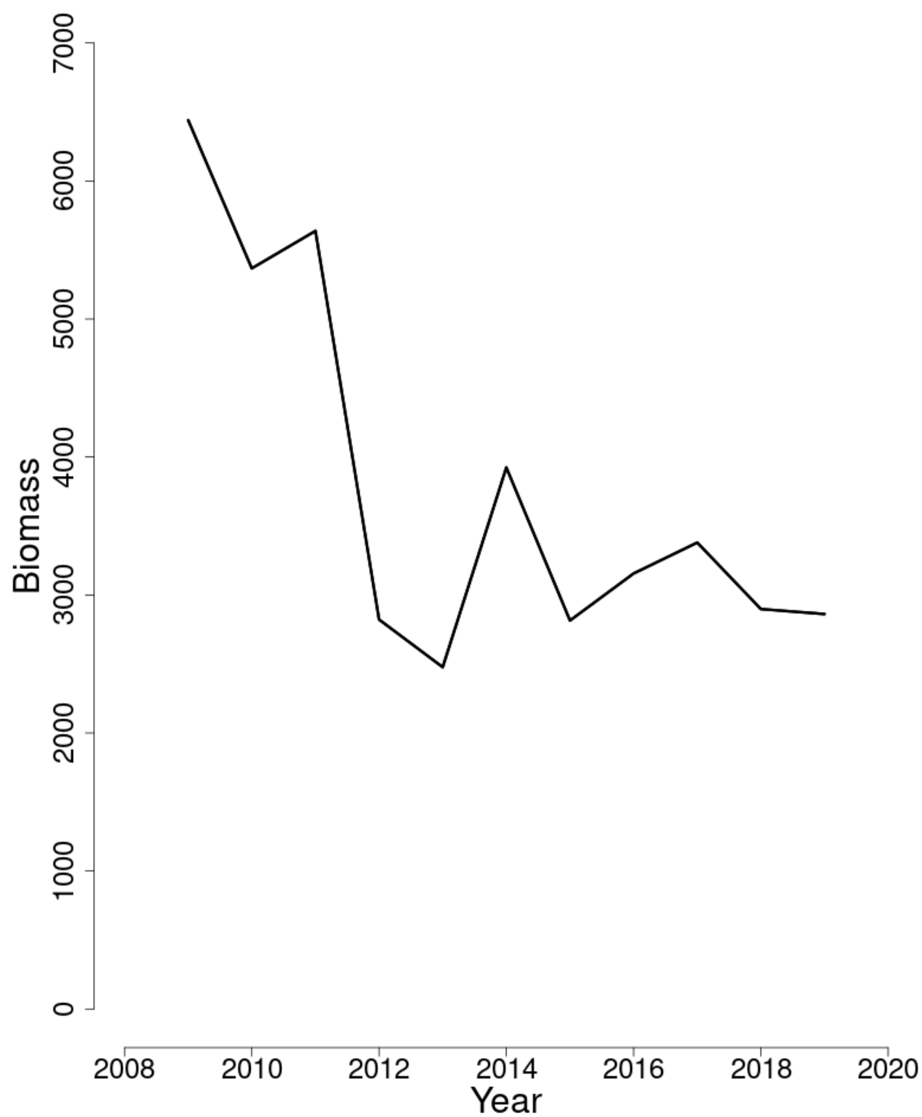

Figure 1: Trends in 30+ cm area-swept biomass of Gulf of Maine winter flounder between 2009 and 2019 from the current assessment based on the fall (MENH, MDMF, NEFSC) surveys.

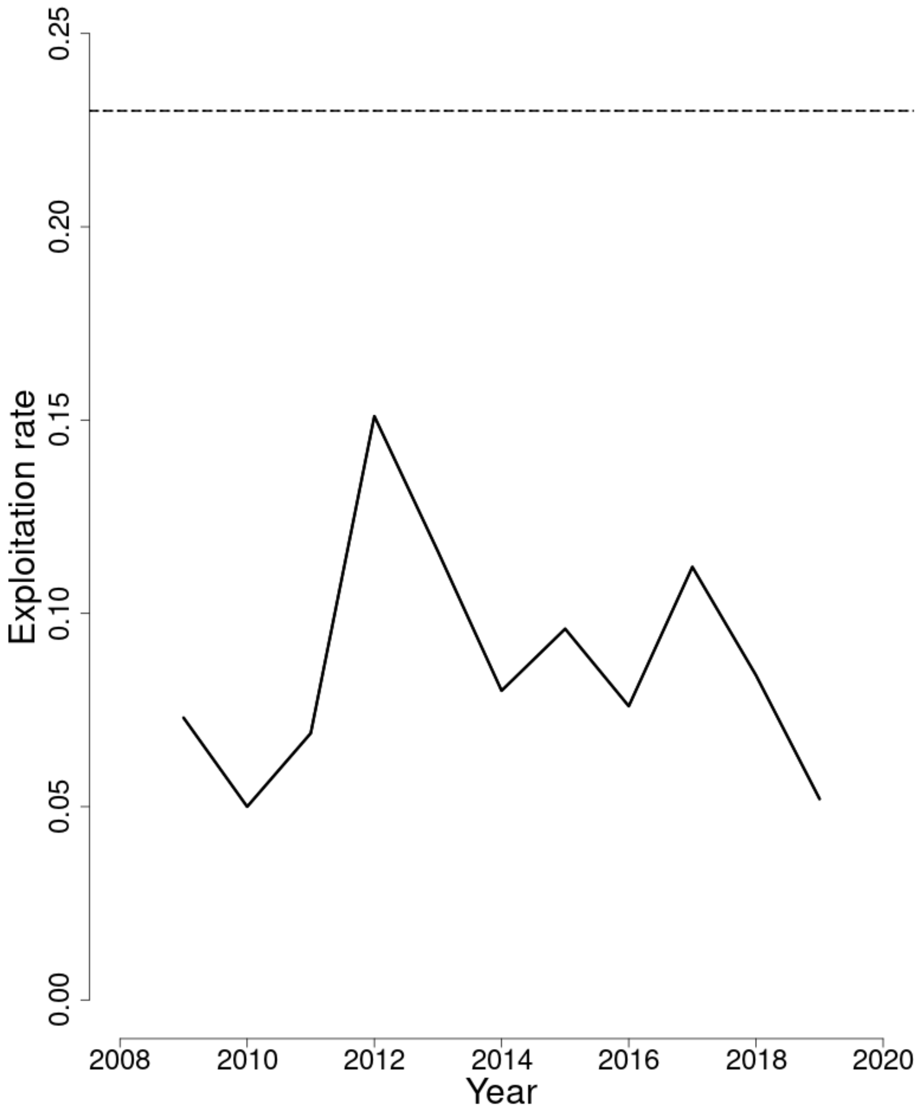

Figure 2: Trends in the exploitation rates (E_{Full}) of Gulf of Maine winter flounder between 2009 and 2019 from the current assessment and the corresponding $F_{Threshold}$ (E_{MSY} *proxy*=0.23; horizontal dashed line).

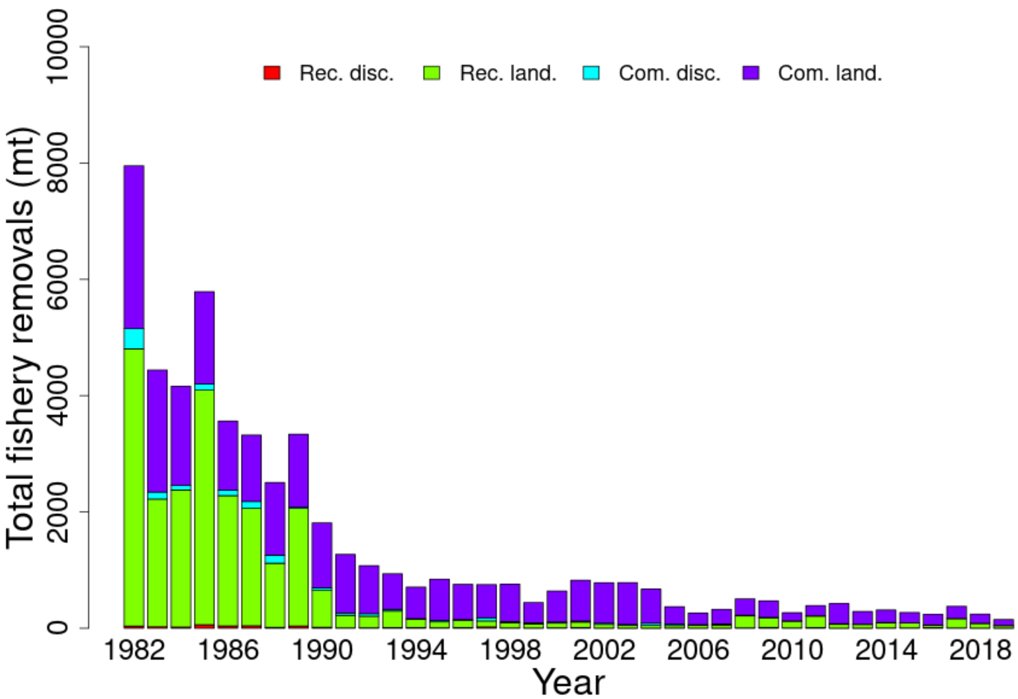

Figure 3: Total catch of Gulf of Maine winter flounder between 2009 and 2019 by fleet (commercial and recreational) and disposition (landings and discards). A 15% mortality rate is assumed on recreational discards and a 50% mortality rate on commercial discards.

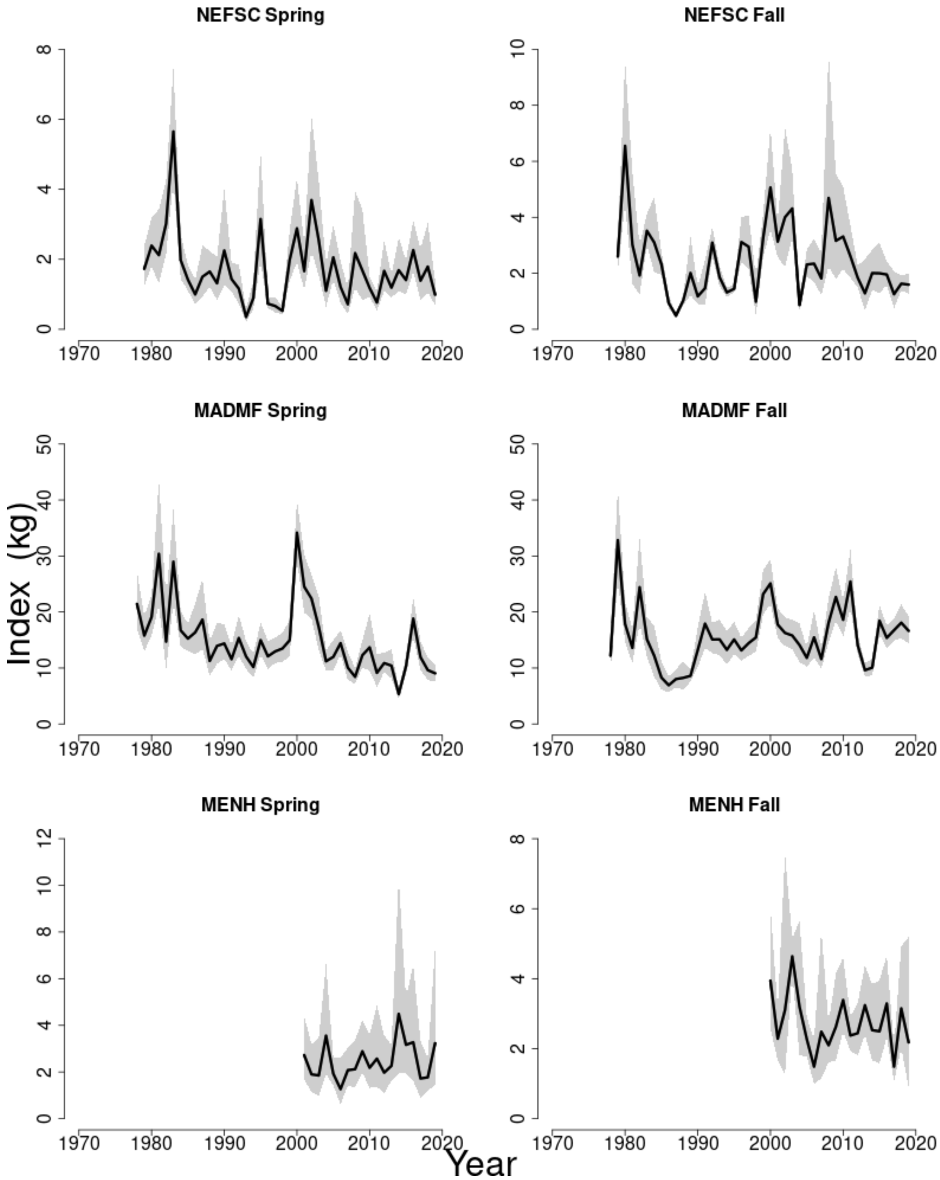

Figure 4: Indices of biomass for the Gulf of Maine winter flounder between 1978 and 2019 for the Northeast Fisheries Science Center (NEFSC), Massachusetts Division of Marine Fisheries (MDMF), and the Maine New Hampshire (MENH) spring and fall bottom trawl (strata 1-3) surveys. NEFSC indices are calculated with gear and vessel conversion factors where appropriate. The approximate 90% lognormal confidence intervals are shown.

draft working paper for peer review only

Southern New England Mid-Atlantic winter flounder

2020 Assessment Update Report

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Woods Hole, Massachusetts

Compiled August 2020

This assessment of the Southern New England Mid-Atlantic winter flounder (Pseudopleuronectes americanus) stock is an operational assessment of the existing banchmark assessment (NEFSC 2011), and follows operational updates in 2015 and 2017. In each assessment since the benchmark the stock was overfished, but overfishing was not occurring (NEFSC 2015, 2017). The current assessment updates commercial fishery catch data, recreational fishery catch data (using new MRIP calibrated data), research survey indices of abundance, and the analytical ASAP assessment models and reference points through 2019. Additionally, stock projections have been updated through 2023.

State of Stock: Based on this updated assessment, the Southern New England Mid-Atlantic winter flounder (*Pseudopleuronectes americanus*) stock is overfished but overfishing is not occurring (Figures 1-2). Retrospective adjustments were not made to the model results. Spawning stock biomass (SSB) in 2019 was estimated to be 3,959 (mt) which is 32% of the biomass target (12,261 mt), and 64% of the biomass threshold for an overfished stock ($SSB_{Threshold} = 6130.5$ (mt); Figure 1). The 2019 fully selected fishing mortality was estimated to be 0.071 which is 25% of the overfishing threshold ($F_{MSY} = 0.286$; Figure 2).

Table 1: Catch and status table for Southern New England Mid-Atlantic winter flounder. All weights are in (mt), recruitment is in (000s), and F_{Full} is the fishing mortality on fully selected ages (ages 4 and 5). Model results are from the current updated ASAP assessment.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Data										
Recreational discards	24	18	11	8	4	13	3	2	4	2
Recreational landings	119	155	126	15	99	39	61	10	10	1
Commercial discards	153	298	482	206	64	82	125	101	108	105
Commercial landings	173	149	134	859	660	661	516	495	326	202
Catch for Assessment	469	620	752	1,087	827	795	704	608	449	310
Model Results										
Spawning Stock Biomass	5,692	6,712	6,734	6,483	5,379	4,780	4,106	3,928	4,173	3,959
F_{Full}	0.075	0.092	0.114	0.183	0.17	0.169	0.173	0.146	0.102	0.071
Recruits	6,583	4,682	4,370	2,416	4,471	5,361	5,558	3,405	6,395	3,380

Table 2: Comparison of reference points estimated in the 2017 operational assessment and from the current assessment update. F40% was used as a proxy for F_{MSY} and an SSB_{MSY} proxy was calculated from a long-term stochastic projection drawing from the time-series of empirical recruitment. Recruitment estimates are median values of the time-series. 90% CI are shown in parentheses.

	2017	2020
F_{MSY} proxy	0.340	0.286
SSB_{MSY} (mt)	24,687	12,261 (6,209 - 21,075)
MSY (mt)	7,532	3,915 (2,018 - 6,643)
Median recruits (000s)	15,802	16,727
Overfishing	No	No
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from a cumulative distribution function of the full time-series of recruitment estimates. The annual fishery selectivity, maturity ogive, and mean weights at age used in the projection are the most recent 5 year averages; The model exhibited a minor retrospective pattern in F and SSB so no retrospective adjustments were applied in the projections.

Table 3: Short term projections of total fishery catch and spawning stock biomass for Southern New England Mid-Atlantic winter flounder based on a harvest scenario of fishing at *F_{MSY} proxy* between 2021 and 2023. Catch in 2020 was assumed to be 251 (mt), a value provided by GARFO. 90% CI are shown next to SSB estimates.

Year	Catch (mt)	SSB (mt)	F_{Full}
2020	251	4,434 (3,664 - 5,307)	0.052

Year	Catch (mt)	SSB (mt)	F_{Full}
2021	1,240	4,468 (3,742 - 5,322)	0.286
2022	1,180	3,456 (2,850 - 4,229)	0.286
2023	1,721	4,146 (2,526 - 9,819)	0.286

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  A source of uncertainty is the estimate of natural mortality based on longevity, which is not well studied in Southern New England Mid-Atlantic winter flounder, and assumed constant over time. Natural mortality affects the scale of the biomass and fishing mortality estimates. Natural mortality was adjusted upwards from 0.2 to 0.3 during the last benchmark assessment (2011) assuming a max age of 16. However, there is still uncertainty in the true *max age of the population and the resulting natural mortality estimate.*

Other sources of uncertainty include the length distribution of the recreational discards. The recreational discards are a small component of the total catch, but the assessment suffers from very little length information used to characterize the recreational discards (1 to 2 lengths in recent years). For this assessment a compiled discard length distribution over all years was used to characterize the recreational discards. In addtion, the paucity of recreational data going forward could be an issue for this assessment.

The population projections are sensitive to the recruitment model chosen, as well as the temporal period selected from which recruitment estimates are drawn.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Table **??**).

  The retrospective patterns for both Ffull and SSB are minor and no retrospective adjustment in 2019 was required.

- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?

  Population projections for Southern New England Mid-Atlantic winter flounder are reasonably well determined. However, the results are sensitive to both the recruitment model and the time-period of recruitment used. In addition, while the retrospective pattern is considered minor (within the 90% CI of both F and SSB), the rho adjusted terminal value of F and SSB are close to falling outside of the bounds which would indicate a major retrospective pattern. This would lead to retrospective adjustments being needed for the projections. The stock is in a rebuilding plan with a rebuild date of 2023. A projection using assumed catch in 2020 and F = 0 through 2023 indicated about a 5% chance of reaching the SSB target.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.

  A number of changes were made to the Southern New England Mid-Atlantic winter flounder assessment for this update. Changes and were made to model settings and BRP determination in response to NEFMC SSC concerns with the methodology from the previous benchmark: 'The SSC noted a couple of issues with SNE/MA winter flounder. The first was that the projections were overly optimistic, and this was driven by over estimating recruitment. The SSC noted that we appeared to be in a period of low recruitment, therefore assuming that this recruitment will be higher in the projections was not a reasonable assumption. Additionally, the assessment for this stock was allowing for domed shaped selectivity. This was creating an abundance of cryptic biomass, or biomass seen in the computer output of the population, but which does not show up in catch or survey data.'

  The changes made to the data input and benchmark model for this operational update were: 1. Incorporated new MRIP calibrated time-series, 2. Added a selectivity block from 2010 to present, 3. Forced flat top selectivity for the fleet (Ages 4-7) to get rid of cryptic *biomass, 4. Added NEAMAP Spring Trawl survey index. 5. Shifted from FMSY (assumed B-H S-R relationship) to F40% as a proxy, 6. Used empirical CDF of recruitment time-series for projections instead of assuming B-H stock recruit relationship.*

Overall, these changes caused a minor decrease in SSB (getting rid of some cryptic biomass) and cut the SSB reference point in half from 24,687 MT to 12,261 MT. Forcing a flat top selectivity for the fleet increased the SSB retro when compared to the previous operational assessment (Mohn's rho of 0.248 vs 0127). However, the retrospective error for both F and SSB were still considered minor for this assessment.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status of Southern New England Mid-Atlantic winter flounder has not changed since the previous operational updates in 2017 and 2015, and remains the same as the last benchmark assessment in 2011.

- Provide qualitative statements describing the condition of the stock that relate to stock status.

  The Southern New England Mid-Atlantic winter flounder stock shows an overall declining trend in SSB over the time series, with the current estimate (3959 MT) at the time series low. Estimates of fishing mortality have been declining since 2015 and the current value (0.072) is also at a time-series low. Recruitment had a small peak in 2018 (6.4 million), however, it has again dropped below the 10-yr average (4.7 million) in 2019 (3.4 million).

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Southern New England Mid-Atlantic winter flounder assessment could be improved with additional studies on maximum age, as well as improved recreational discard length information. In addition, further investigation into the localized struture/genetics of the stock is warranted. Finally, a future shift to ASAP version 4 (during the next research track assessment) will provide the ability to model envirionmental factors that may influence survey catchability and help develop more informed population projections.

- Are there other important issues?
  None.

References:

Northeast Fisheries Science Center. 2011. 52^{nd} Northeast Regional Stock Assessment Workshop (52^{nd} SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 11-17; 962 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Northeast Fisheries Science Center. 2015. Operational Assessment of 20 Northeast Groundfish Stocks, Updated through 2014. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-24; 251 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA

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Northeast Fisheries Science Center. 2017. Operational Assessment of 19 Northeast Groundfish Stocks, Updated through 2016. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 17-17; 264 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

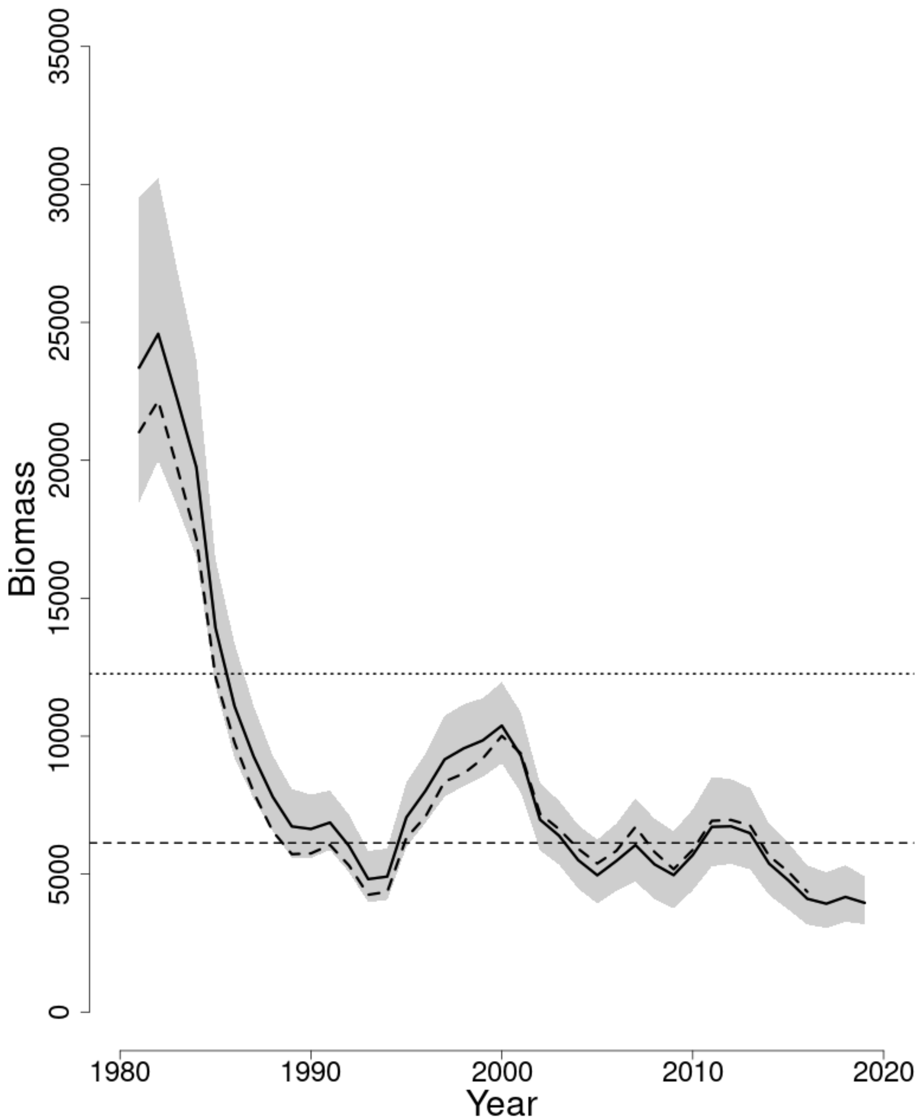


Figure 1: Trends in spawning stock biomass of Southern New England Mid-Atlantic winter flounder between 1981 and 2019 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2020 assessment. The approximate 90% lognormal confidence intervals are shown.

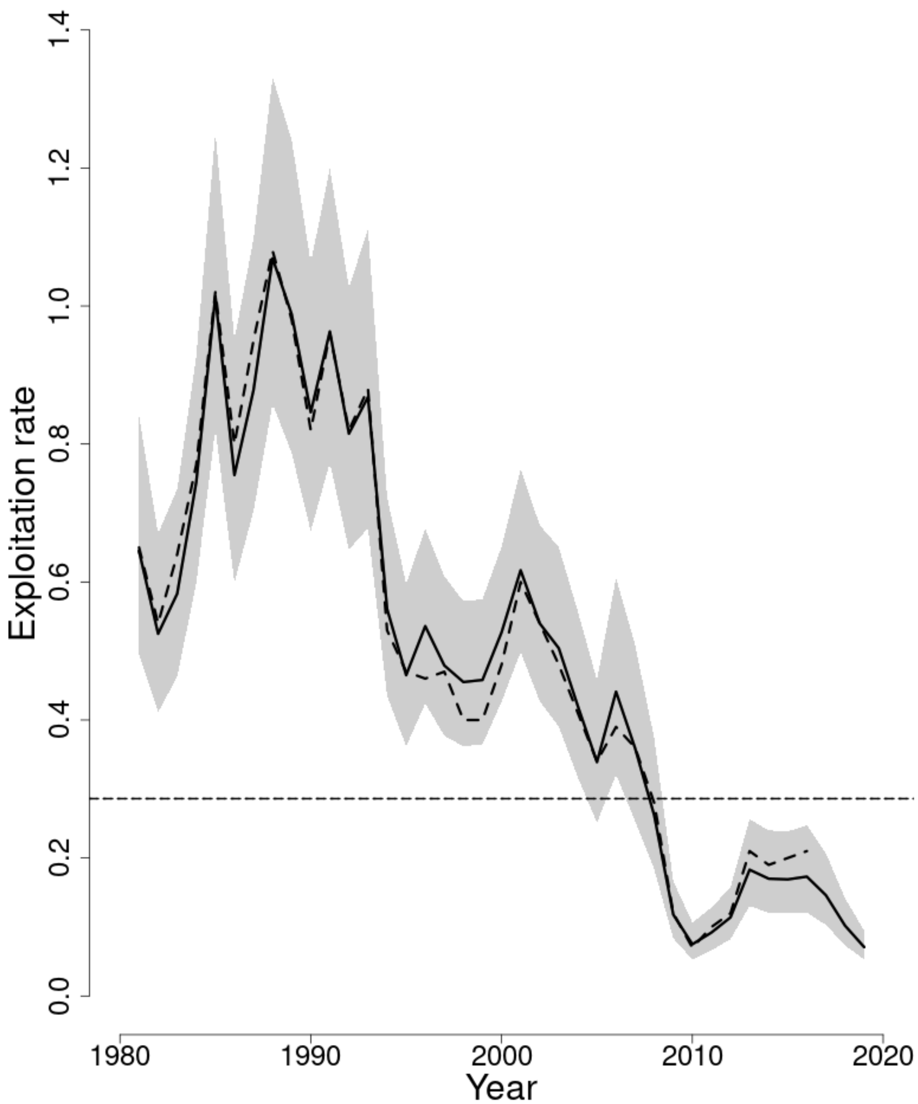


Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of Southern New England Mid-Atlantic winter flounder between 1981 and 2019 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY}=0.286; horizontal dashed line) based on the 2020 assessment. The approximate 90% lognormal confidence intervals are shown.

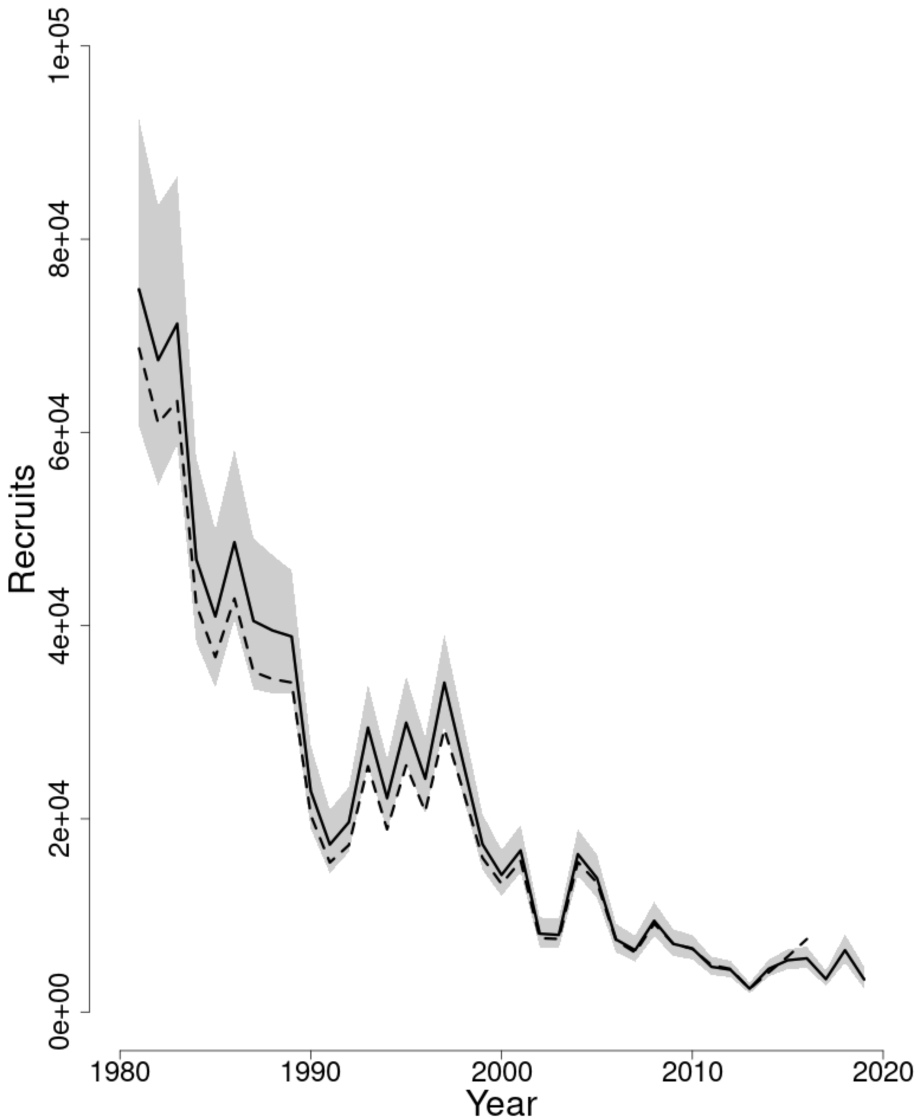


Figure 3: Trends in Recruits (000s) of Southern New England Mid-Atlantic winter flounder between 1981 and 2019 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

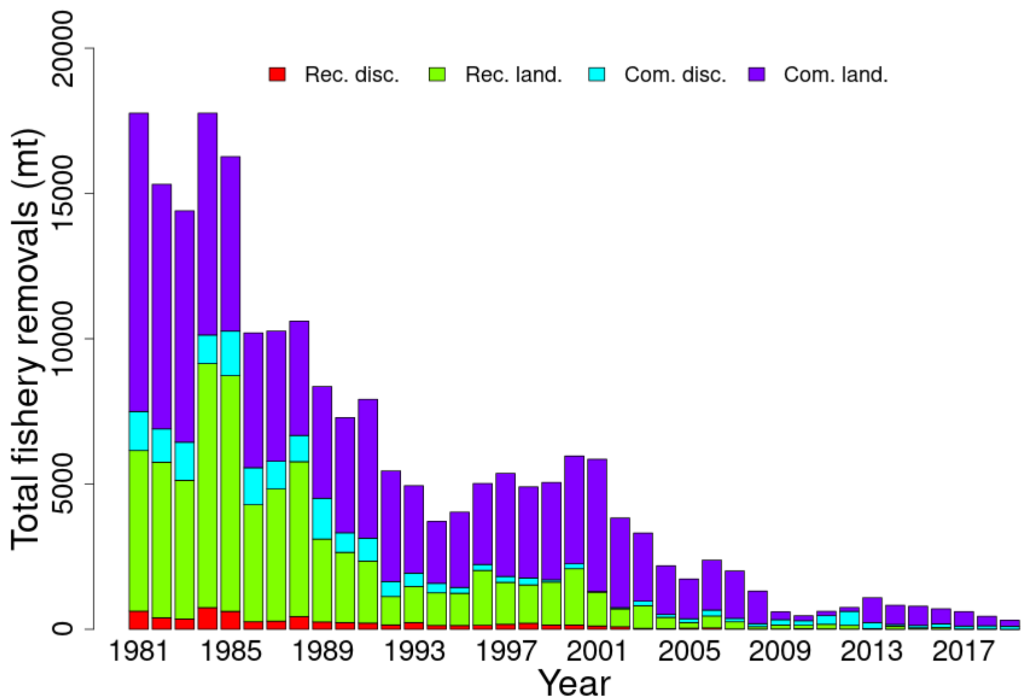


Figure 4: Total catch of Southern New England Mid-Atlantic winter flounder between 1981 and 2019 by fleet (commercial, recreational) and disposition (landings and discards).

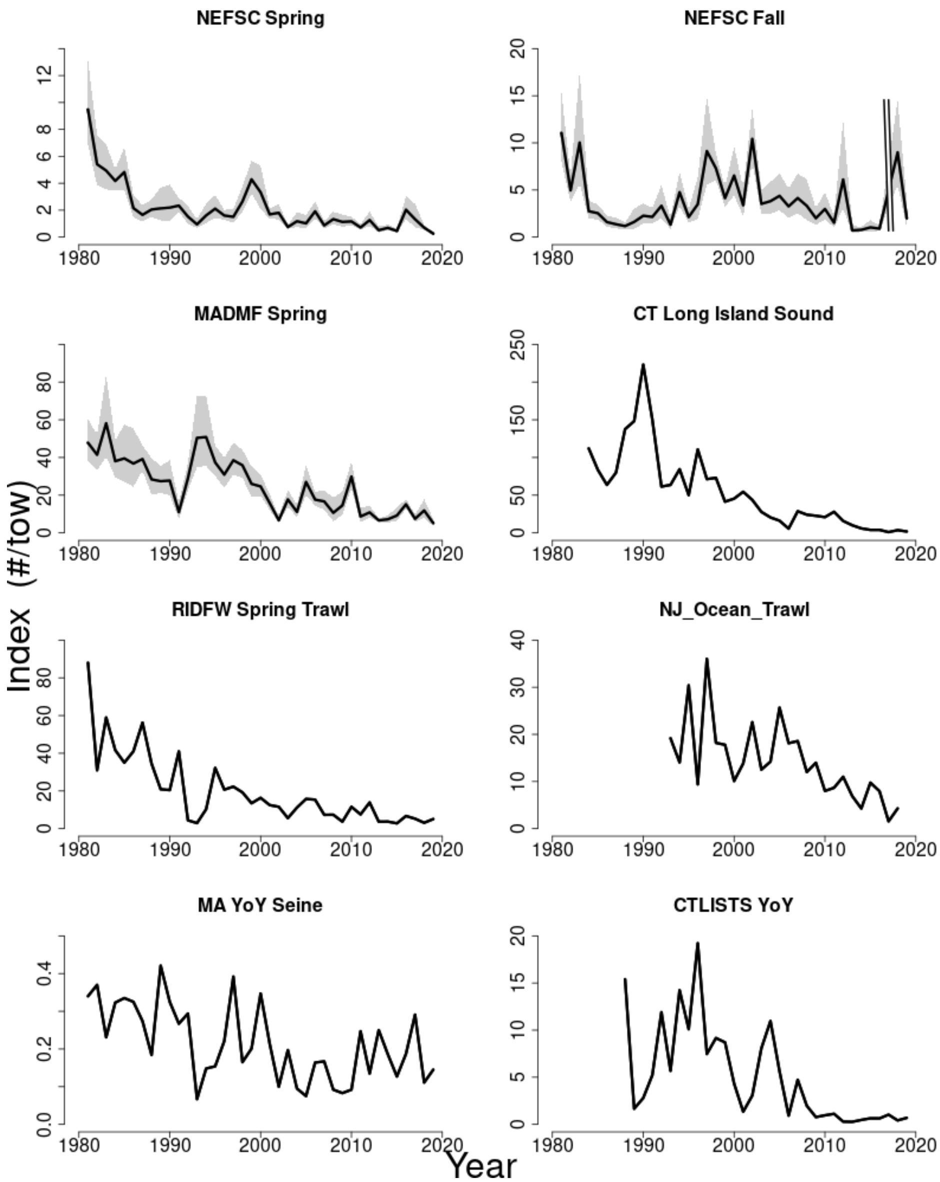
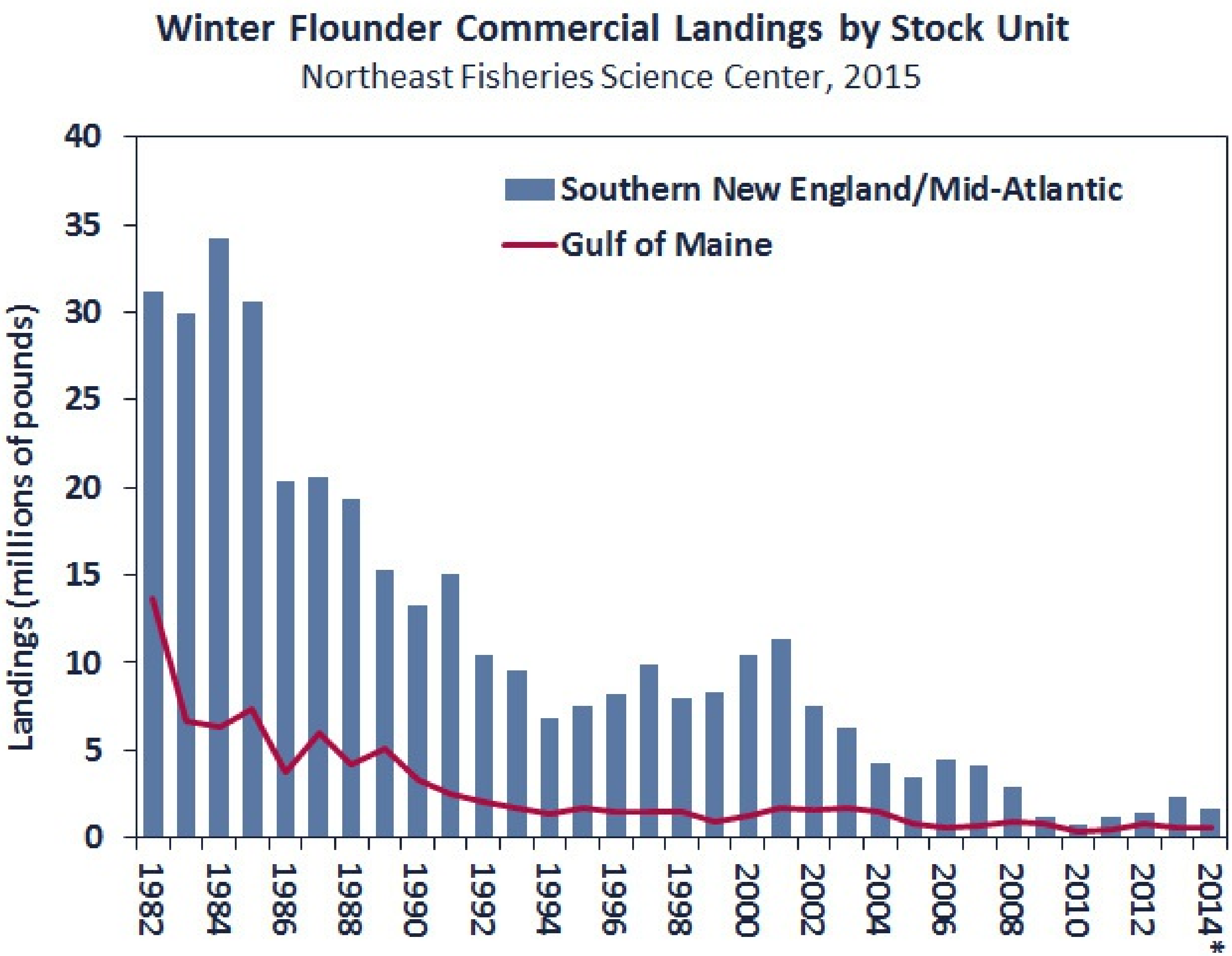


Figure 5: Indices of biomass for the Southern New England Mid-Atlantic winter flounder between 1981 and 2019 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys, the MADMF spring survey, the CT LISTS survey, the RIDFW Spring Trawl survey, the NJ Ocean Trawl survey, and two YoY surveys from MADMF and CT LISTS. Where available, the approximate 90% lognormal confidence intervals are shown. Slashes through the solid line indicate a hole in the survey time series.



*** Landings are shown through 2014 since stock-specific landings can only be obtained through a benchmark stock assessment, with the last one occurring in 2015.**

The Marine Sport Fishery and Resource in Maine

THE MARINE SPORT FISHERY AND RESOURCE IN MAINE

by

Frederick T. Baird, Jr.
and
Robert L. Dow

Department of Sea and Shore Fisheries

Augusta, Maine

December 1966

Published under Appropriation No. 7745

3. Pollock *(Pollachius virens)*—This species is the third member of the "big-three" (cod, haddock, pollock) of the party boat fishery. As a juvenile it is becoming increasingly important as the harbor pollock of the dock, wharf, and shore fishery.

It is distinguished from cod and haddock by its olive green color, lack of barbel, sharp nose and tail. It is a highly voracious species, takes readily to artificial lures and is somewhat seasonal in abundance, being taken primarily in the spring and fall. It is highly regarded as a fighter.

4. Mackerel *(Scomber scombus)*—This is the only true mackerel to visit the Maine coast in numbers and can readily be distinguished from the occasional chub mackerel in that the blue coloration of the common mackerel does not extend below the median line, while the chub mackerel shows blue blotches below this line.

The mackerel is among the top species of the sport fishery and is seasonally taken in large numbers from docks, bridges, wharves and boats. It is highly active on light tackle and strikes readily on natural baits and small lures.

5. Winter Flounder *(Pseudopleuronectes americanus)*—The winter or blackback flounder is the most common of the sport-caught flatfishes. It is readily distinguished from the halibut by size and its right-sided position and from other flatfishes by such identifying features as the number of anal and dorsel rays and the size of the head.

The winter flounder is present at all seasons of the year in the coastal rivers, bays, and close offshore waters, and is normally taken with hand line or rod and reel with such baits as clams, mussels, or marine worms.

This species has long been a favorite of coastal residents and is especially noted for its fresh sweet flavor.

6. Haddock *(Melanogrammus aeglefinus)*—The haddock is distinguished from the cod by its dark median line and the presence of a dark spot over the middle of the pectoral fin. Unlike that of the cod, color of the haddock is normally dark purplish-grey above and white below. Again unlike the cod, the haddock does not reach great size and averages only one and one-half to five pounds. The largest fish reported are approximately forty pounds.

before 1941. Although there has been a general upward trend of annual means since, highs and lows have alternated at roughly decade intervals (Table 5).

Table 5

HIGH		LOW	
Year	Temperature °F	Year	Temperature °F.
1910	48.2	1917	43.3
1931	48.4	1939	43.4
1953	51.9		

In contrast July temperatures have generally been declining since 1911, which was the warmest July on record (64.8°F.), and since the beginning of the current decade have been approximately 7° below the maximum. Although less pronounced, the same trend has taken place with respect to August temperature, which has declined from the 1928 peak.

The current annual decline which has been in progress since 1953, and through 1964 was 5.0°F. below the 1953 peak, suggests two possible developments in the next several years; (1) a continuation of the decline to the end of the present decade with the lowest annual mean probably occurring about 1970, or (2) a resumption of the long-term upward movement of temperature which has characterized the entire period since 1905.

To illustrate possible temperature cycles, a 3-year moving average of July-August sea water temperature for the period 1905-1964 has been plotted and is presented in Figure 1.

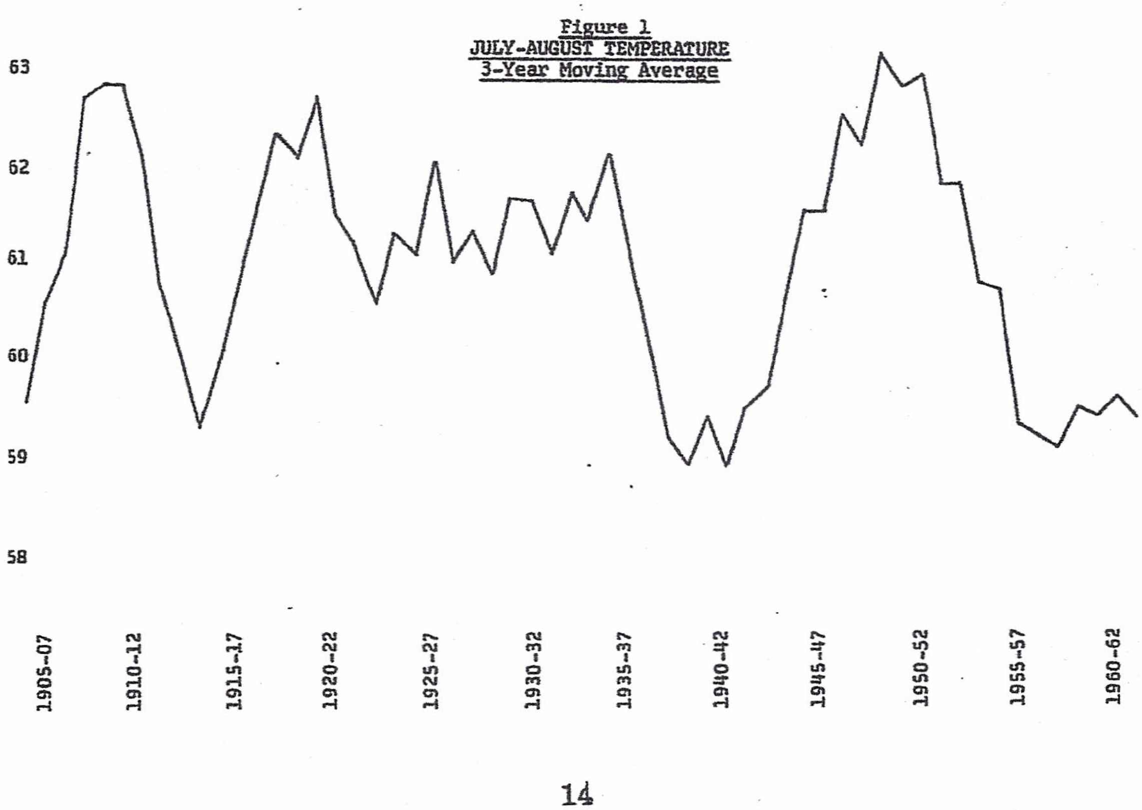


Figure 1
JULY-AUGUST TEMPERATURE
3-Year Moving Average

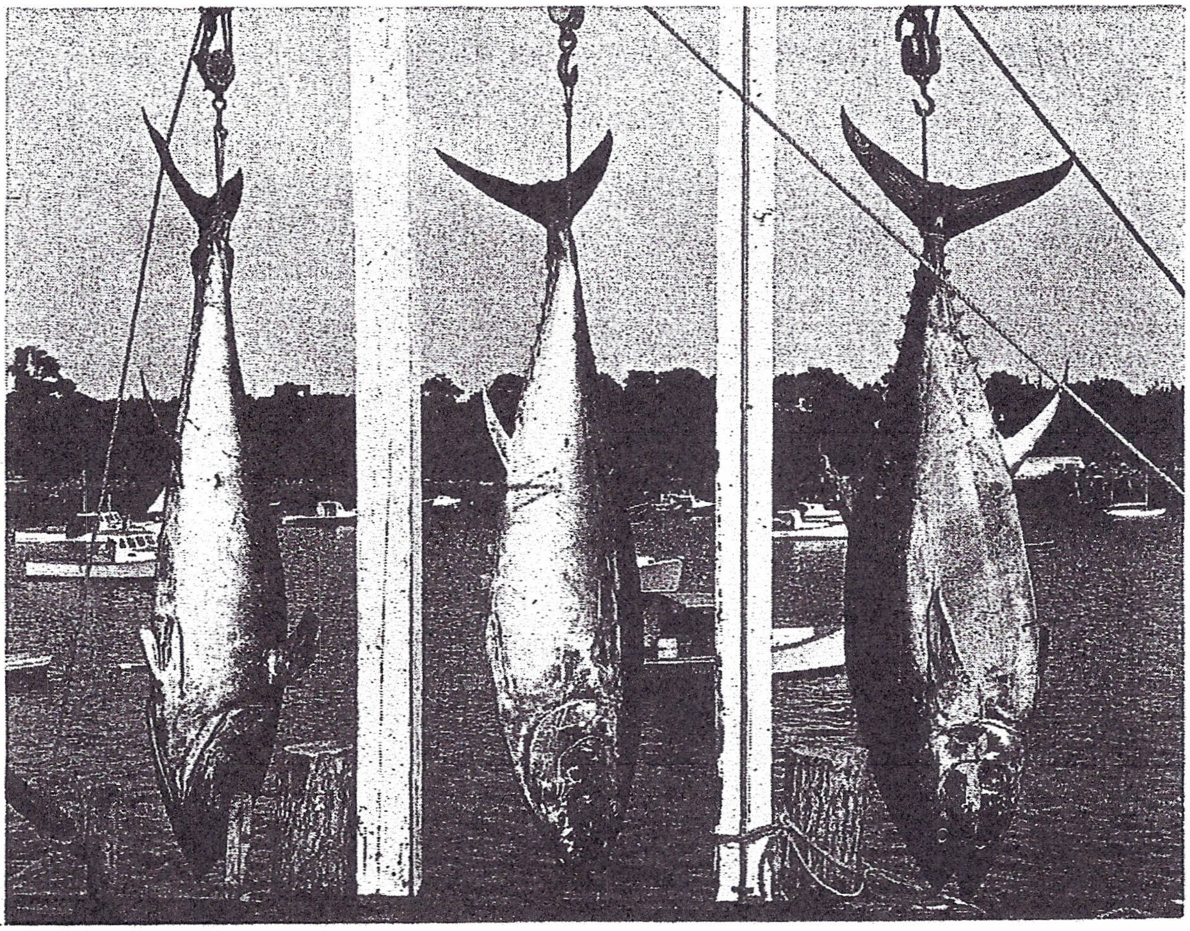
Since fluctuations in abundance associated with sea water temperature have occurred in the past within a relatively short time period, it is most probable that such fluctuations will recur in the future.

When sea water temperatures decline, as they are doing at present, it can be anticipated that such cold water species as cod, pollock, smelt, cunner, Greenland shark, among the finfish, and soft-shell clams, sea scallops, and northern shrimp, among the shellfish, will become more abundant.

Conversely, such warm water species as tuna, butterfish, sea bass, scup, bluefish, and most of the sharks will become less abundant or appear less frequently as seasonal migrants in the Gulf of Maine.

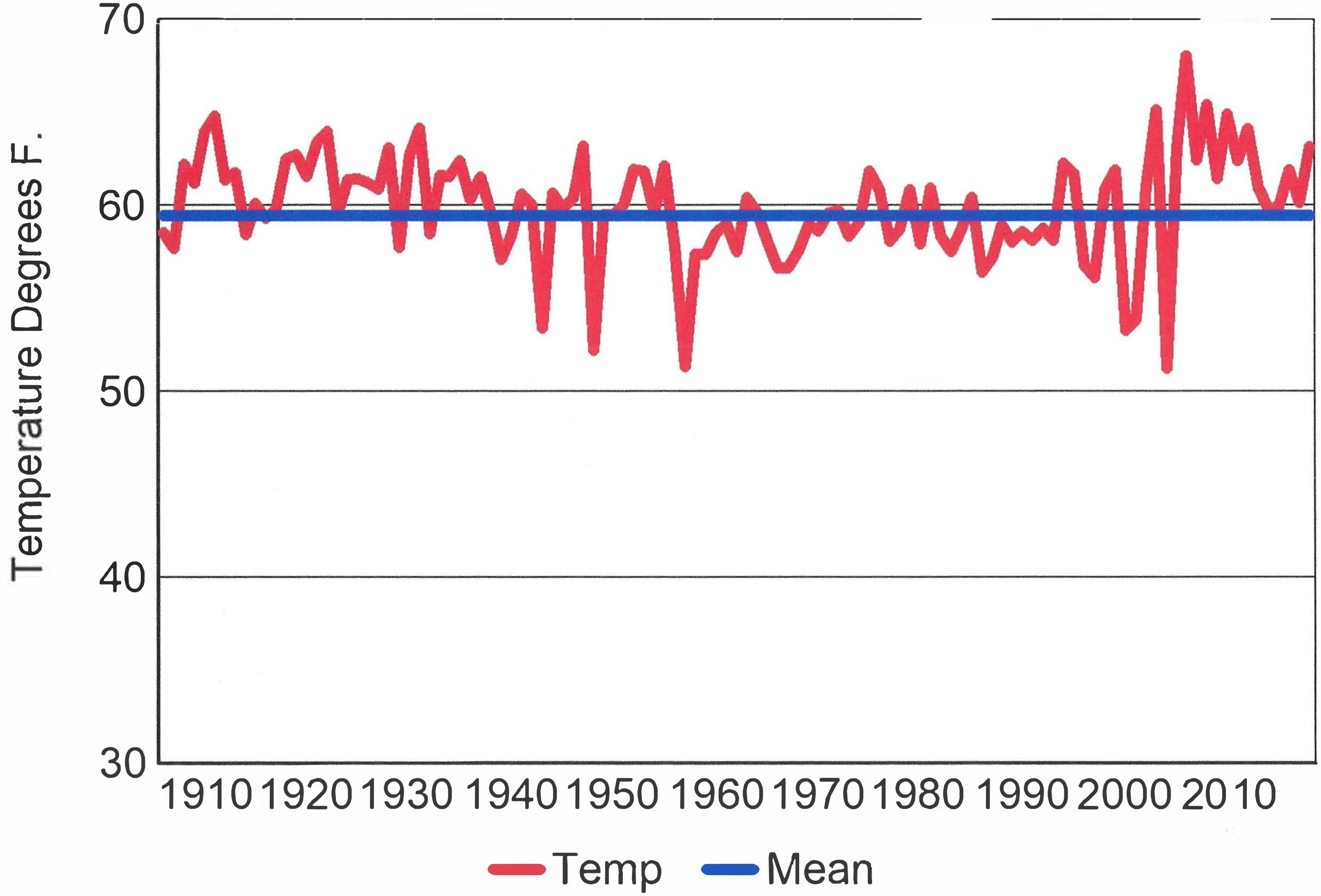
Future stocks of many commercial and gamefish species will likewise depend upon the extent to which coastal marshes are preserved as sources of nutrients and food.

Relatively few species are local residents only. Even such resident fish as smelt and blackback flounder will be only relatively more dependent upon discrete inshore sources of food than are seasonally migrant species such as the mackerel.

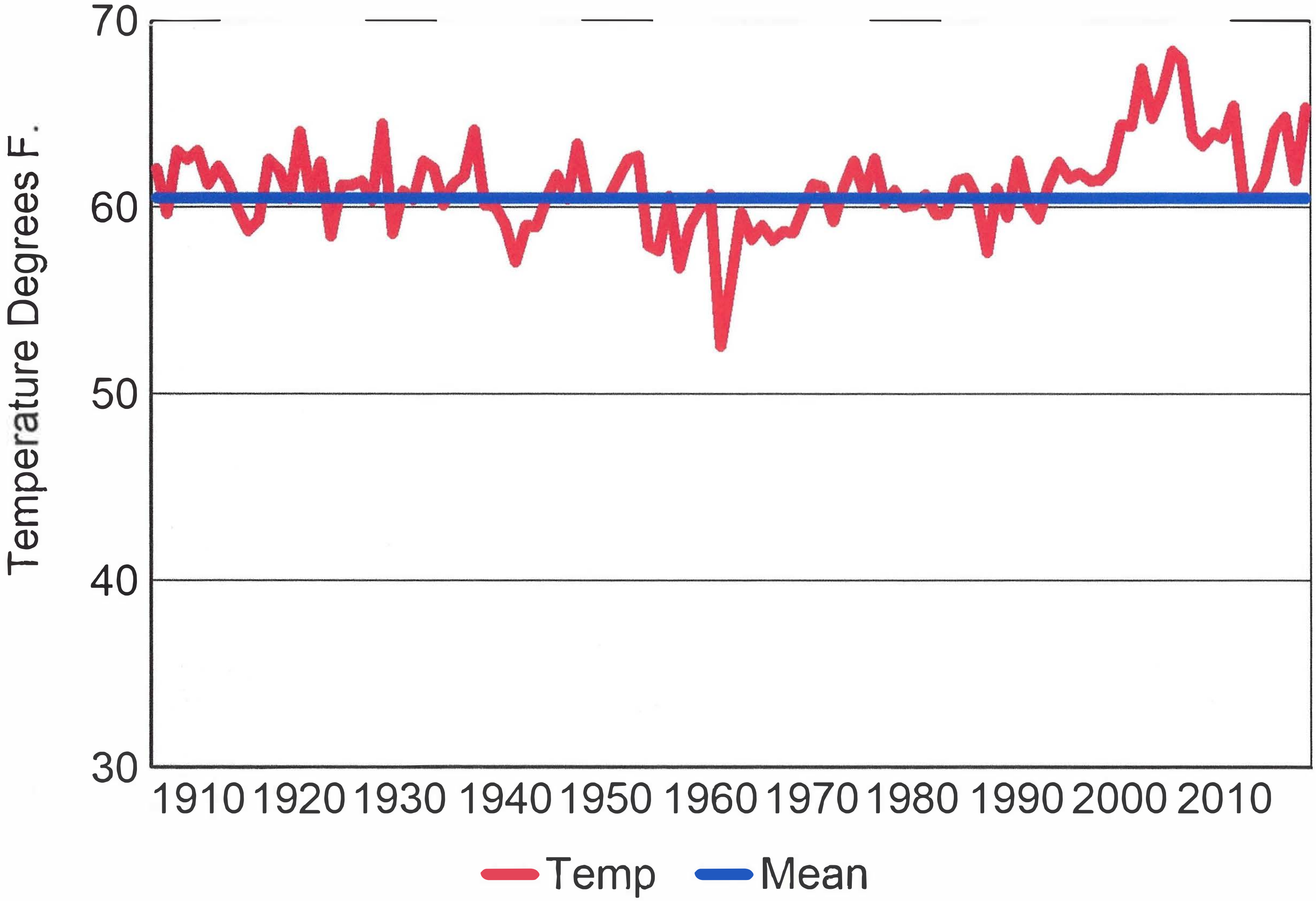


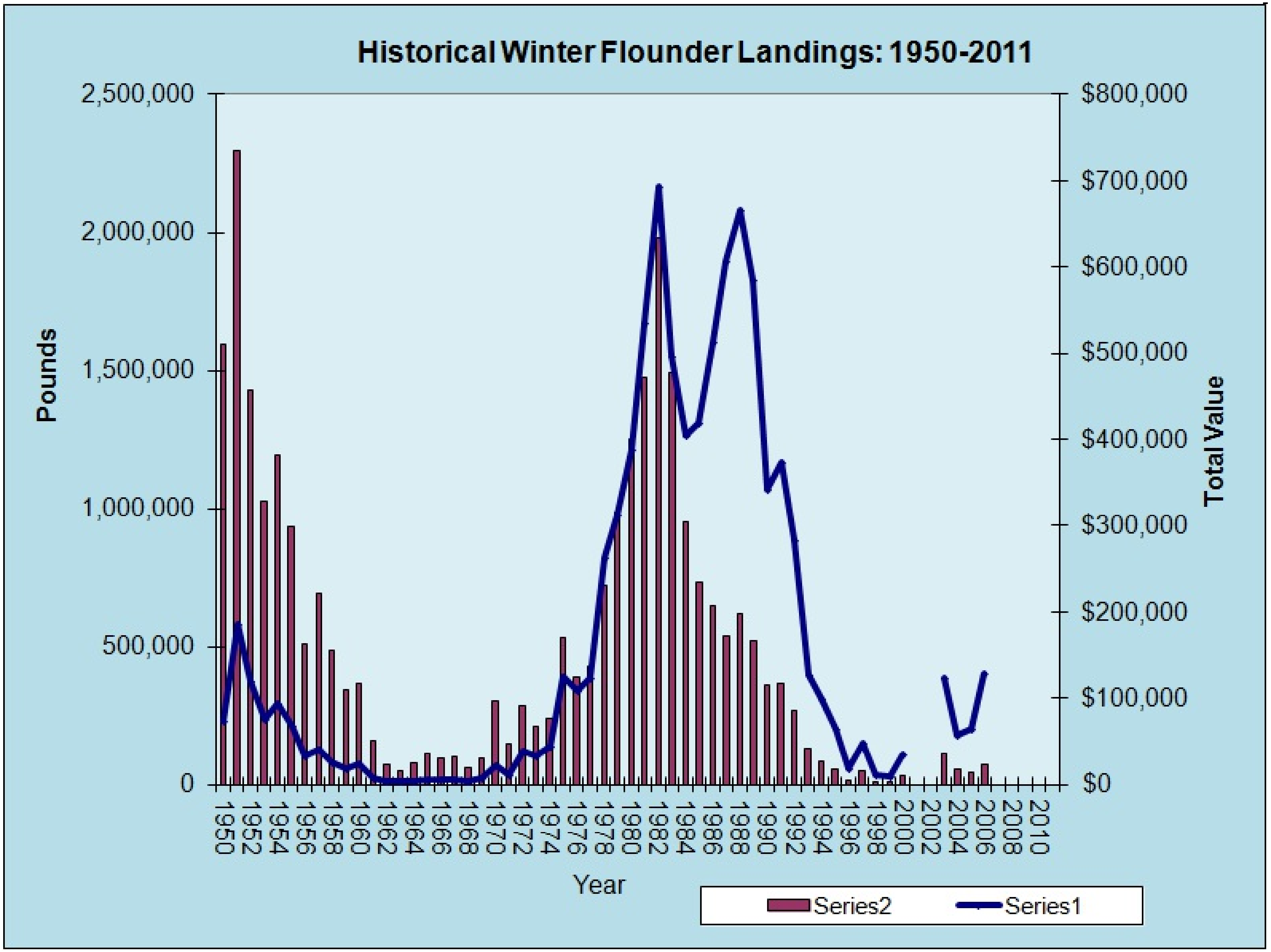
Tuna or horse mackerel — taken during one of the several tuna tournaments. These fish are the largest of the many marine species sport-caught in Maine.

July Boothbay Harbor Temperatures



August Boothbay Harbor Temperatures





Historical Winter Flounder Landings: 1950-2011
Pounds
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Total Value
$800,000
$700,000
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$0
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year
Series2
Series1