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M E M O R A N D U M

DATE: February 29, 2012

TO: Chris Moore, Executive Director

FROM: José Montañez, Staff

SUBJECT: Tilefish Management Measures for Fishing Years 2013-2015

Executive Summary

Based on the assessment that was conducted in 2009, the tilefish stock is not overfished and overfishing is not occurring. The ASPIC model estimated the 2008 biomass at 11,910 mt (26.257 M lb; 4% above the rebuilding target). Staff developed three recommendations for acceptable biological catch (ABC) that depend on how the Scientific and Statistical Committee (SSC) categorizes the tilefish stock assessment (Level 3, Level 4) and applies the risk policy. Table ES1 shows the recommendations for other catch components and limits associated with the three ABC recommendations made by staff. In addition, under all three developed staff recommendations, the total IFQ quota amount is 859.75 mt (1.895 M lb) and the incidental category allocation is 45.25 mt (0.997 M lb).

Table ES1. Staff recommendations for ABC, other catch components and limits associated with two stock assessment level criteria.

	Assessment Level 3		**Assessment Level 4**
	ABC ≈ P*=40th percentile, based on an assumed lognormal OFL distribution that has a CV=100%	**Control rule of 75%F_{MSY}**	**Constant harvest strategy**
ABC	1,513 mt (3.336 M lb)	1,401 mt (3.089 M lb)	905 mt (1.995 M lb)
ACL	1,513 mt (3.336 M lb)	1,401 mt (3.089 M lb)	905 mt (1.995 M lb)
ACT	1,513 mt (3.336 M lb)	1,401 mt (3.089 M lb)	905 mt (1.995 M lb)
TAL	905 mt (1.995 M lb)	905 mt (1.995 M lb)	905 mt (1.995 M lb)

We do not recommend any change to the current recreational possession limit (8-fish per person per trip with no minimum size). Also, we recommend that no quota be allocated to the Research Set-Aside Program.

Introduction

The Magnuson Stevens Act (MSA) as currently amended requires each Council's SSC to provide, among other things, ongoing scientific advice for fishery management decisions, including recommendations for ABC, preventing overfishing, and maximum sustainable yield. The Mid-Atlantic Fishery Management Council's (Council) catch limit recommendations for the upcoming fishing year(s) cannot exceed the ABC recommendation of the SSC. In addition, the Tilefish Fishery Management Plan (FMP) established a Monitoring Committee which develops recommendations for management measures designed to achieve the recommended catch limits. The SSC recommends an ABC for tilefish that addresses scientific uncertainty and the Monitoring Committee recommends measures to address management uncertainty (ACT or annual catch target). Based on the SSC and Monitoring Committee’s recommendations, the Council will make a recommendation to the NMFS (National Marine Fisheries Service) Northeast Regional Administrator.

Management System

See Tilefish AP [Advisory Panel] Informational Document (APID, page 1). In summary, the:

- FMP became effective November 1, 2001
- FMP established a stock rebuilding strategy and TAL as the primary control on fishing mortality
- FMP established a constant harvest strategy of 905 mt (1.995 M lb) to rebuild stock in a ten year rebuilding time frame (i.e. Sunset of October 31, 2011). (The tilefish fishing year is November 1 - October 31)
- Amendment 1 (effective November 1, 2009) implemented an IFQ system and continued rebuilding strategy implemented under the original FMP

Catch and Landings

Commercial landings (calendar year) from 1915 to 2011 are provided in Appendix I. Commercial landings from 1970 to 2011 are presented graphically in the APID (Figure 3, page 6) and landings for fishing years (FY) 2002 through 2012 are presented in Table 1. With the exception of FY 2003, 2004, and 2010 commercial tilefish landings have been below the commercial quota specified each year since the Tilefish FMP was first implemented.

Recreational catches and landings are described in the APID (pages 15-17). A small recreational fishery briefly occurred during the mid 1970's, with less than 100,000 pounds annually (MAFMC 2000). Recreational catches have been low for the 1982 - 2008 period, ranging from zero for most years to less than 15,000 pounds in 2007 according to MRFSS data (Table 10 of the APID). VTR data indicates that the number of tilefish caught by party/charter vessels from Maine through Virginia is low, ranging from 81 fish in 1996 to 1,856 fish in 2010 (Table 11 of the APID). On average, 700 tilefish were caught by party/charter vessel during the 1996-2010 period.

Commercial discards are described in the APID (pages 12-13). According to VTR data, very little (< 0.1%) discarding was reported by longline vessels that targeted tilefish for the 2001 through 2010 period (Table 9 of the APID). The Standardized Bycatch Reporting Methodology (SBRM) 3-year Review Report - - 2011 indicates that 16,806 (SBRM 2009; July 2007-June 2008), 6,835 (SBRM 2010; July 2008-June 2009), and 16,349 (SBMR 2011; July 2009-June 2010) pounds of the tilefish species group (blueline, golden, and NK tilefish) were discarded according to Vessel Trip Report landings data. The bulk of the discards occurred mostly from small mesh bottom otter trawls (Wigley et al. 2011).

Table 1. Summary of management measures and landings for FY[a] 2002 through 2012.

Management measures	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAL (m lb)	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995
Com. quota-initial (m lb)	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995
Com. quota-adjusted (m lb)	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995	1.995
Com. landings	1.935	2.318[b]	2.647[b]	1.497	1.897	1.777	1.672	1.887	1.997	1.892	-
Com. overage/underage (m lb)	-0.060	+0.323	+0.652	-0.498	-0.098	-0.218	-0.323	-0.108	+0.002	-0.103	-
Incidental trip limit (lb)	300	300	300	133	300	300	300	300	300	300	500
Rec. possession limit	-	-	-	-	-	-	-	-	8[c]	8[c]	8[c]

[a] FY 2002 (November 1, 2001 - October 31, 2002).
[b] Lawsuit period (see 2nd paragrpah on page 6 of the APID).
[c] Eight fish per person per trip.

Biological Reference Points

The 2009 SARC 48 updated reference points derived from the SARC 48. These are: B_{MSY} = 11,400 mt (25.132 M lb), F_{MSY} = 0.16 and MSY = 1,868 mt (4.118 M lb). B_{MSY} and K increased by 21% relevant to the 2005 SAW 41 estimates, F_{MSY} decreased by 24%, and MSY decreased by 6%.

Stock Status and Projections

The most recent benchmark peer-reviewed accepted assessment for golden tilefish is from the 2009 Stock Assessment Workshop (SAW/SARC 48). The assessment utilized a surplus production model (ASPIC) which has been the basis of the stock assessment for the last three assessments. The assessment summary report and the entire assessment report can be found at http://www.nefsc.noaa.gov/publications/crd/crd0910/crd0910.pdf and http://www.nefsc.noaa.gov/publications/crd/crd0915/, respectively.

This stock assessment indicated that the golden tilefish stock was not overfished and overfishing was not occurring. Based on the 2009 assessment model results and updated reference points, fishing mortality (F) in 2008 was estimated to be 0.06, 38% of F_{MSY} and stock biomass (B) in 2008 was estimated to be 11,910 mt (26.257 M lb), 4% above B_{MSY}. The 50% confidence interval (25%ile to 75%ile) for F in 2008 is between 0.05 and 0.07. The 50% confidence interval (25%ile to 75%ile) for total biomass in 2008 is between 9,550 mt (21.054 M lb) and 13,538 mt (29.846 M lb).

Based on the Review Panel reports, the ASPIC model did not fit the catch per unit effort (CPUE) well. However, because the model uncertainties were adequately investigated, the SARC was able to conclude that stock was not overfished and overfishing was not occurring. The stock assessment indicates that while the ASPIC model results suggested a recent increase in abundance trends in commercial VTR (vessel trip report) CPUE had declined in recent years (2005-2008) in a mode consistent with the passage of the strong 1999 cohort through the population. Since the ASPIC model currently used does not account for those factors and much of the confidence interval around the 2008 biomass estimate falls below the updated B_{MSY}, there was no convincing evidence that the stock has rebuilt to levels above B_{TARGET}.

Updated Effort Information

The NEFSC provided updated effort information that may be useful for ABC considerations. This information is presented in Appendix I and summarized below.

- Catch per unit effort (CPUE) has increased since the last stock assessment (SAW/SARC 48). The increase in CPUE appears to be due to the presence of one or more strong year classes (2005-2006).

- There is evidence that there is a broader size distribution of the fish being caught.

Rebuilding Timeline

The Tilefish FMP was implemented in November of 2001. Rebuilding of the tilefish stock to B_{MSY} was based on a ten-year constant harvest quota of 905 mt (1.995 M lb). Under the current management program, the tilefish stock was to be fully rebuilt by October 31, 2011. While the most recent stock assessment indicates that the 2008 stock biomass (11,910 mt or 26.257 M lb) was 4% above B_{MSY}, the stock has not been declared rebuilt due to the uncertainty issues described above.

Advisory Panel Fishery Performance Report

Some of the key points of the AP Fishery Performance Report (FPR) considered by staff include:

- CPUE improving. In the last 3 years, the length of a fishing trip has been very stable (ranging from 4 to 5 days) and shorter than in previous years (7 to 10 days), reflecting higher catch rates.

- Observations indicate new incoming multiple-year classes; there is more of a size mix than before (healthy mix of ages). Commercial fishermen are catching a broad size distribution of fish.

Basis for 2013-2015 ABC Recommendation

The tilefish FMP allows for the specification of multi-year management measures. Since the next benchmark tilefish assessment is not scheduled until December 2013 (SARC 57), staff recommend measures be specified for 3 fishing years: FY 2013 (November 1, 2012 - October 31, 2013), FY 2014 (November 1, 2013 - October 31, 2014), and FY 2015 (November 1, 2014 - October 31, 2015). When the next stock benchmark stock assessment is completed (December 2013) the management measures adopted by the Council will be reevaluated.

The SSC is responsible for recommending an ABC which accounts for the level of scientific uncertainty inherent in the determination of the overfishing limit (OFL), as well as other relevant sources of scientific uncertainty. Scientific uncertainty is less than perfect knowledge about the likely outcome of an event, based on estimates derived from scientific information (models and data). Scientific uncertainty enters into the process to set catch limits in several ways; data input into the stock assessment, the assessment modeling, and the projections to determine what upcoming fishing year catches should be. In addition, as indicated in the tilefish flowchart (Figure 1), recreational catches can be accommodated under scientific uncertainty or management uncertainty[1].

The Omnibus Amendment was developed to bring the Council into compliance with the annual catch limit (ACL) and accountability measure (AM) requirements of the MSA. The Omnibus Amendment outlines ABC control rules for use by the SSC in recommending ABC to the Council and a risk policy for use in conjunction with the ABC control rules (four levels) to inform the SSC of the Council's preferred tolerance for the risk of overfishing a stock.

The ABC recommendation will depend on the level that the SSC deems most appropriate for the tilefish assessment.

Level 3

The SSC may designate the assessment as Level 3 because it does not contain estimates of the probability distribution of OFL or the probability distribution provided is not considered best available science by the SSC.

Assuming $B>B_{MSY}$, based on the last benchmark stock assessment that indicates that stock biomass in 2008 (11,910 mt or 26.257 M lb) was 4% above B_{MSY}, staff recommendations associated with the following two scenarios are made:

1) Since the assessment is likely to have overestimated the accuracy of the OFL, the distribution of the OFL can be adjusted using the Council's risk policy. More specifically, the ABC can be roughly equivalent to a $P^*=40^{th}$ percentile, based on an assumed lognormal OFL distribution that has a CV=100%, and that tilefish exhibit a typical life history. The staff recommended ABC is 1,513 mt (3.336 M lb). The recommended ABC is 81% of the catch at OFL.

2) If the OFL distribution cannot be developed, a control rule of $75\%F_{MSY}$ (0.12) could be applied as a default. This control rule would yield an ABC of 1,401 mt (3.089 M lb).

Level 4

The SSC may designate the assessment as Level 4 because while biomass and fishing mortality trends in the assessment are deemed reliable, the reference points associated with them are not considered reliable. In this level, a simple control rule can be based on biomass and catch history and the Council's risk policy.

As indicated before, the tilefish FMP implemented a constant harvest strategy (905 mt or 1.995 M lb) as the primary tool to control fishing mortality. Staff recommends that an ABC is set at 905 mt (1.995 M lb). Note that this staff recommended ABC is substantially lower (65%) than the yield associated with a $75\%F_{MSY}$.

[1] Concerns have been raised about the potential emergence of a recreational tilefish fishery and the ability of the recreational landings survey (i.e., MRFSS) to accurately capture the magnitude of that fishery given the levels of sampling. Mortality from the recreational fishery is not presently accounted for through the stock assessment, which would be the appropriate place to address sources of fishing mortality. If not accounted for under scientific uncertainty, uncertainty associated with the imprecision of the recreational fishery (i.e., inability to accurately capture the true magnitude of that fishery) could be accommodated under management uncertainty.

General Note: Recreational catches and commercial discards were not included in previous assessments due to the fact that: recreational catches have been low according to MRFSS and VTR data and the potential high uncertainty associated with trawl discards estimates, respectively. Paul Nitschke (NEFSC, Tilefish Assessment Lead) indicated to staff that the incorporation of these small amounts of recreational catches and commercial discards in the ASPIC model would likely increase the biomass estimates results. Commercial discards and recreational catches, while small, will be incorporated into the next benchmark assessment if possible.

Staff recommendations under assessment level 3 above could potentially result in larger catches when compared to the current constant harvest strategy. As indicated in the 48th SAW stock assessment, fishing mortality has been decreasing and biomass has been increasing since the beginning of the FMP in 2001. The assessment projections suggest the stock will continue to build if catches remain below MSY (1,854 mt or 4.087 M lb). However, as indicated in a note from SAW chairman it is important to bear in mind that the "working's group view was that increasing the status quo TAC = 905 mt [1.995 M lb] to the updated MSY = 1868 mt [4.118 M lb] would be risky considering the uncertainty in the assessment and stock status determination."

Other Management Measures

Considerations for ACL

In the Omnibus Amendment, ABC=ACL (Figure 1; Table 3). Table 2 shows the ACLs associated with the two potential assessment level designations presented in the previous section.

Table 2. Tilefish ABCs and ACLs for 2013-2015 under two stock assessment level specifications (Staff recommended).

	Assessment Level 3		Assessment Level 4
	ABC ≈ P*=40th percentile, based on an assumed lognormal OFL distribution that has a CV=100%	Control rule of 75%F_{MSY}	Constant harvest strategy
ABC	1,513 mt (3.336 M lb)	1,401 mt (3.089 M lb)	905 mt (1.995 M lb)
ACL	1,513 mt (3.336 M lb)	1,401 mt (3.089 M lb)	905 mt (1.995 M lb)

Considerations for ACT

As described in the Omnibus Amendment, the Tilefish Monitoring Committee will be responsible for recommending an ACT for the Council to consider. The relationship between the ACT, and other catch components are given in Figure 1 and Table 3. The Committee may provide other recommendations relevant to setting catch limits consistent with the MSA. The Monitoring Committee can consider all relevant sources of management uncertainty in the tilefish fishery and provide the technical basis, including any formulaic control rules, for any reduction in catch when recommending an ACT. The ACT, technical basis, and sources of management uncertainty would be described and provided to the Council.

Management uncertainty is comprised of two parts: uncertainty in the ability of managers to control catch and uncertainty in quantifying the true catch (i.e., estimation errors). Management uncertainty can occur because of a lack of sufficient information about the catch (e.g., due to late reporting, underreporting, and/or misreporting of landings or bycatch) or because of a lack of management precision (i.e., the ability to constrain catch to desired levels).

Table 3. Omnibus Amendment terminology and relationship to previous FMP terms.

Previous Term	New Term	Definition	Use in Omnibus
Overfishing Limit (OFL)	Unchanged	The OFL is an estimate of the catch level above which overfishing is occurring. The amount of catch that corresponds to the estimate of MFMT applied to a stock and is expressed in terms of numbers or weight of fish.	OFL = catch level calculated by MFMT
Acceptable Biological Catch (ABC)	Unchanged	The level of a stock's annual catch that accounts for the scientific uncertainty in the estimate of OFL. May not exceed OFL.	ABC is established by SSC
	Annual Catch Limit (ACL)	The level of annual catch of a stock that serves as the basis for invoking AMs.	ACL = ABC
	Annual Catch Target (ACT)	An amount of annual catch of a stock that is the management target of the fishery, inclusive of discards, and accounts for management uncertainty in controlling the actual catch at or below ACL.	ACT
Total Allowable Landings (TAL)	Unchanged	Annual amount of total landings permitted after removing estimated discards.	TAL = ACT – discards
Research Total Allowable Catch (TAC)	Research Set-Aside (RSA)	Amount of Total Allowable Landings (TAL) up to 3 percent that may be set aside to fund research activities	TAL – X% (up to 3%) = IFQs + Incidental Category
Total IFQ Amount	Unchanged	95 percent of the annual TAL (After deducting RSA).	IFQ Allocations
Incidental Category	Unchanged	5 percent of the annual TAL (After deducting RSA).	Incidental Category
Optimum Yield (OY)	Optimum Yield (OY)	The long-term average amount of desired yield from a stock or fishery. OY cannot exceed MSY.	OY
½ B_{MSY}	Minimum Stock Size Threshold (MSST)	Level of stock biomass below which the stock is considered to be overfished.	MSST = ½ B_{MSY}
F_{MSY}	Maximum Fishing Mortality Threshold (MFMT)	The level of fishing mortality (F), on an annual basis, above which overfishing is occurring.	MFMT = F_{MSY}

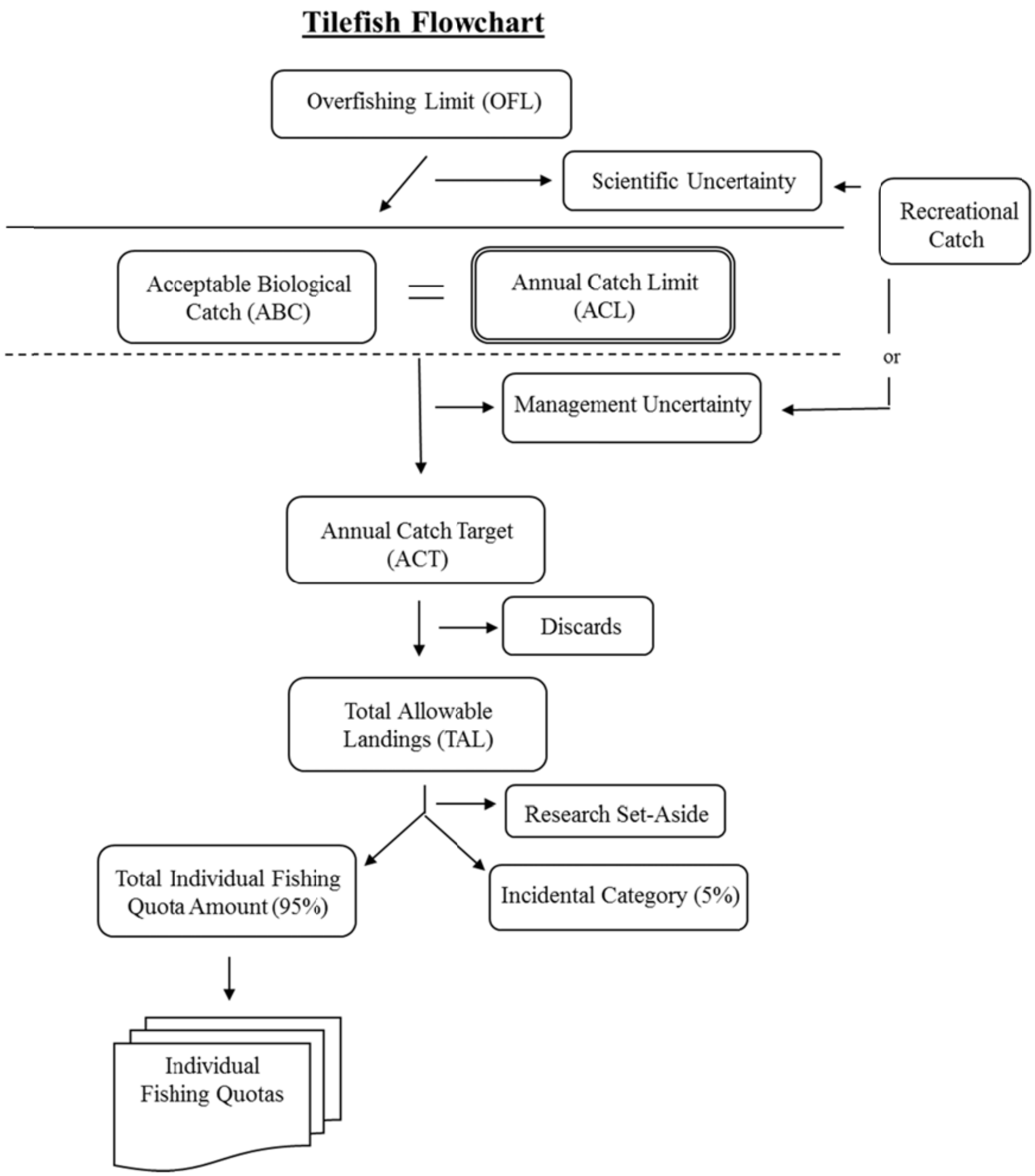

Figure 1. Tilefish flowchart.

Staff recommend the Monitoring Committee consider past specific landings performance, as a basis for quantifying management uncertainty (i.e., implementation error) and as an indicator of future ability to achieve catch target when developing the 2013-2015 ACT recommendation for the fishery (Table 1). The Monitoring Committee should also consider the potential imprecision/variability in expected observed commercial and recreational catch[2] to ensure the ACL is not exceeded. As indicated in the tilefish flow chart (Figure 1), recreational catches can be accommodated under scientific uncertainty or management uncertainty (see footnote 1 for additional information).

The tilefish fishery is managed via an IFQ system and managers believe that all tilefish commercial landings under this program are accounted for. The recreational catch is minimal, and as indicated under the General Note in page 5, the incorporation of these small amounts of recreational catches and commercial discards in the ASPIC model would likely increase the biomass estimates results. <u>Staff recommend no reduction in catch from the ACL</u>. Table 4 shows the ACTs associated with the two potential assessment level designations presented in the ABC recommendation section.

Table 4. Tilefish ACTs for 2013-2015 under two stock assessment level specifications (Staff recommended).

	Assessment Level 3		**Assessment Level 4**
	ABC ≈ P*=40th percentile, based on an assumed lognormal OFL distribution that has a CV=100%	**Control rule of 75%F_{MSY}**	**Constant harvest strategy**
ACT	1,513 mt (3.336 M lb)	1,401 mt (3.089 M lb)	905 mt (1.995 M lb)

Total Allowable Landings (TAL)

Management uncertainty can occur because of insufficient information about discards (Figure 1). As previously indicated, commercial discards are low and have not previously been included in the assessment due to the potential high uncertainty associated with trawl discards estimates. As indicated under the General Note in page 5, the incorporation of small amounts of recreational catches and commercial discards in the ASPIC model would likely increase the biomass estimates results. <u>Staff recommends no reduction in catch from the ACT</u> due to discards (Table 5). However, due to the fact that both of the scenarios under assessment Level 3 criteria would result in substantially larger TALs when compared to the current harvest strategy quota (905 mt or 1.995 M lb), and the potential risk associated with increasing landings considering the uncertainty in the assessment and stock status determination, staff recommend that under the assessment Level criteria 3, both TALs are reduced to the current harvest limit.

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[2] At the AP meeting, Gary Caputi indicated that he would further inquire about headboats trips targeting Golden Tilefish. He reported to Council staff that:

- "I have not been able to find any headboats in Jersey that are scheduling trips targeting tilefish this winter or spring. The cost of fuel and potential return on the investment for anglers is not great enough to generate much excitement."
- "I found one out of Rudee Inlet, but they target blueline tilefish and grouper and only rarely move off to water deep enough to harbor goldens."
- "Didn’t see any Montauk boats listing tilefish trip, either."

The commercial quota has been almost entirely taken since the IFQ system went in effect. The landings-based allocations (IFQ 95%, incidental 5%) were maintained in the derivation of the sector-specific TALs. Under all three developed recommendations, the total IFQ quota amount is 859.75 mt (1.895 M lb) and the incidental category allocation is 45.25 mt (0.997 M lb).

Table 5. Tilefish TALs for 2013-2015 under two stock assessment level specifications (Staff recommended).

	Assessment Level 3		**Assessment Level 4**
	ABC ≈ P*=40th percentile, based on an assumed lognormal OFL distribution that has a CV=100%	**Control rule of 75%F_{MSY}**	**Constant harvest strategy**
TAL	905 mt (1.995 M lb)	905 mt (1.995 M lb)	905 mt (1.995 M lb)

Recreational Bag Limit

Current regulations require an 8-fish recreational bag-size limit per person per trip. The recreational bag limit may be changed through specifications based on the recommendations of the Monitoring Committee. Staff does not recommend any changes to the recreational bag limit.

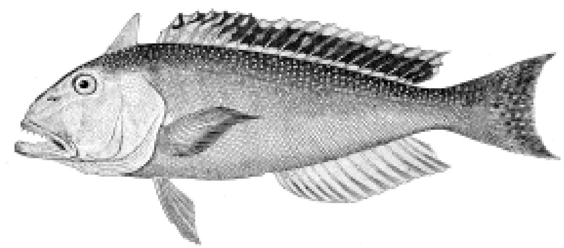
Research Set-Aside

Staff recommends that no TAL be made available for the Research Set-Aside Program until the next benchmark stock assessment for tilefish in completed and the Council has complete the review of the RSA program.

Appendix I

This appendix contains updated data on commercial landings, landings per unit effort, and size distribution of commercial landings. The information presented in this appendix was tabulated by Paul Nitschke (NEFSC, Tilefish Assessment Lead).

Golden Tilefish data update through 2011, *Lopholatilus chamaeleonticeps,* in the Middle Atlantic-Southern New England Region



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Introduction

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 narrow temperature preference of 9 to 14 C. Their temperature preference limits their range to a narrow band along the upper slope of the continental shelf where temperatures vary by only a few degrees over the year. They are generally found in and around submarine canyons where they occupy burrows in the sedimentary substrate. Tilefish are relatively slow growing and long-lived, with a maximum observed age of 46 years and a maximum length of 110 cm for females and 39 years and 112 cm for males (Turner 1986). At lengths exceeding 70 cm, the predorsal adipose flap, characteristic of this species, is larger in males and can be used to distinguish the sexes. Tilefish of both sexes are mature at ages between 5 and 7 years (Grimes et. al. 1988).

Golden Tilefish was first assessed at SARC 16 in 1992 (NEFSC 1993). The Stock Assessment Review Committee (SARC) accepted a non-equilibrium surplus production model (ASPIC). The ASPIC model estimated biomass-based fishing mortality (F) in 1992 to be 3-times higher than F_{MSY}, and the 1992 total stock biomass to be about 40% of B_{MSY}. The intrinsic rate of increase (r) was estimated at 0.22.

The Science and Statistical (S&S) Committee reviewed an updated tilefish assessment in 1999. Total biomass in 1998 was estimated to be 2,936 mt, which was 35% of B_{MSY} = 8,448 mt. Fishing mortality was estimated to be 0.45 in 1998, which was about 2-times higher than F_{MSY} = 0.22. The intrinsic rate of increase (r) was estimated to be 0.45. These results were used in the development of the Tilefish Fishery Management Plan (Mid-Atlantic Fishery Management Council 2000). The Mid-Atlantic Fishery Management Council implemented the Tilefish Fishery Management Plan (FMP) in November of 2001. Rebuilding of the tilefish stock to B_{MSY} was based on a ten-year constant harvest quota of 905 mt.

SARC 41 reviewed a benchmark tilefish assessment in 2005. The surplus production model indicated that the tilefish stock biomass in 2005 has improved since the assessment in 1999. Total biomass in 2005 is estimated to be 72% of B_{MSY} and fishing mortality in 2004 is estimated to be 87% of F_{MSY}. Biological reference points did not change greatly from the 1999 assessment. B_{MSY} is estimated to be 9,384 mt and F_{MSY} is estimated to be 0.21. The SARC concluded that the projections are too uncertain to form the basis for evaluating likely biomass recovery schedules relative to B_{MSY}. The TAC and reference points were not changed based on the SARC 41 assessment.

The current status for this stock from SARC 48 (2009) is based on the ASPIC surplus production model which was the basis of the stock assessment for the last three assessments. The model is calibrated with CPUE series, as there are no fishery-independent sources of information on trends in population abundance. While the Working Group expressed concern about the lack of fit of the model to the VTR CPUE index at the end of the time series, they agreed to accept the estimates of current fishing mortality and biomass and associated reference points. The instability of model results in the scenario projections was also a source of concern. It was noted that the bootstrap uncertainty estimates do not capture the true uncertainty in the assessment. The ASPIC model indicates that the stock is rebuilt. However, the working group acknowledges that there is high uncertainty on whether the stock is truly rebuilt.

In this update commercial landings, longline fishery CPUE, and landings size distributions were updated through 2011 to help inform decisions on setting ABCs for golden tilefish in fishing year (November 1st) 2012 and 2013. Time constraints prevented a full vetting of an updated ASPIC model using data through 2011. However, updated data through 2011 suggests that the conclusions from SARC 48 would not change. ASPIC model results would likely still suffer process error caused from year class effects.

Commercial catch data

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. 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 (Table 1, Figure 1). The preliminary landings retrieval for 2011 as of 2/9/12 was 864 mt. During the late 1970s and early 1980s Barnegat, NJ was the principal tilefish port; more recently Montauk, NY has accounted for most of the landings. Most of the commercial landings are taken by the directed longline fishery. Discards in the trawl and longline fishery appear to be a minor component of the catch. Recreational catches have also appeared to be low over the last 25 years.

Commercial CPUE data

A fishery independent index of abundance does not exist for tilefish. Analyses of catch (landings) and effort data were confined to the longline fishery since directed tilefish effort occurs in this fishery (e.g. the remainder of tilefish landings are taken as bycatch in the trawl fishery). Most longline trips that catch tilefish fall into two categories: (a) trips in which tilefish comprise greater than 90% of the trip catch by weight and (b) trips in which tilefish accounted for less than 10% of the catch. Effort was considered directed for tilefish when at least 75% of the catch from a trip consisted of tilefish.

Three different series of longline effort data were analyzed. The first series was developed by Turner (1986) who used a general linear modeling approach to standardize tilefish effort during 1973-1982 measured in kg per tub (0.9 km of groundline with a hook every 3.7 m) of longline obtained from logbooks of tilefish fishermen. Two additional CPUE series were calculated from the NEFSC weighout (1979-1993) and the VTR (1995-2011) systems. Effort from the weighout data was derived by port agents' interviews with vessel captains whereas effort from the VTR systems comes directly from mandatory logbook data. In the SARC 48 assessment and in the 1998 and 2005 tilefish assessments we used Days absent as the best available effort metric. In the 1998 assessment an effort metric based on Days fished (average hours fished per set / 24 * number of sets in trip) was not used because effort data were missing in many of the logbooks and the effort data were collected on a trip basis as opposed to a haul by haul basis. In the SARC 48 assessment effort was calculated as:

Effort = days absent (time & date landed - time & date sailed) - number of trips.

For some trips, the reported days absent were calculated to be a single day. This was considered unlikely, as a directed tilefish trip requires time for a vessel to steam to near the edge of the continental shelf, time for fishing, and return trip time. Thus, to produce a realistic effort metric based on days absent, a one day steam time for each trip (or the number of trips) was subtracted from days absents and therefore only trips with days absent greater than one day were used.

The number of vessels targeting tilefish has declined since the 1980s (Table 2, Figure 2); during 1994-2003 and 2005-2011, five vessels accounted for more than 70 percent of the total tilefish landings. The number of vessels targeting tilefish has remained fairly constant since the assessment in 2005. The length of a targeted tilefish trip had been generally increasing until the mid 1990s. At the time of the 2005 assessment trip lengths have shorten to about 5 days. Trip length has increased slightly until 2008 and has subsequently declined (Figure 2). In the weighout data the small number of interview is a source of concern; very little interview data exists at the beginning of the time series (Table 2, Figure 3). The 5 dominant tilefish vessels make up almost all of the VTR reported landings.

The number of targeted tilefish trips declined in the early 1980s while trip length increased at the time the FMP was being developed in 2000 (Figures 2 and 4). During the 2005 assessment the number of trips became relatively stable as trip length decreased. The interaction between the number of vessels, the length of a trip and the number of trips can be seen in the total days absent trend in Figure 4. Total days absent remained relatively stable in the early 1980s, but then declined at the end of the weighout series (1979-1994). In the beginning of the VTR series (1994-2004) days absent increased through 1998 but declined to 2005. Since 2005 total days absent has increase until 2008. Since 2008 the total days absent has declined slightly. Figure 4 also shows that a smaller fraction of the total landings were included in the calculation of CPUE compared to the VTR series.

CPUE trends are very similar for most vessels that targeted tilefish (Figure 5). A sensitivity test of the GLM using different vessel combinations was done in SARC 41. The SARC 41 GLM was found not to be sensitivity to different vessels entering the CPUE series.

Very little CPUE data exist for New York vessels in the 1979-1994 weighout series despite the shift in landing from New Jersey to New York before the start of the VTR series in 1994. Splitting the weighout and VTR CPUE series can be justified by the differences in the way effort was measured and difference in the tilefish fleet between the series. In breaking up the series we omitted 1994 because there were very little CPUE data. The sparse 1994 data that existed came mostly from the weighout system in the first quarter of the year. Very similar trends exist in the four years of overlap between Turner (1986) CPUE and the weighout series (Figure 6).

Since 1979, the tilefish industry has changed from using cotton twine to steel cables for the backbone and from J hooks to circle hooks. The gear change to steel cable and snaps started on New York vessels in 1983. In light of possible changes in catchability associated with these changes in fishing gear, the working group considered that it would be best to use the three available indices separately rather than combined into one or two series. The earliest series (Turner 1986) covered 1973-1982 when gear construction and configuration was thought to be relatively consistent. The Weightout series (1979-1993) overlapped the earlier series for four years and showed similar patterns and is based primarily on catch rates from New Jersey vessels. The VTR (1995-2004) series is based primarily on information from New York vessels using steel cable and snaps.

The NEFSC Weighout and VTR CPUE series were standardized using a general linear model (GLM) incorporating year and individual vessel effects. The CPUE was standardized to an individual longline vessel and the year 1984; the same year used in the last assessment. For the VTR series the year 2000 was used as the standard. Model coefficients were back-transformed to a linear scale after correcting for transformation bias. The full GLM output for the Weighout and the VTR CPUE series is included as Appendix 1. The updated GLM model that accounted of individual vessel effects appears to show more of an overall increasing trend in CPUE in comparison to the nominal series (figure 7).

More recently changes in the CPUE can be generally explained with evidence of strong incoming year classes that track through the landings size composition over time (See below). Since the SARC 48 assessment there appear to be increases in CPUE due to one or two new strong year classes. In general, strong year classes appear to persist longer in the fishery after FMP and the constant quota management came into effect which is evident in both the CPUE and size composition data.

Commercial market category and size composition data

Six market categories exist in the database. From smallest to largest they are: small, kitten, medium, large and extra large as well as an unclassified category. The proportion of landings in the kittens and small market categories increased in 1995 and 1996. Evidence of two strong recruitment events can be seen tracking through these market categories. At the time of the 2005 tilefish assessment the proportion of large market category has declined since the early 1980s. However more recently a greater proportion of the landings are coming from the large market category as the last strong year class (1999) has grown (Table 3, Figure 8). Commercial length sampling has been inadequate over most of the time series. However some commercial length sampling occurred in the mid to late 1990s. More recently there has been a substantial increase in the commercial length sampling from 2003 to 2011 (Table 4).

Commercial length frequencies were expanded for years where sufficient length data exist (1995-1999 and 2002-2011) (Table 4). The large length frequency samples from 1996 to 1998 were used to calculate the 1995 to 1999 expanded numbers at length while the large length samples from 2001 and 2003 were used to calculate the 2002 expanded numbers at length. Evidence of strong 1992/1993 and 1998/1999 year classes can be seen in the expanded numbers at length in the years when length data existed (1995-1999, 2002-2008, and 2008-2011) (Figures 9 and 10). The matching of modes in the length frequency with ages was done using Turner's (1986) and Vidal's (2009) aging studies. In 2004 and 2005 the 1998/1999 year class can be seen growing into the medium market category and in 2006 and 2007 the year class has entered the large market category (Figure 9). From 2002 to 2007 it appears that most of the landings were comprised of this year class. The catch appears to be comprised of multiple year classes in 2008 when catch rates have declined in the VTR series. An increase in the landings and CPUE can be seen when the 1992/1993 and 1998/1999 year classes recruit to the longline fishery. As the year classes gets older the catch rates decline (Figure 11).

Concern was expressed at SARC 48 with little evidence of an incoming year class, catch rates declining and the mismatch between the biomass trends predicted by the model in comparison to the observed CPUE at the end of the time series. However since the last 2009 assessment there is evidence of another strong year class (2005-2006) tracking through the landings size distributions which results in increases in the CPUE. There is also some evidence of the broader size distribution of the fish being caught. However concerns with model process error due to the year class effects on CPUE still exist and will likely still produce instability in the results of the surplus production model.

SARC 48 Southern Demersal Working Group Stock Assessment Report Conclusions

The possibility of unknown refuge effects due to conflicts with lobster and trawl gear, effects of targeting incoming year classes, and the unknown effects on tilefish CPUE due to competition/interference from increased dogfish abundance introduce uncertainty in interpreting CPUE from this fishery as a measure of stock abundance. CPUE index of abundance and catch length frequency distributions are likely a reflection of both the population abundance and the unaccounted changes in fishing practice.

The Working Group accepted the ASPIC model solution but noted that there is very high uncertainty regarding whether the stock is rebuilt. The SARC 48 review panel concluded that the ASPIC model is likely over optimistic and that the stock has not rebuilt above B_{MSY}. The surplus production model inability to fit the decline in CPUE due to a year class effect at the end of the time series is a source of concern. The bootstrap uncertainty estimates from the ASPIC model likely do not capture the true uncertainty in this assessment. Results from the SCALE model which incorporates the species lifespan, growth, and recruitment dynamics evident in the commercial length distributions provide reason to be concerned that the stock is not rebuilt. However the overall lack of data within the scale model and questions on the estimated selectivity may result in a pessimistic stock status determination (Figures 12 and 13). The uncertainty in this assessment is encompassed by the results from two very different models which resulted in different status determinations. However increases in biomass and lower fishing mortality rates since the beginning of the FMP are evident in the results from both models. Consideration should be given to the possibility that the SCALE model results may be a reflection of the true state of nature when setting ABCs rather than using the results of the ASPIC surplus production model which states that the stock is rebuilt.

SARC 48 State of Stock/Review Panel Conclusions from the Assessment Summary Report

The Golden Tilefish stock is not overfished and overfishing is not occurring (Figures 14 and 15). Fishing mortality in 2008 was estimated to be 0.06, 38% of the updated F_{MSY} = 0.16. Total biomass in 2008 was estimated to be 11,910 mt, 104% of the updated B_{MSY} = 11,400 mt (Table 5, Figure 15). The 50% confidence interval (25%ile to 75%ile) for F in 2008 is between 0.05 and 0.07 (Figure 16). The 50% confidence interval (25%ile to 75%ile) for total biomass in 2008 is between 9,550 mt and 13,538 mt (Figure 17). The biomass estimates for recent years from the ASPIC model are likely over-optimistic because trends in commercial VTR CPUE declined recently in a manner consistent with the passage of the strong 1999 cohort through the population (an interpretation further supported by the length frequency data). The current assessment model (ASPIC) does not account for those factors. Much of the confidence interval around the 2008 biomass estimate falls below the updated B_{MSY} listed above. Based on these considerations there are no convincing evidence that the stock has rebuilt to levels above B_{TARGET}. The review panel also concluded that for the most recent years (e.g., 2008) the biomass estimates from the ASPIC model are likely overestimates and that the estimates are more uncertain than the model suggests. An immediate increase in the commercial landings from the *status quo* TAC = 905 mt to the updated MSY = 1,868 mt would be risky considering the uncertainty of the assessment and stock status determination.

Table 1. Landings of tilefish in live metric tons from 1915-2008. 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 2004-2011 is from Dealer electronic reporting. - indicates missing data.
* Preliminary data retrieved on 2/9/12

year	mt	year	mt	year	mt
1915	148	1960	1,064	2005	676
1916	4,501	1961	388	2006	907
1917	1,338	1962	291	2007	751
1918	157	1963	121	2008	737
1919	92	1964	596	2009	864
1920	5	1965	614	2010	922
1921	523	1966	438	2011	*864
1922	525	1967	50		
1923	623	1968	32		
1924	682	1969	33		
1925	461	1970	61		
1926	904	1971	66		
1927	1,264	1972	122		
1928	1,076	1973	394		
1929	2,096	1974	586		
1930	1,858	1975	710		
1931	1,206	1976	1,010		
1932	961	1977	2,082		
1933	688	1978	3,257		
1934	-	1979	3,968		
1935	1,204	1980	3,889		
1936	-	1981	3,499		
1937	1,101	1982	1,990		
1938	533	1983	1,876		
1939	402	1984	2,009		
1940	269	1985	1,961		
1941	-	1986	1,950		
1942	62	1987	3,210		
1943	8	1988	1,361		
1944	22	1989	454		
1945	40	1990	874		
1946	129	1991	1,189		
1947	191	1992	1,653		
1948	465	1993	1,838		
1949	582	1994	786		
1950	1,089	1995	666		
1951	1,031	1996	1,121		
1952	964	1997	1,802		
1953	1,439	1998	1,334		
1954	1,582	1999	508		
1955	1,629	2000	504		
1956	707	2001	871		
1957	252	2002	843		
1958	672	2003	1,130		
1959	380	2004	1,215		

Table 2. Total commercial and vessel trip report (VTR) landings in live mt and the commercial catch-per-unit effort (CPUE) data used for tilefish. Dealer landings before 1990 are from the general canvas data. CPUE data from 1979 to the first half of 1994 are from the NEFSC weighout database, while data in the second half of 1994 to 2011 are from the vtr system (below the dotted line). Effort data are limited to longline trips which targeted tilefish (= or >75% of the landings were tilefish) and where data existed for the days absent. Nominal CPUE series are calculated using landed weight per days absent minus one day steam time per trip. Da represents days absent.

	Weighout		Commerical CPUE data subset								
year	& Dealer landings	vtr landings	interview landings	No. interviews	% interview trips	No. vessels	subset landings	days absent	No. trips	da per trip	nominal cpue
1979	3,968		0.0	0	0.0%	20	1,807	1,187	330	3.6	1.93
1980	3,889		0.8	1	0.3%	18	2,153	1,390	396	3.5	1.99
1981	3,499		35.0	4	1.2%	21	1,971	1,262	333	3.8	1.95
1982	1,990		90.7	13	5.7%	18	1,267	1,282	229	5.6	1.10
1983	1,876		85.8	16	8.9%	21	1,013	1,451	179	8.1	0.73
1984	2,009		140.1	25	18.2%	20	878	1,252	138	9.1	0.72
1985	1,961		297.1	64	30.6%	25	933	1,671	209	8.0	0.59
1986	1,950		120.7	31	16.5%	23	767	1,186	188	6.3	0.71
1987	3,210		198.5	38	18.5%	30	1,014	1,343	206	6.5	0.82
1988	1,361		148.2	30	19.4%	23	422	846	154	5.5	0.56
1989	454		92.8	11	15.7%	11	165	399	70	5.7	0.46
1990	874		32.4	8	11.9%	11	241	556	68	8.2	0.45
1991	1,189		0.8	3	2.8%	7	444	961	107	9.0	0.48
1992	1,653		58.0	9	8.6%	13	587	969	105	9.2	0.62
1993	1,838		71.9	11	10.5%	10	571	959	105	9.1	0.61
1994	-		0	0	0.0%	7	127	385	42	9.2	0.34
1994	786	30				4	26	76	9	8.4	0.36
1995	666	547				5	470	964	100	9.6	0.50
1996	1,121	865				8	822	1,318	134	9.8	0.64
1997	1,810	1,439				6	1,427	1,332	133	10.0	1.09
1998	1,342	1,068				9	1,034	1,517	158	9.6	0.70
1999	525	527				10	516	1,185	133	8.9	0.45
2000	506	446				11	427	942	110	8.6	0.47
2001	874	705				8	691	1,046	116	9.0	0.68
2002	851	724				8	712	951	114	8.3	0.78
2003	1,130	790				7	788	691	101	6.8	1.22
2004	1,215	1,153				12	1,136	811	134	6.1	1.54
2005	676	808				11	802	470	93	5.1	1.95
2006	907	870				12	852	682	105	6.5	1.35
2007	749	710				12	691	727	101	7.2	1.01
2008	737	675				14	672	1,119	124	9.0	0.62
2009	864	812				12	800	1,106	130	8.5	0.75
2010	922	871				11	845	689	107	6.4	1.33
2011	830	761				9	729	485	84	5.8	1.67

Table 3. Landing (metric tons) by market category. Small-kitten market category was added to kittens.

year	small	kittens	medium	large	xl	unclassified	total
1990	24	14	103	45	0	687	871
1991	43	16	154	85	0	891	1,189
1992	193	136	88	86	0	1,149	1,653
1993	237	131	206	66	4	1,193	1,838
1994	8	11	89	54	7	617	786
1995	26	73	88	91	2	386	666
1996	169	423	149	156	2	221	1,121
1997	249	878	257	110	2	306	1,802
1998	97	375	699	103	6	54	1,334
1999	37	143	197	106	8	17	508
2000	17	193	153	114	8	19	504
2001	11	553	160	124	6	18	871
2002	26	341	311	128	3	34	843
2003	132	644	170	144	5	34	1,130
2004	169	248	523	129	9	137	1,215
2005	6	12	335	149	1	173	676
2006	8	9	233	369	1	287	907
2007	17	81	148	397	4	105	751
2008	68	99	194	297	18	60	737
2009	55	279	179	226	28	61	864
2010	28	256	373	166	17	81	922
2011	6	143	336	216	10	154	864

Table 4. Number of lengths (1995-2008), samples (2002-2008), and metric tons landed per sample (2002-2011) for Golden tilefish. Number of lengths includes borrowing across years in bold. Trawl lengths were not used in the expansion. Large lengths used from 1995 to 1999 were taken from years 1996, 1997, and 1998. Large lengths in 2002 also used large lengths from 2003. Unclassified were redistributed according to mkt and qtr proportions.

Number of lengths.

year	half	sm	ki	med	lg	xl	total
1995	1		244	208	**332**		
	2						784
1996	1		312	100	**332**		
	2						744
1997	1		958	688	**332**		
	2						1978
1998	1		202	407	**332**		
	2						941
1999	1		211	155	**332**		
	2						698

Number of lengths.

year	half	sm	ki	med	lg	xl	total
2002	1		353	206	**492**		
	2						1051
2003	1	735	385	396	467	32	
	2		522	958			3495
2004	1	788	115	882	432		
	2	106	197	427			2947
2005	1		393	1378	825		
	2			763			3359
2006	1	112	346	1856	1284		
	2	218		1079	752		5647
2007	1	396	379	1128	898	25	
	2	220	1152	1871	1316		7385
2008	1	93	719	1356	1506	20	
	2		369	339			4402
2009	1	508	650	731	658	5	
	2	402	470	1024	322		4770
2010	1	1122	858	2363	1995	43	
	2	213	1081	2031	1140		10846
2011	1	852	1236	2682	2011	35	
	2		1104	1626	851		10397

Number of samples

year	half	sm	ki	med	lg	xl	total
2002	1		6	2	**8**		
	2						16
2003	1	5	4	3	7	2	
	2		6	5			32
2004	1	4	1	6	7		
	2	1	2	4			25
2005	1		6	10	12		
	2			8			36
2006	1	3	6	14	11		
	2	2		11	8		55
2007	1	4	4	12	12	1	
	2	1	5	9	8		56
2008	1	1	9	16	28	3	
	2		4	6			67
2009	1	5	11	13	11	2	
	2	4	8	17	11		82
2010	1	11	13	30	29	3	
	2	2	11	23	27		149
2011	1	10	16	30	24	3	
	2		12	17	10		122

mt/samples

year	half	sm	ki	med	lg	xl	total
2002	1		61	156	**19**		
	2						54
2003	1	26	98	22	21	3	
	2		42	21			34
2004	1	37	209	50	20		
	2	23	20	55			43
2005	1		3	19	12		
	2			18			14
2006	1	2	1	9	19		
	2	2		9	21		11
2007	1	1	6	6	18	4	
	2	12	11	8	23		12
2008	1	49	8	7	11	6	
	2		12	13			10
2009	1	9	8	8	14	14	
	2		25	5	6		9
2010	1	2	10	7	3	6	
	2		10	8	3		6
2011	1	1	4	7	5	3	
	2		6	8	9		6

Table 5. Biological reference point estimates from the 2000 SSC committee review, 2005 SARC 41 assessment, and the 2009 BASE run from SARC 48.

	SSC 2000 1999	SARC 41 2004	SARC 48 2008
BMSY			
Point	8,448	9,384	11,400
Boot mean	-	9,764	10,336
Boot sd	-	5,152	2,089
Boot median	-	9,193	10,135
Boot 25%ile	-	8,379	8,974
Boot 75%ile	-	10,263	11,436
Boot bias	-	4%	-9%
FMSY			
Point	0.22	0.21	0.16
Boot mean	-	0.24	0.2
Boot sd	-	0.21	0.06
Boot median	-	0.22	0.19
Boot 25%ile	-	0.19	0.16
Boot 75%ile	-	0.25	0.23
Boot bias	-	15%	21%
MSY	1,858	1,988	1,868
r	0.45	0.42	0.33
Turner Q	0.009	0.010	0.009
Weighout	0.222	0.225	0.175
VTR Q	-	0.392	0.260

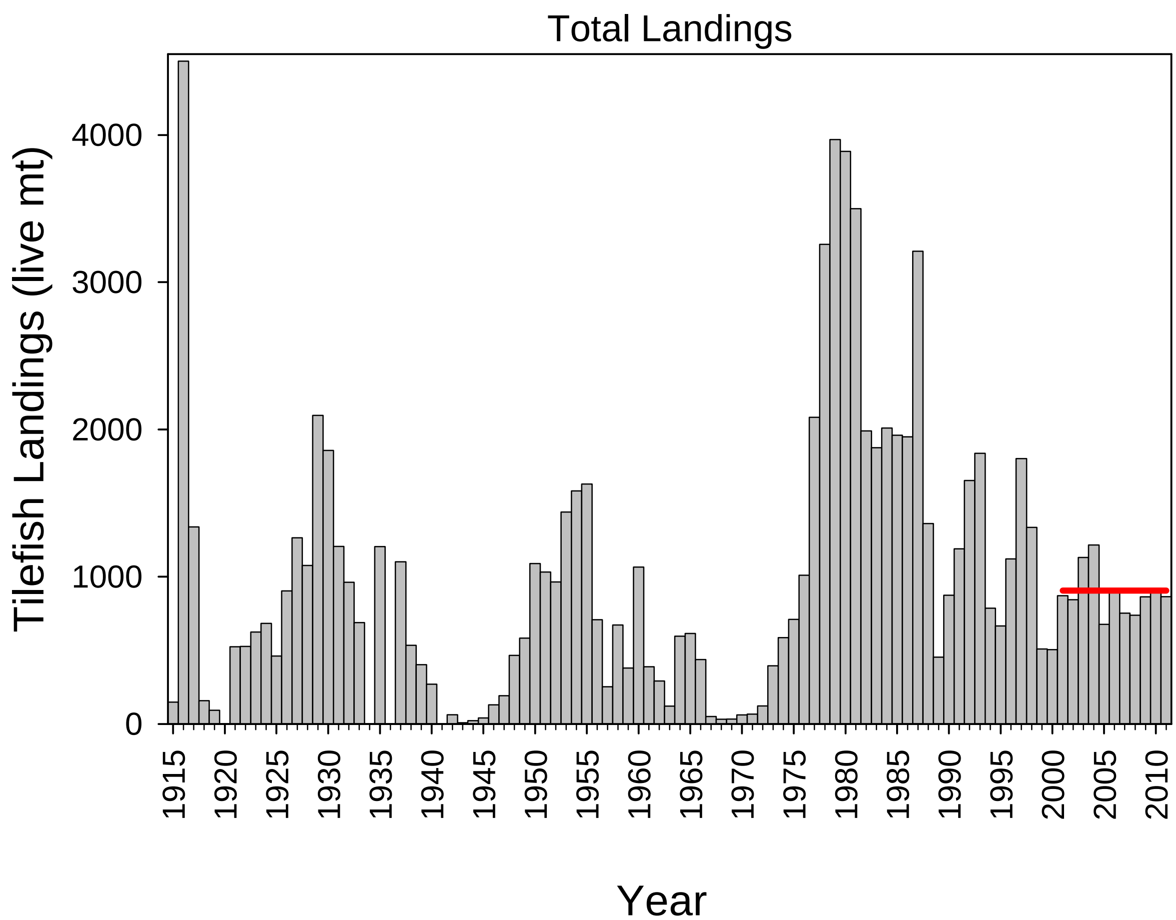

Figure 1. Landings of tilefish in metric tons from 1915-2004. Landings in 1915-1972 are from Freeman and Turner (1977), 1973-1989 are from the general canvas data, 1990-1993 are from the weighout system, 1994-2003 are from the dealer reported data, and 2004-2011 is from dealer electronic reporting. Preliminary landings data for 2011 retrieved on 2/9/12. Red line is the constant TAC of 905 mt.

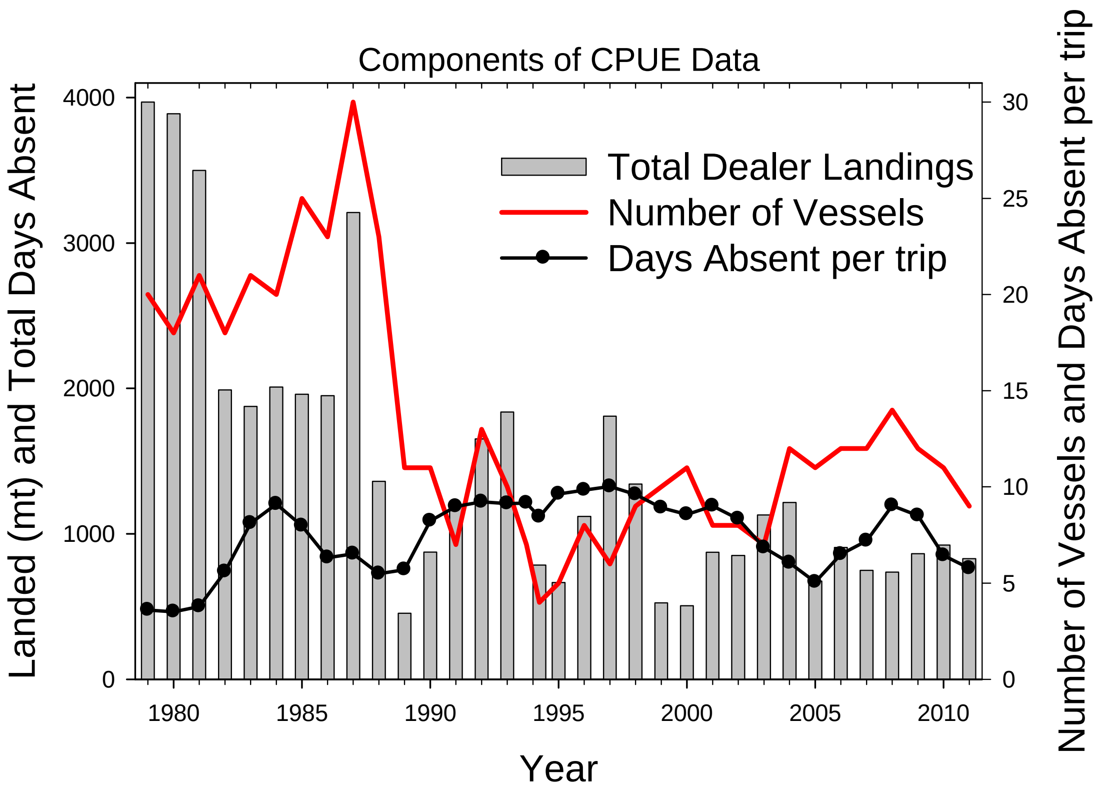

Figure 2. Number of vessels and length of trip (days absent per trip) for trips targeting tilefish (= or >75% tilefish) from 1979-2008. Total Dealer landings are also shown.

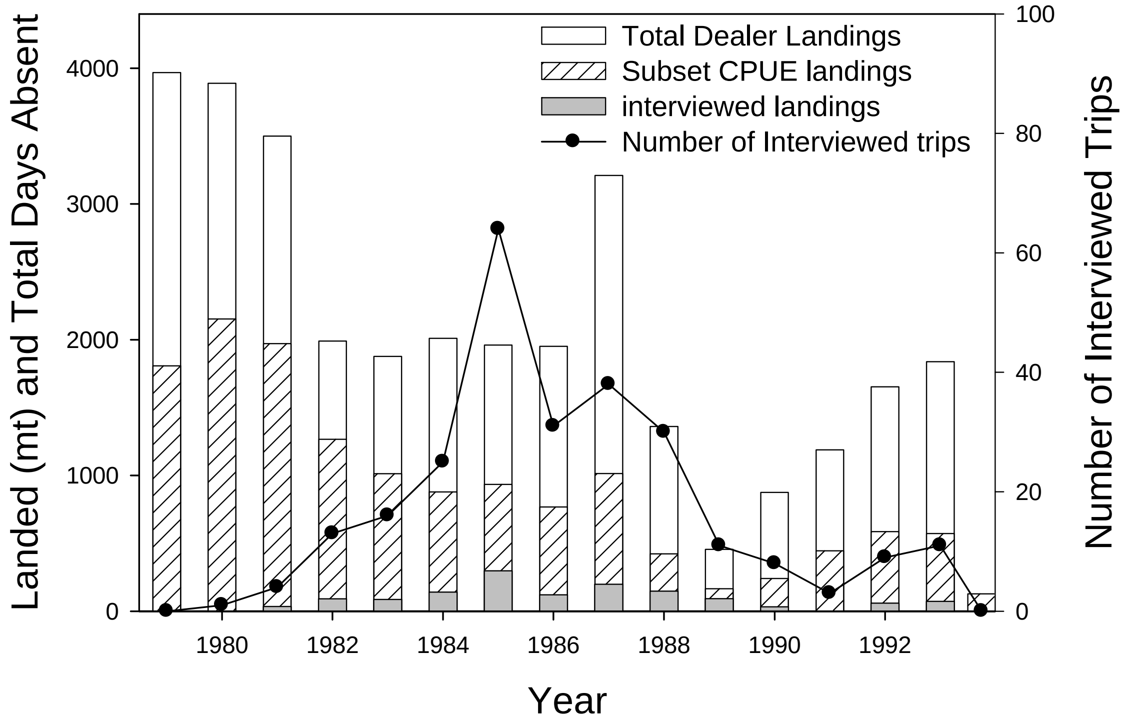

Figure 3. Number of interviewed trips and interviewed landings for trips targeting tilefish (= or >75% tilefish) for the Weighout data from 1979-1994. Total Weighout landings and the subset landings used in CPUE estimate are also shown.

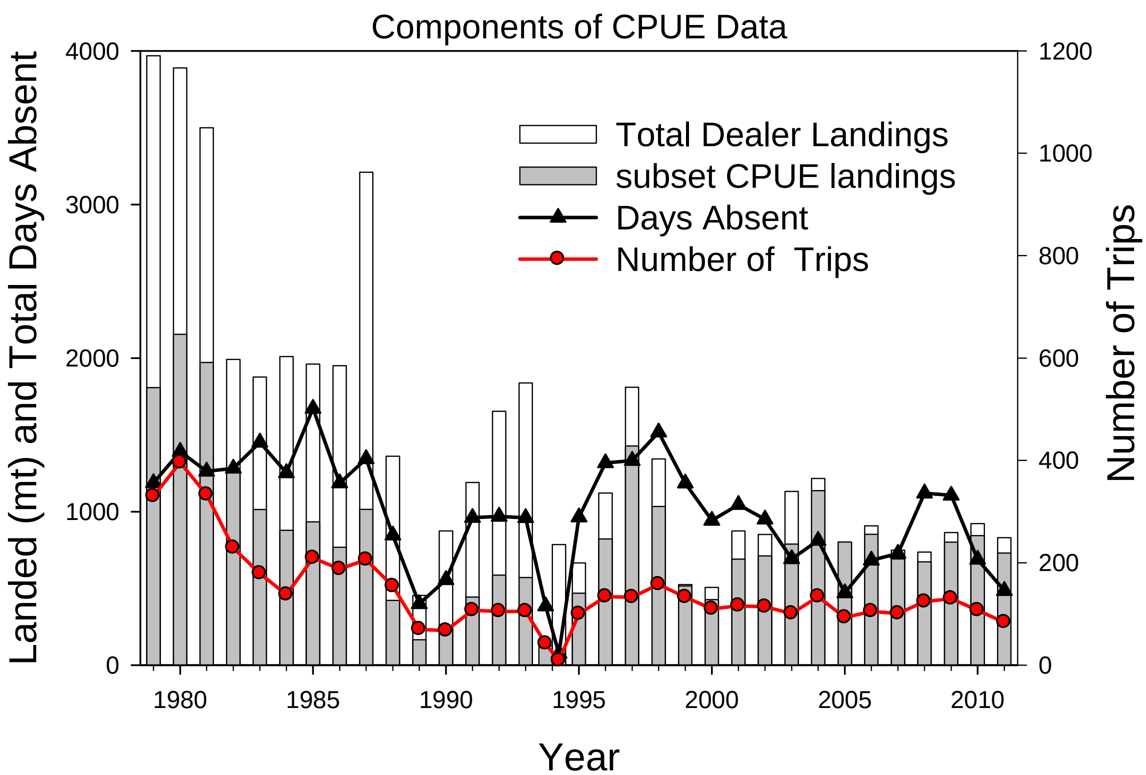

Figure 4. Total number of trips and days absent for trips targeting tilefish (= or >75% tilefish) from 1979-2008. Total Dealer and CPUE subset landings are also shown

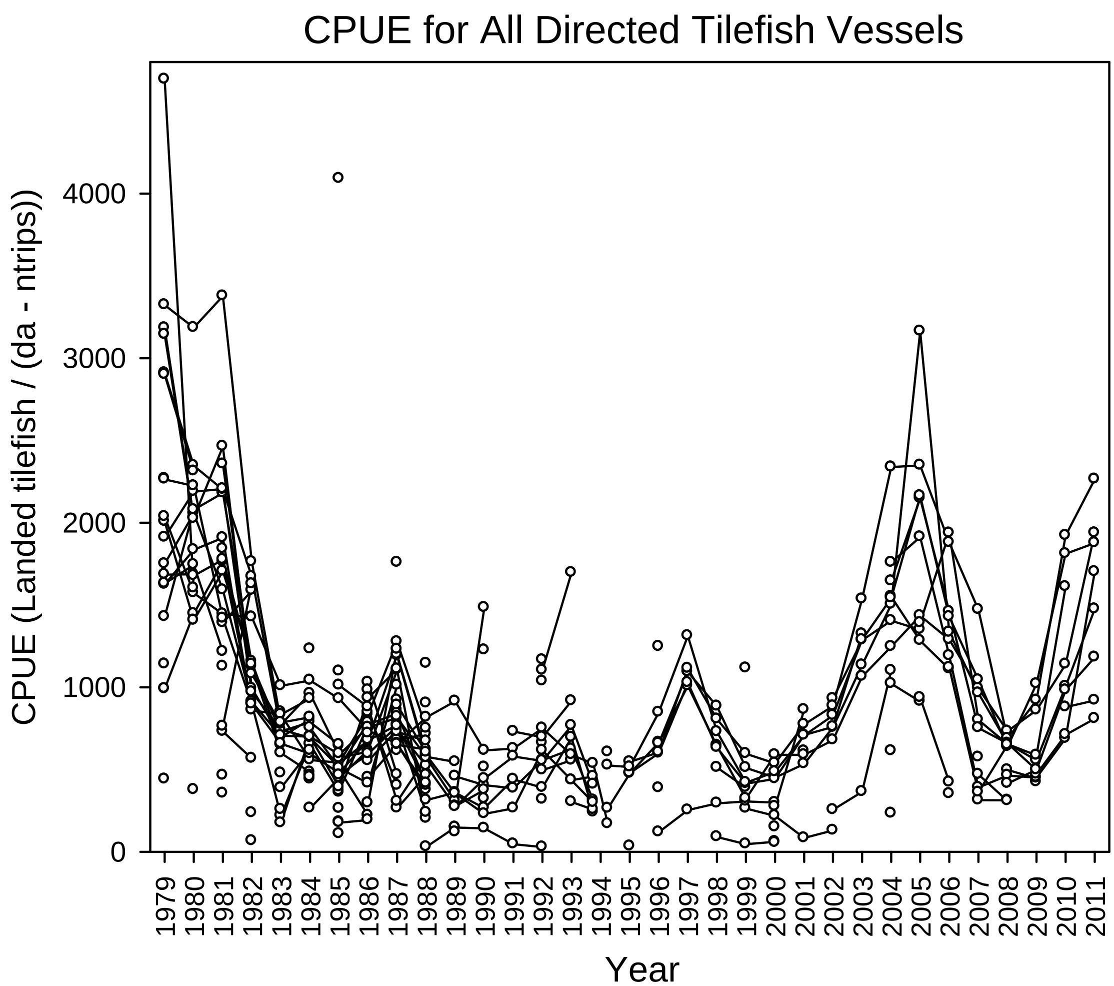

Figure 5. All individual tilefish vessel CPUE data for trips targeting tilefish (= or >75% tilefish) from 1979-2011.

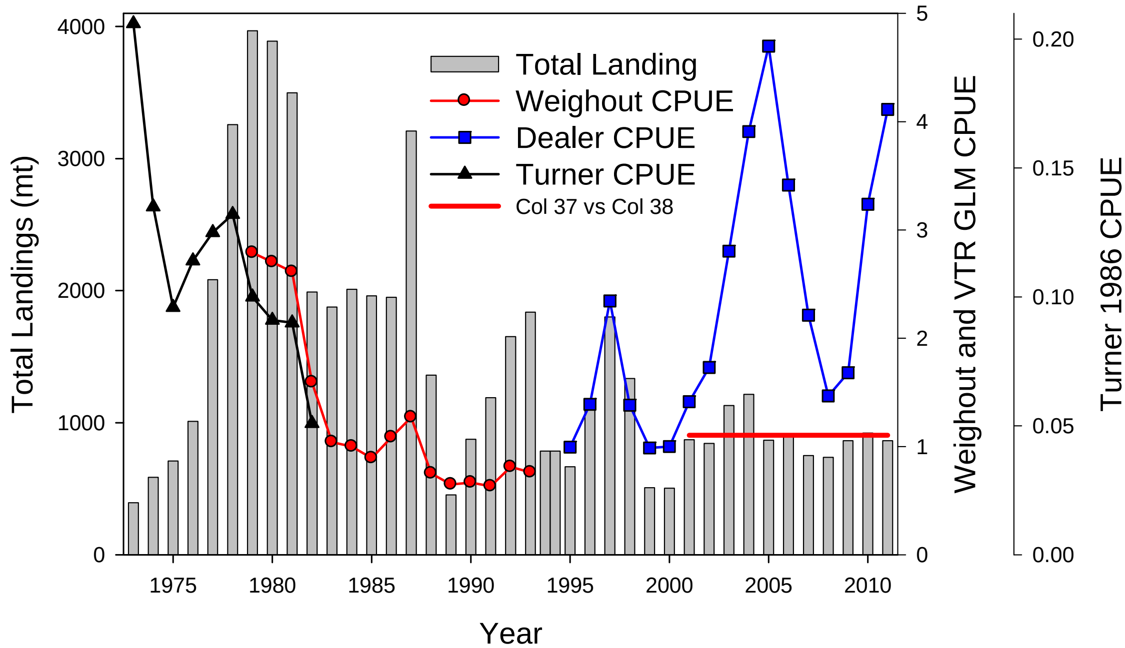

Figure 6. GLM CPUE for the Weighout and VTR data split into two series. Four years of overlap between Turner's and the Weighout CPUE series can be seen. Assumed total landings are also shown. Landing in 2005 was taken from the IVR system. Red line is the constant TAC of 905 mt.

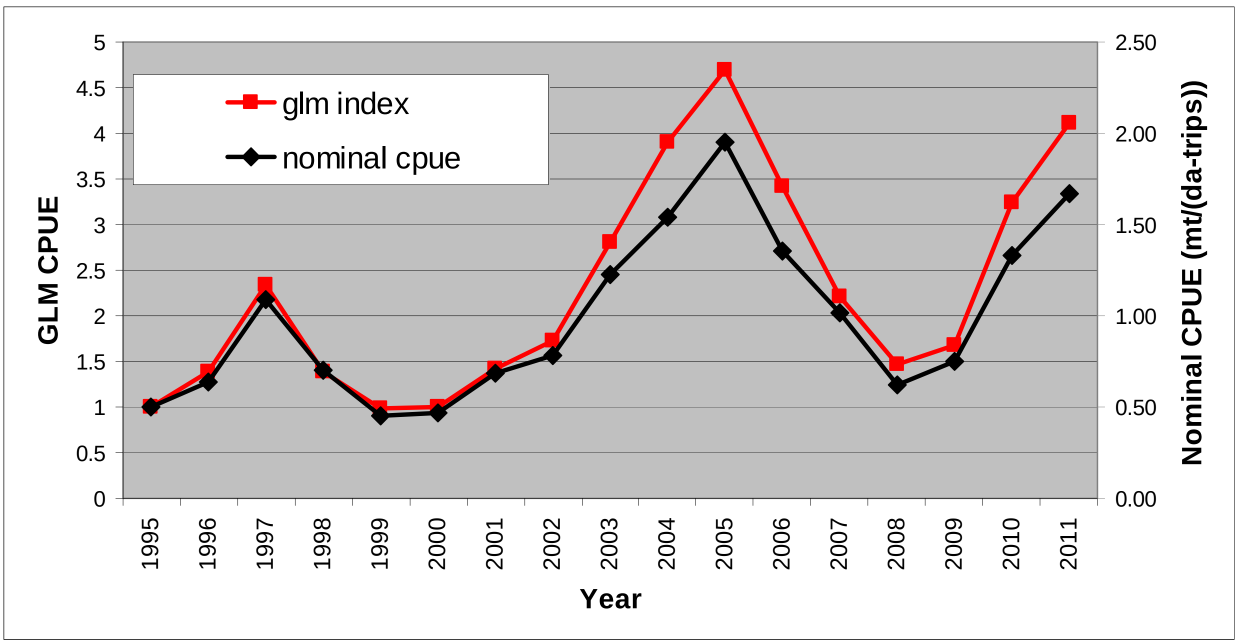

Figure 7. Comparison of the nominal and GLM VTR CPUE indices for golden tilefish.

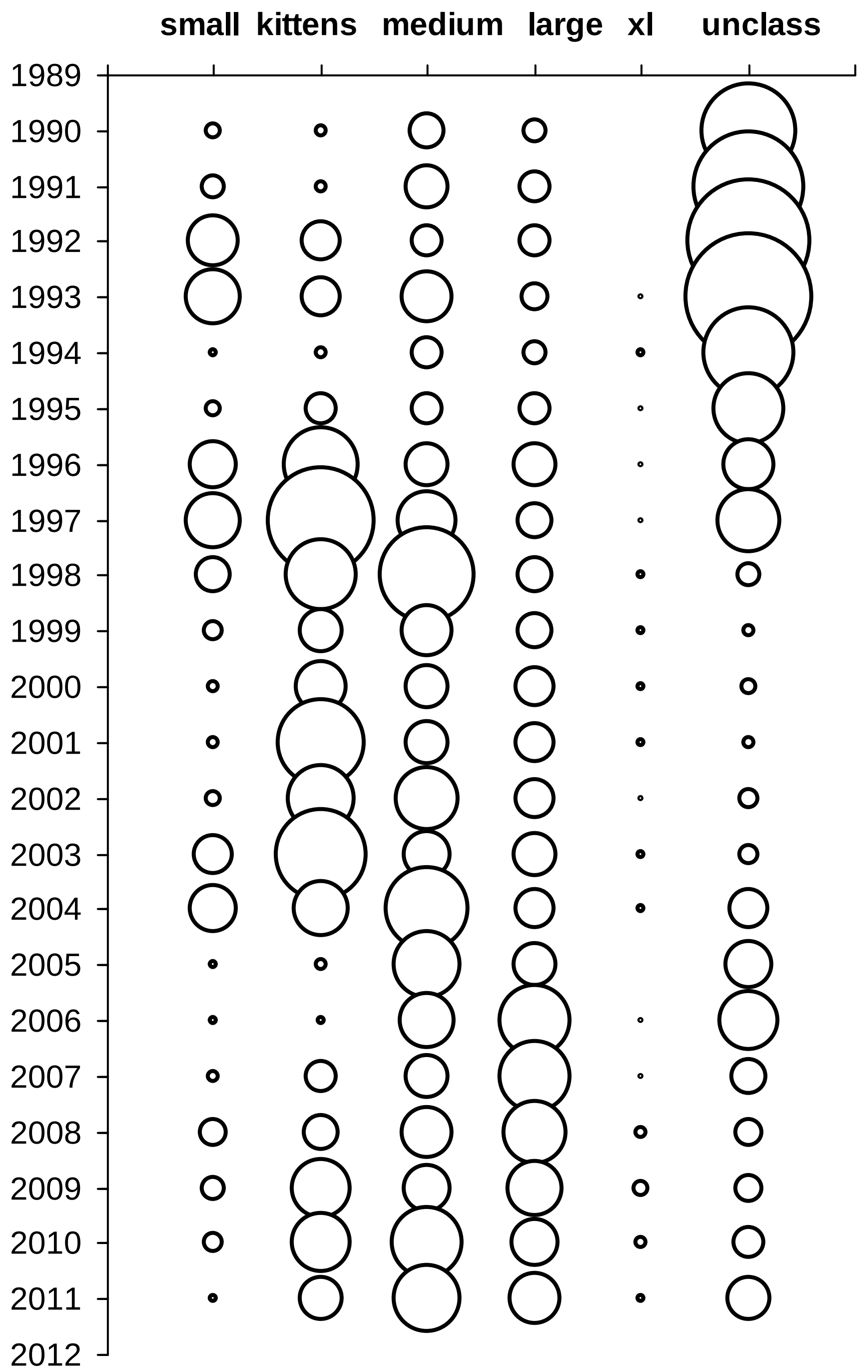

Figure 8. Bubble plot of Golden tilefish landings by market category.

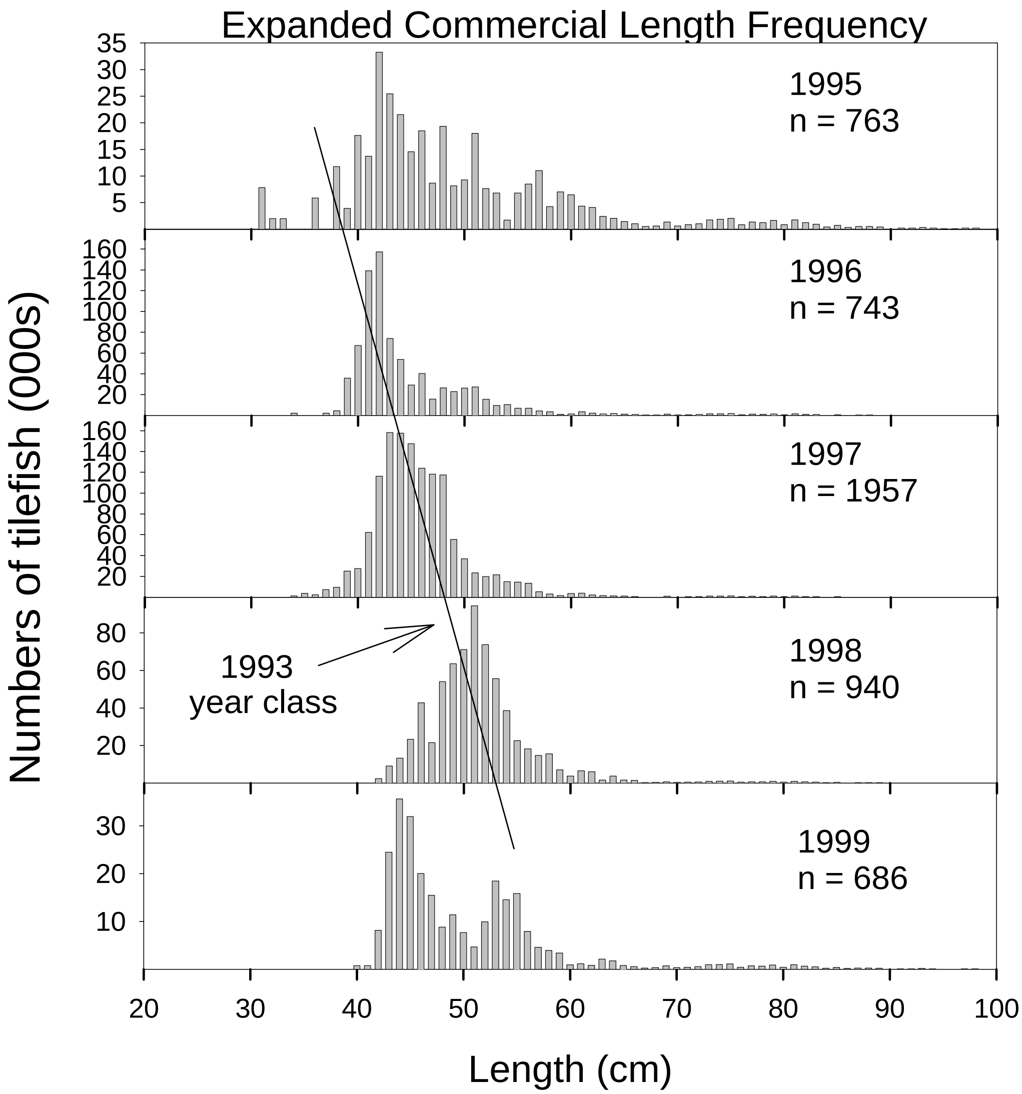

Figure 9. Expanded length frequency distributions by year. Large market category lengths used from 1995 to 1999 were taken from years 1996, 1998, and 1998. Smalls and kittens were combined and large and extra large were also combined.

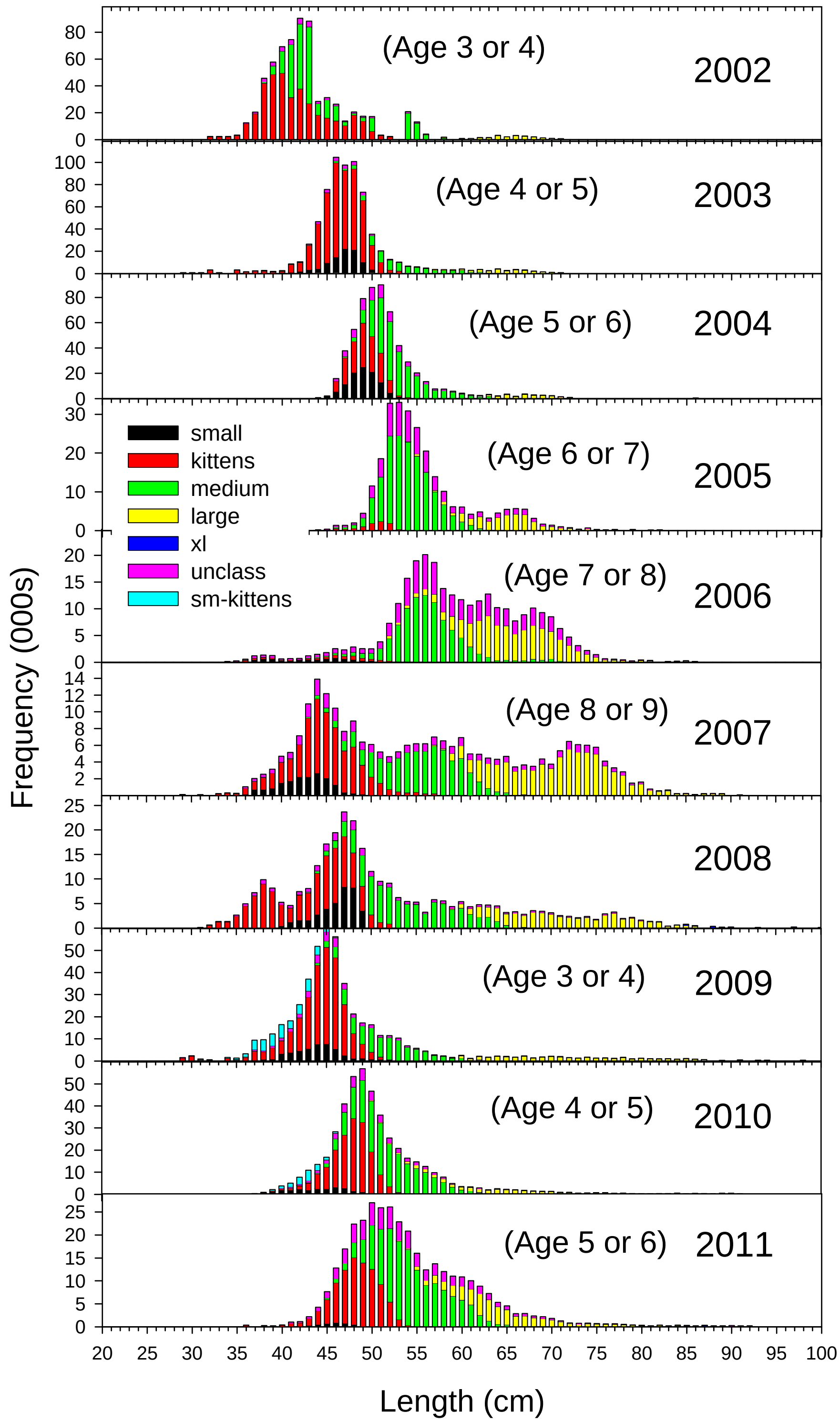

Figure 10. Expanded length frequency distributions by year. Y-axis is allowed to rescale.

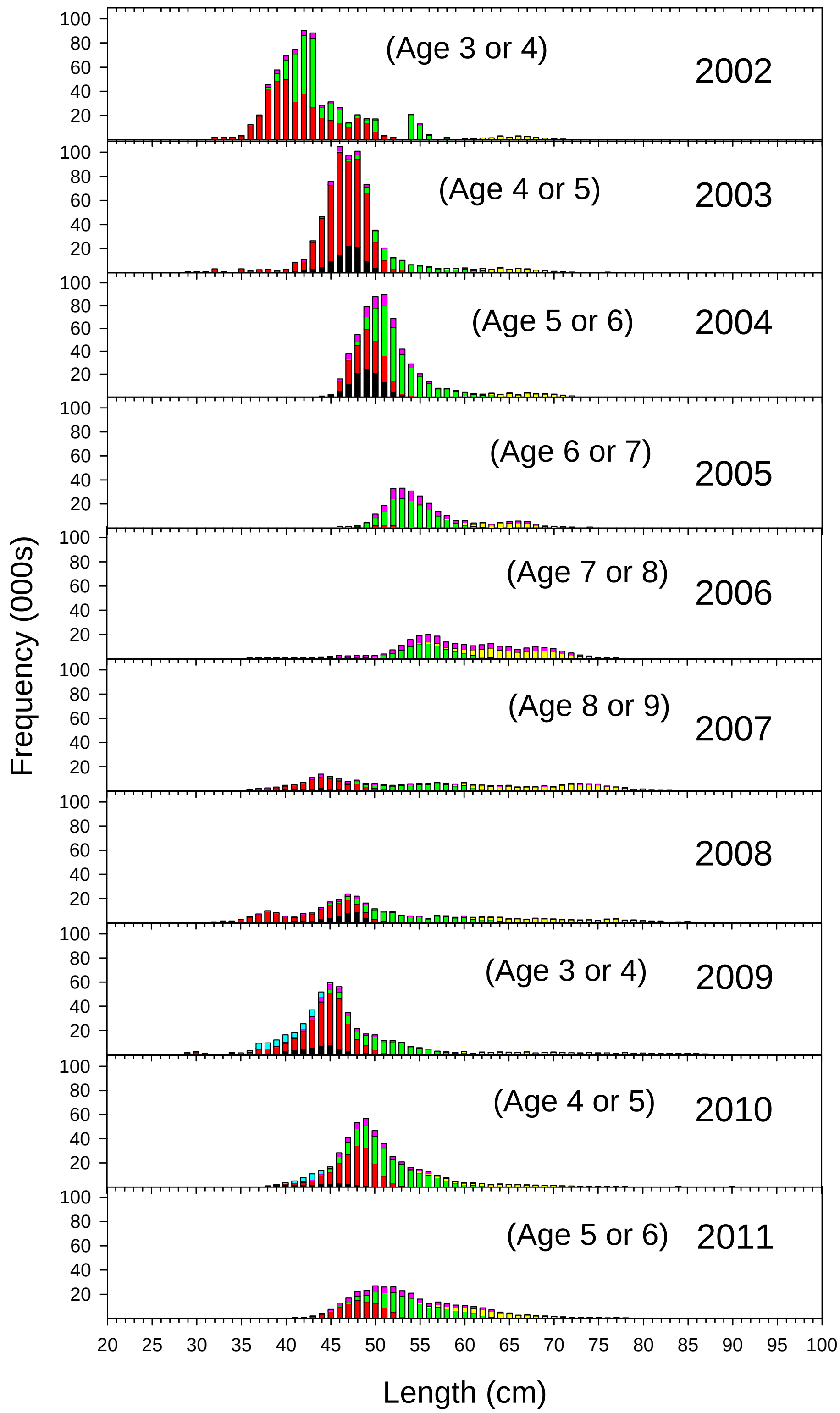

Figure 11. Expanded length frequency distributions by year. Y-axis scale is fixed.

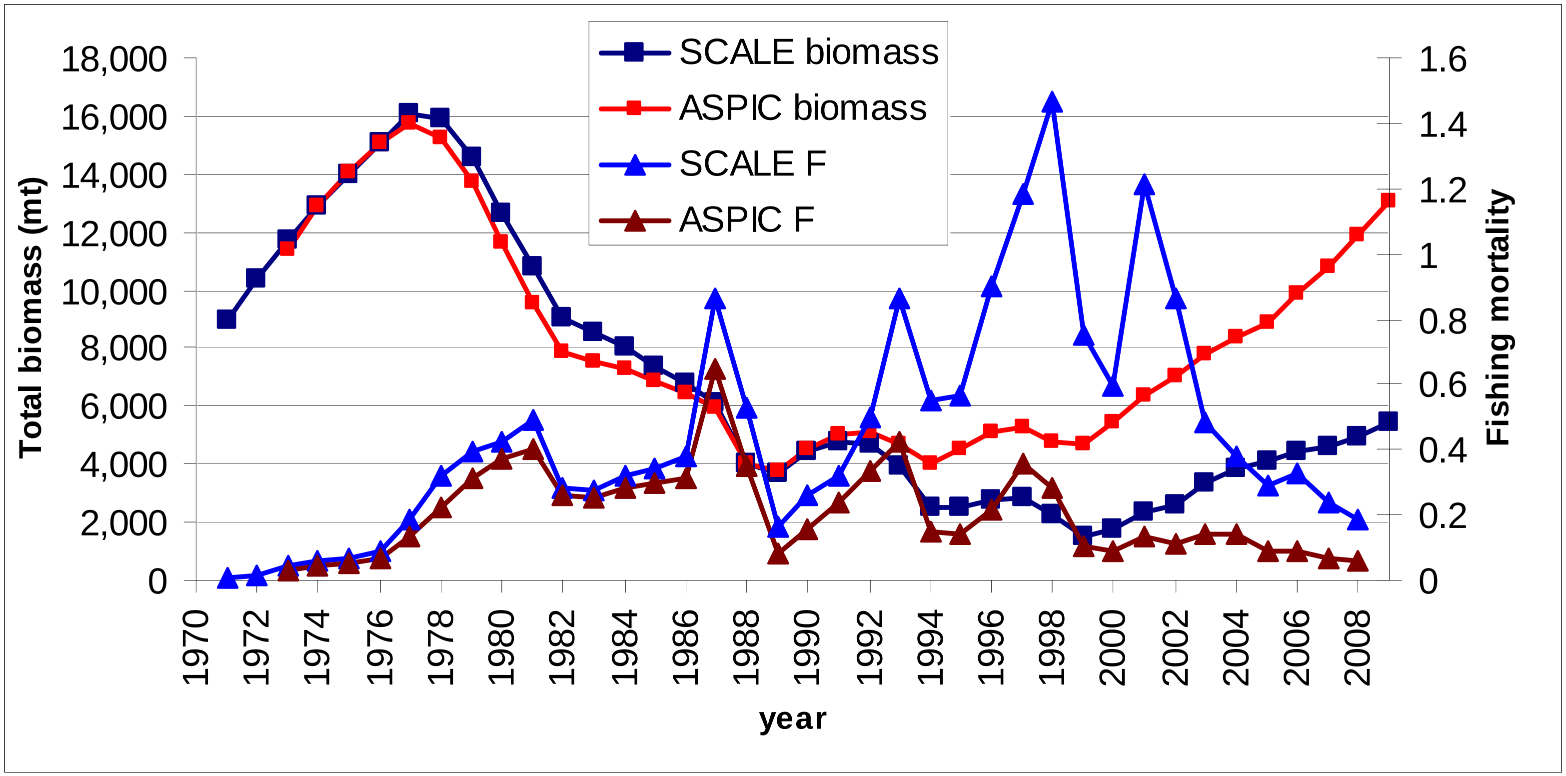

Figure 12. Comparison of F (triangles) and total biomass (squares) between the ASPIC base run 1 with the SCALE base run 1. Note ASPIC base run fixed the biomass in 1973 at Bmsy and SCALE base run estimated Fstart at 0.20.

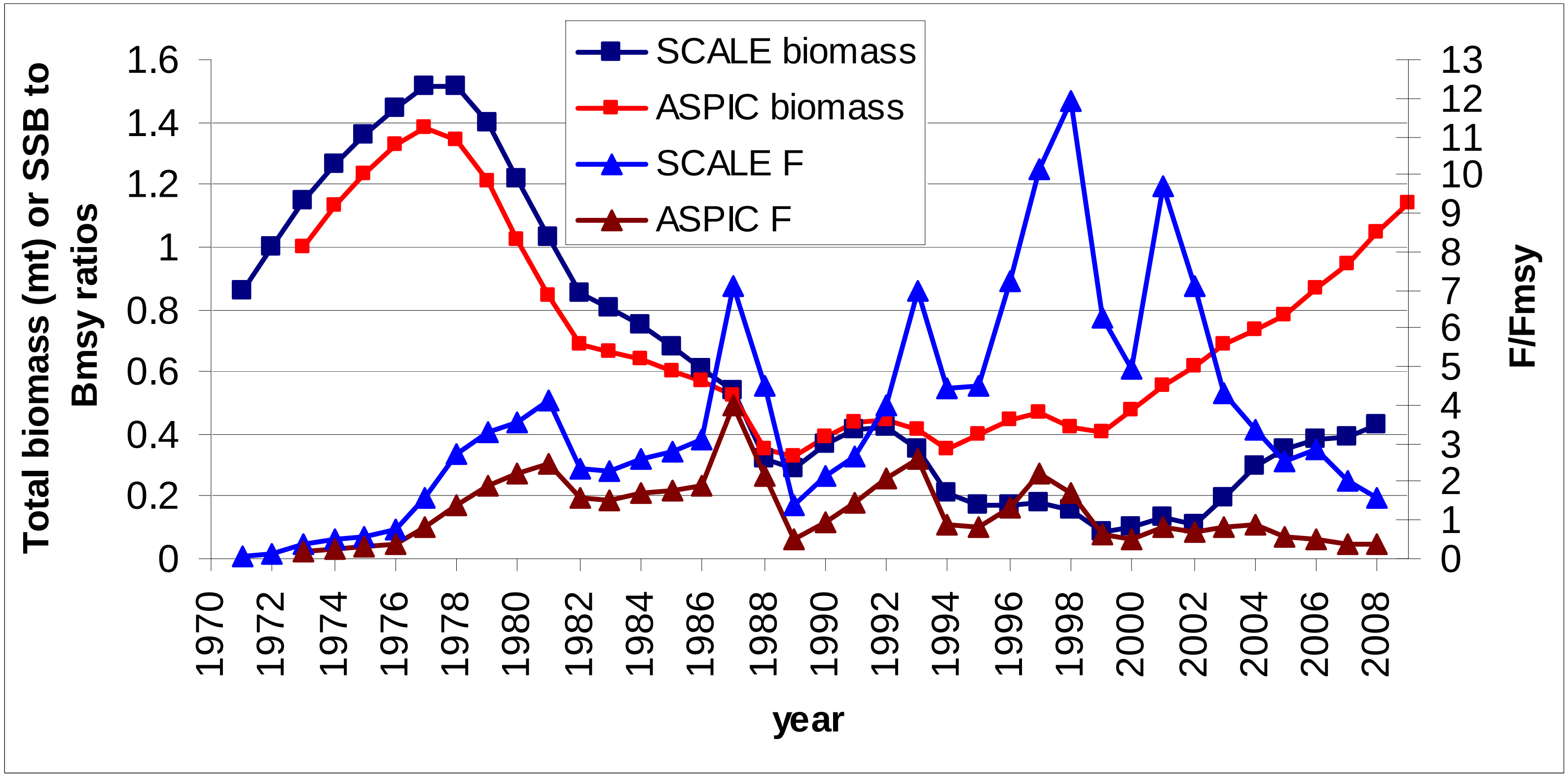

Figure 13. Comparison of F to Fmsy ratio (triangles) and total biomass or SSB to Bmsy ratios (squares) between the ASPIC base run 1 with the SCALE base run 1. Note ASPIC base run fixed the biomass in 1973 at Bmsy and SCALE base run estimated Fstart at 0.20. Fmax (0.128) is used as a proxy for Fmsy and SSBmsy (5,335 mt) is for females only in the SCALE base run 1.

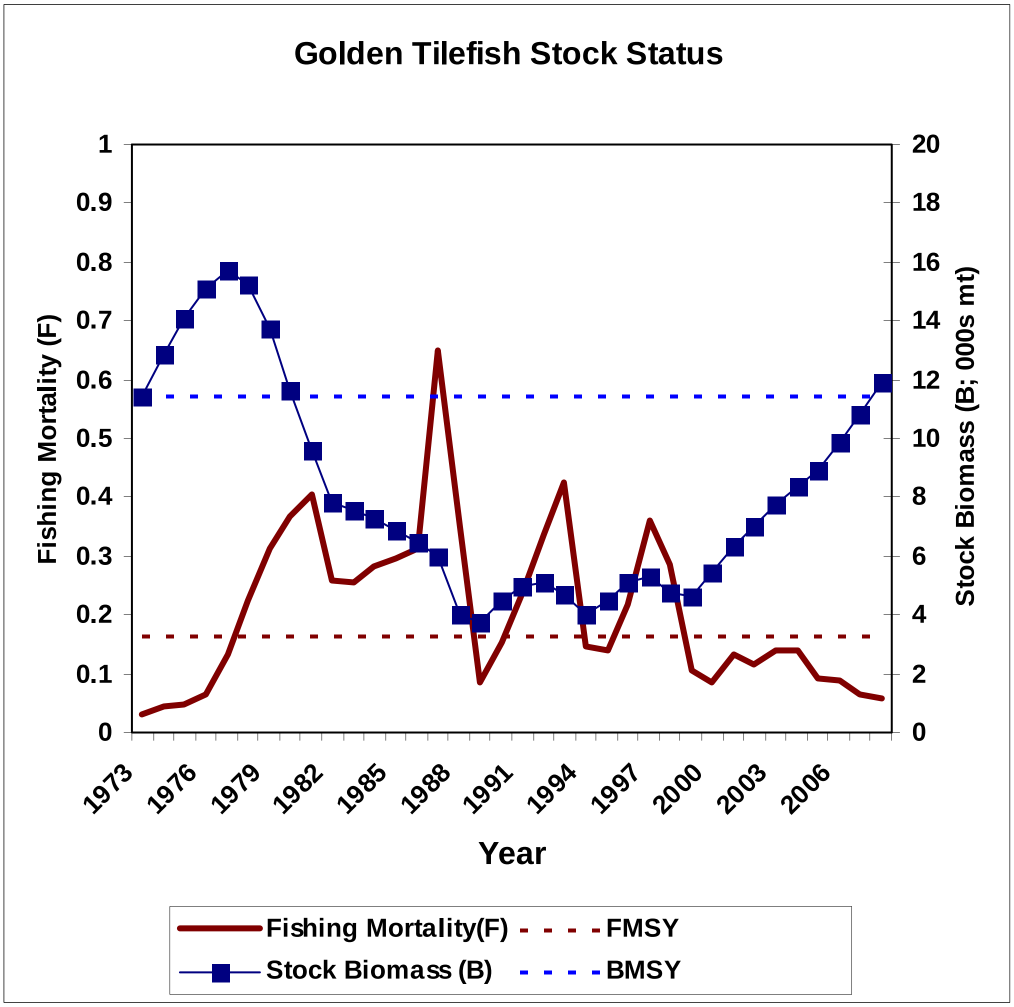

Figure 14. Stock status evaluation for Golden tilefish: 2009 BASE model run.

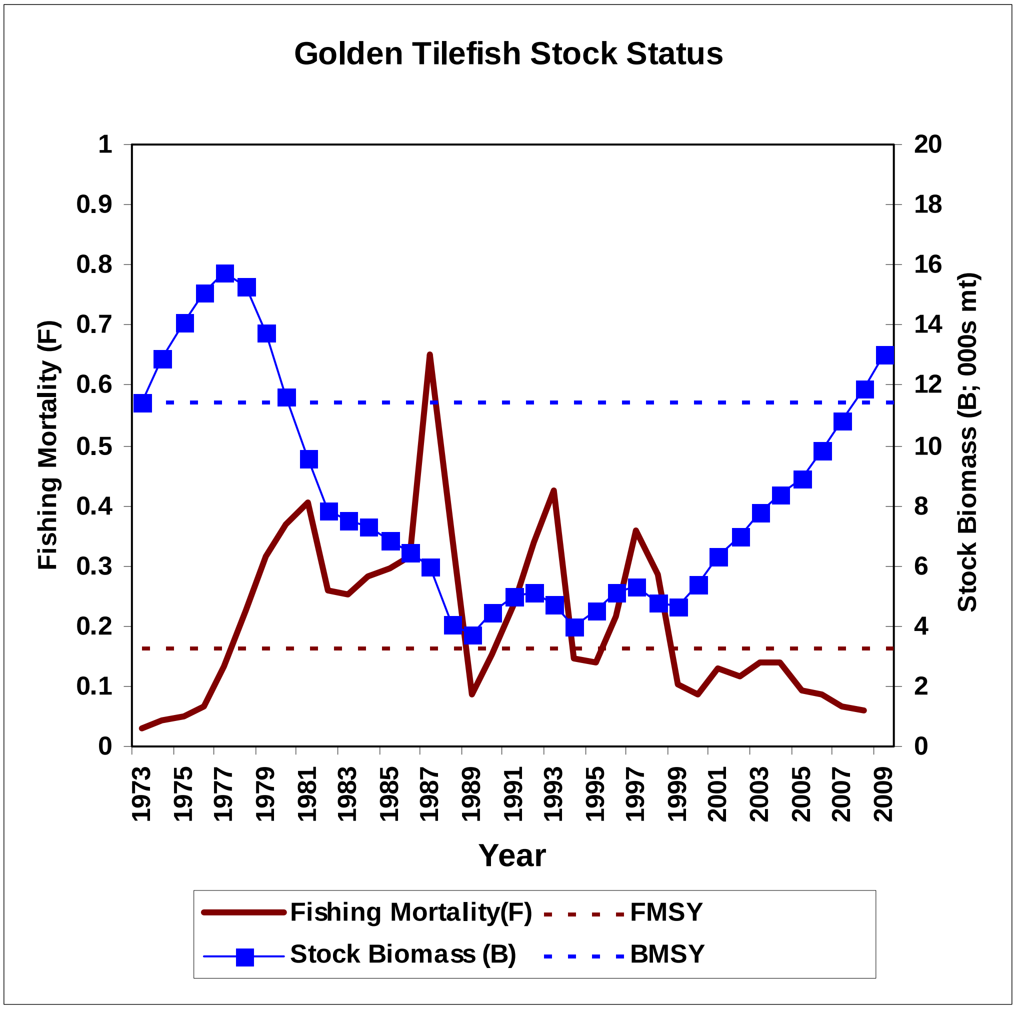

Figure 15. Estimates of tilefish stock biomass (1973-2009) and fishing mortality rate (1973-2008) derived from the ASPIC model. The two horizontal dashed lines represent the Biological Reference Points for the overfishing threshold (F_{MSY}, lower red line) and biomass target (B_{MSY}, upper blue line).

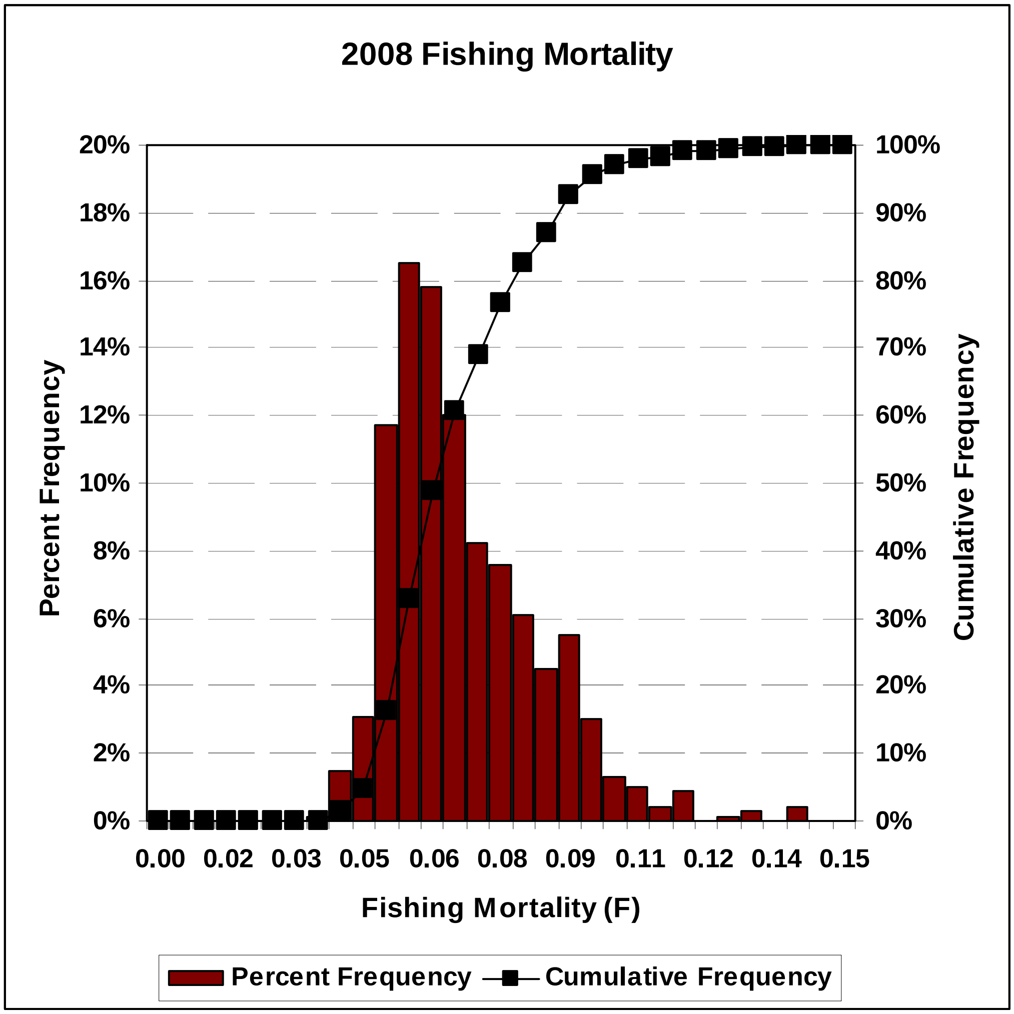

Figure 16. Bootstrap estimates (1000 iterations) of the precision of 2008 fishing mortality from the 2009 BASE run. Vertical bars display the range of the bootstrap estimates; the percent confidence intervals can be taken from the cumulative frequency. The 2008 point estimate of fishing mortality = 0.059.

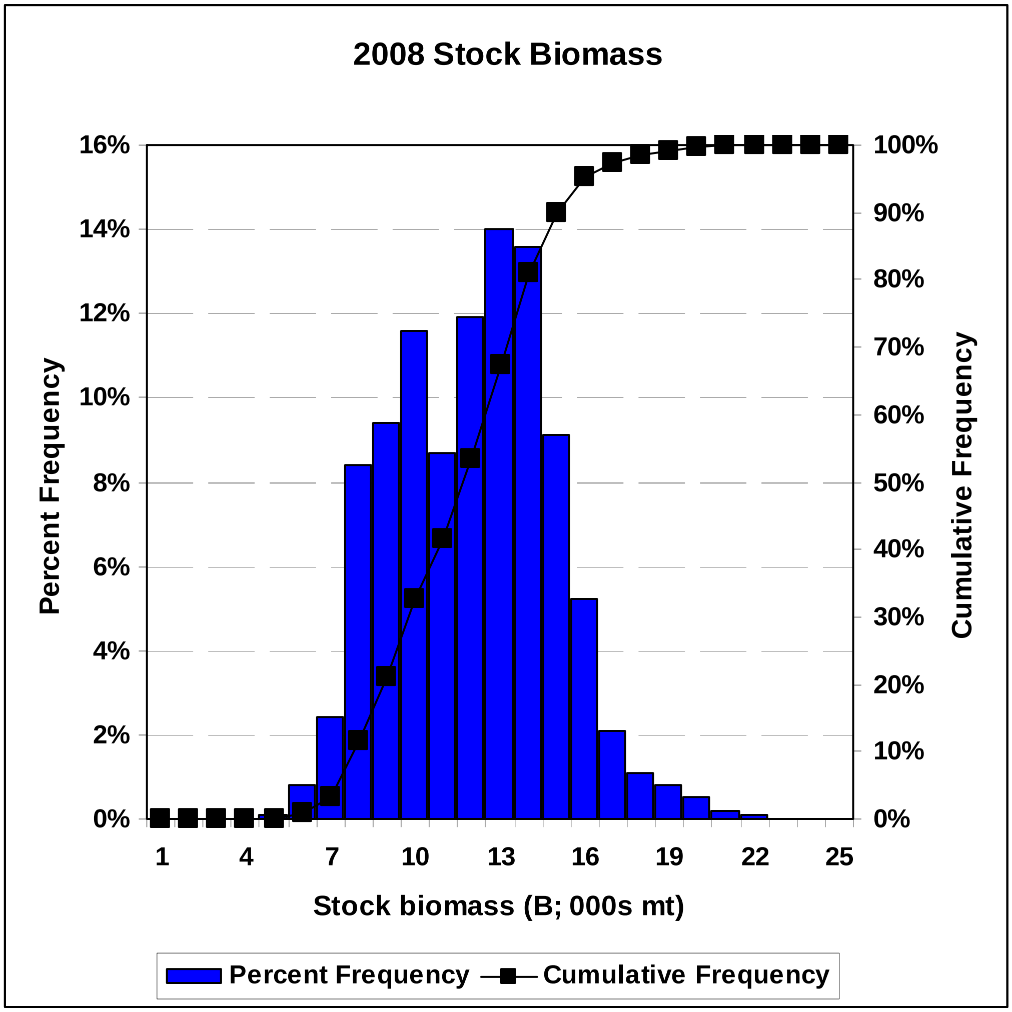

Figure 17. Bootstrap estimates (1000 iterations) of the precision of 2008 stock biomass from the 2009 BASE run. Vertical bars display the range of the bootstrap estimates; the percent confidence intervals can be taken from the cumulative frequency. The 2008 point estimate of stock biomass = 11.910 thousand mt.

Appendix 1. VTR GLM CPUE output

```
The SAS System
                   16:04 Thursday, January 5, 2012   1

The GLM Procedure

                                                                  Class Level Information

Class       Levels  Values

lndyear         17  1995 1996 1997 1998 1999 2001 2002 2003 2004 2005 2006
2007 2008 2009 2010 2011 9999

permit          32  XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX
XXXXXX XXXXXX

Number of Observations Read        1976
Number of Observations Used        1976

The SAS System
                   16:04 Thursday, January 5, 2012   2

The GLM Procedure

Dependent Variable: LNCPUE

                                        Sum of
Source                      DF         Squares     Mean Square    F Value    Pr > F
Model                       47      599.302523       12.751118      59.32    <.0001

Error                     1928      414.403480        0.214940

Corrected Total           1975     1013.706002

R-Square     Coeff Var      Root MSE    LNCPUE Mean

0.591200      6.937351      0.463616       6.682893

Source                      DF       Type I SS     Mean Square    F Value    Pr > F
lndyear                     16     427.4585651      26.7161603     124.30    <.0001
permit                      31     171.8439577       5.5433535      25.79    <.0001

Source                      DF     Type III SS     Mean Square    F Value    Pr > F
lndyear                     16     381.0006951      23.8125434     110.79    <.0001
permit                      31     171.8439577       5.5433535      25.79    <.0001

                                                 Standard
Parameter                Estimate                   Error    t Value    Pr > |t|

Intercept             5.070094812 B        0.27513903      18.43      <.0001
lndyear   1995       -0.008702201 B        0.06556108      -0.13      0.8944
lndyear   1996        0.326559314 B        0.06154246       5.31      <.0001
lndyear   1997        0.849732701 B        0.06046921      14.05      <.0001
lndyear   1998        0.320383735 B        0.05882433       5.45      <.0001
lndyear   1999       -0.015266611 B        0.06068007      -0.25      0.8014
lndyear   2001        0.343794609 B        0.06246719       5.50      <.0001
lndyear   2002        0.545494601 B        0.06286482       8.68      <.0001
```

lndyear	2003	1.028876483	B	0.06517252	15.79	<.0001
lndyear	2004	1.360819900	B	0.06367858	21.37	<.0001
lndyear	2005	1.544471211	B	0.06768749	22.82	<.0001
lndyear	2006	1.225682092	B	0.06705189	18.28	<.0001
lndyear	2007	0.791866323	B	0.06643600	11.92	<.0001
lndyear	2008	0.380375477	B	0.06384426	5.96	<.0001
lndyear	2009	0.517120753	B	0.06493323	7.96	<.0001
lndyear	2010	1.172444570	B	0.06646148	17.64	<.0001
lndyear	2011	1.411486278	B	0.07074618	19.95	<.0001
lndyear	9999	0.000000000	B	.	.	.
permit	xxxxxx	1.003455567	B	0.53895182	1.86	0.0628
permit	xxxxxx	-1.019346098	B	0.34114288	-2.99	0.0028
permit	xxxxxx	-0.176118247	B	0.42798512	-0.41	0.6807
permit	xxxxxx	0.653428537	B	0.29417626	2.22	0.0265
permit	xxxxxx	0.646975277	B	0.29092999	2.22	0.0263
permit	xxxxxx	1.081147448	B	0.53852706	2.01	0.0448
permit	xxxxxx	0.009760362	B	0.30102550	0.03	0.9741
permit	xxxxxx	0.208125616	B	0.29745646	0.70	0.4842
permit	xxxxxx	0.672888159	B	0.30229067	2.23	0.0261
permit	xxxxxx	0.833182336	B	0.33244379	2.51	0.0123
permit	xxxxxx	0.472322378	B	0.28148080	1.68	0.0935
permit	xxxxxx	0.090525234	B	0.28183930	0.32	0.7481
permit	xxxxxx	0.949603814	B	0.27269078	3.48	0.0005
permit	xxxxxx	-0.019040808	B	0.29011911	-0.07	0.9477
permit	xxxxxx	0.723422129	B	0.28023223	2.58	0.0099
permit	xxxxxx	0.532958195	B	0.31510418	1.69	0.0909
permit	xxxxxx	0.314515761	B	0.32520045	0.97	0.3336
permit	xxxxxx	0.751136368	B	0.27919709	2.69	0.0072
permit	xxxxxx	1.963004154	B	0.53877637	3.64	0.0003
permit	xxxxxx	0.947589049	B	0.27274106	3.47	0.0005
permit	xxxxxx	-0.537227341	B	0.53881701	-1.00	0.3189
permit	xxxxxx	0.387062345	B	0.30378866	1.27	0.2028
permit	xxxxxx	-1.056097298	B	0.53911135	-1.96	0.0503
permit	xxxxxx	0.097721984	B	0.30112713	0.32	0.7456
permit	xxxxxx	0.990653148	B	0.27326957	3.63	0.0003
permit	xxxxxx	0.886845048	B	0.28228796	3.14	0.0017
permit	xxxxxx	1.202406719	B	0.27191592	4.42	<.0001
permit	xxxxxx	0.591555422	B	0.29702627	1.99	0.0466
permit	xxxxxx	-1.539896622	B	0.53932474	-2.86	0.0043
permit	xxxxxx	0.830542564	B	0.27988964	2.97	0.0030
permit	xxxxxx	1.115564763	B	0.27197006	4.10	<.0001
permit	xxxxxx	0.000000000	B	.	.	.