Evaluation of a 12-inch minimum size limit on the Florida pompano populations and fisheries in Florida

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Executive Summary

In this report, the impacts of raising the minimum size limit from 11 inches (FL) to 12 inches (FL) in the Florida pompano fishery were evaluated. It was assumed that the effects of all other existing regulatory measures remained unchanged. A catch-based projection and an equilibrium yield-per-recruit model were used for evaluating the impact of the proposed 12-inch minimum size limit on fishery yield and stock condition. These methods used information on the fisheries landings and size composition data reported for Florida pompano during 2006-09 from the Atlantic and Gulf coasts of Florida. Biological data, size selectivity patterns, and estimates of exploitation rates were also utilized for the evaluation. The size-frequency data were generally sparse for the 2006-09 periods and mostly limited to the hook-and-line samples from the commercial and recreational landings.

The proportion of the average total landings in the size categories of 11-inch and smaller was fairly large, 45% on the Atlantic coast and 40% on the Gulf coast during 2006-09. The catch-based projection runs predicted that the annual landings of Florida pompano could potentially drop between 12% and 24% on the Atlantic coast and drop between 10% and 21% on the Gulf coast with the implementation of the 12-inch minimum size limit under four different compliance rates (85%, 90%, 95%, and 100%). The projected annual landings reductions for 85% compliance were 12% on the Atlantic coast and 10% on the Gulf coast. The stock abundance of Florida pompano was predicted to increase by 19% on the Atlantic coast and 14% on the Gulf coast under the 85% compliance rate.

Results from the length based yield per recruit analysis show that, at current levels of fishing mortality, raising the minimum size limit from 11 inches FL to 12 inches FL in the Florida pompano fishery, will result in an increase in the spawning biomass per recruit (*SB/R*) on both coasts of Florida. The *SB/R* was predicted to increase by 29% on the Atlantic coast and by 18% on the Gulf coast based on the ascending selectivity pattern. Slightly higher gains were estimated for the *SB/R* from the model runs with a knife-edge selectivity pattern. Estimates of the Spawning Potential Ratio (SPR) for different combinations of size-at first capture (minimum size limits) and fishing mortality rates showed 1) The SPR increased with increase in minimum size limit; and 2) the risk of the SPR dropping below 20% was reduced significantly under the 12-inch minimum size limit if the fishing mortality increased above the existing rates.

Results from these analyses must be viewed with caution. The size composition data used in the catch-based projections were limited mostly to the hook-and-line fishery low sample sizes. There was little size information available from the commercial gill-net fishery, which constitutes a large proportion of the total landings on the Gulf coast. A number of simplifying assumptions were made: 1) no stock-recruitment feedback was included in the projections; 2) models assumed constant fishing catchability

and selectivity; 3) model projections did not include potential effects of other management measures (e.g., bag-limit, commercial vessel limit) already in place in the pompano fishery; and 4) the analysis assumed no interplay between the minimum size limit and other management measures in place in the fishery.

Fishery Characteristics

Florida pompano (*Trachinotus carolinus*) is a valuable commercial species and a popular target with recreational anglers. Pompano command the highest price in Florida for a food fish with a statewide average ex-vessel price per pound of $3.90 in 2010. Florida accounts for more than 90% of the U.S. pompano landings. Landings statistics for the period 1981-2009 are presented in Table 1.

Table 1. Commercial and recreational landings of Florida pompano on the Atlantic and Gulf coasts of Florida. Recreational landings do not include discard mortality. Gray lines highlight periods of regulatory measures for Florida pompano including the 10-inch minimum size limit in 1989; constitutional net limitation in 1995; and 11-inch minimum size and 6 fish bag limits in 2004.

	Atlantic Coast			Gulf Coast	
	Commercial(lbs)	Recreational (lbs)		Commercial(lbs)	Recreational (lbs)
1981	347,810	236,315		479,473	22,286
1982	219,871	258,761		660,171	45,620
1983	269,262	177,651		502,284	106,912
1984	143,520	69,859		444,537	45,770
1985	250,623	37,326		405,687	36,969
1986	243,383	37,319		429,622	318,397
1987	333,497	17,425		435,700	26,724
1988	305,673	64,901		435,385	70,203
1989	341,861	50,086		407,536	55,406
1990	406,005	101,767		557,805	20,053
1991	275,339	104,754		362,810	103,876
1992	238,850	59,317		358,204	162,303
1993	194,497	29,612		336,785	57,026
1994	218,150	94,725		382,555	66,089
1995	135,072	236,005		252,559	138,493
1996	120,255	66,200		150,595	73,951
1997	221,516	258,675		463,705	131,571
1998	223,233	376,078		504,704	252,301
1999	103,969	281,095		308,052	250,037
2000	105,446	424,908		381,904	268,163
2001	77,453	248,289		233,620	442,342
2002	96,086	202,246		204,955	293,600
2003	108,359	580,077		170,028	207,138
2004	154,226	375,545		158,875	129,260
2005	131,854	367,509		190,845	246,296
2006	144,901	293,060		310,071	231,419
2007	115,117	307,504		269,544	296,909
2008	160,962	293,818		272,320	205,846
2009	153,368	206,648		185,121	195,993

During 2009, the estimated landings of Florida pompano in Florida were 741,130 pounds. Recreational anglers accounted for about 54% of the total statewide landings. About 51% of the statewide landings were made on the Gulf coast. Commercial landings were made mostly in the area from Volusia through Palm Beach Counties on the Atlantic coast and in Collier County on the Gulf coast (Fig. 1). High landings of pompano made by the recreational fishery were distributed throughout all regions except in Monroe County (Fig.1).

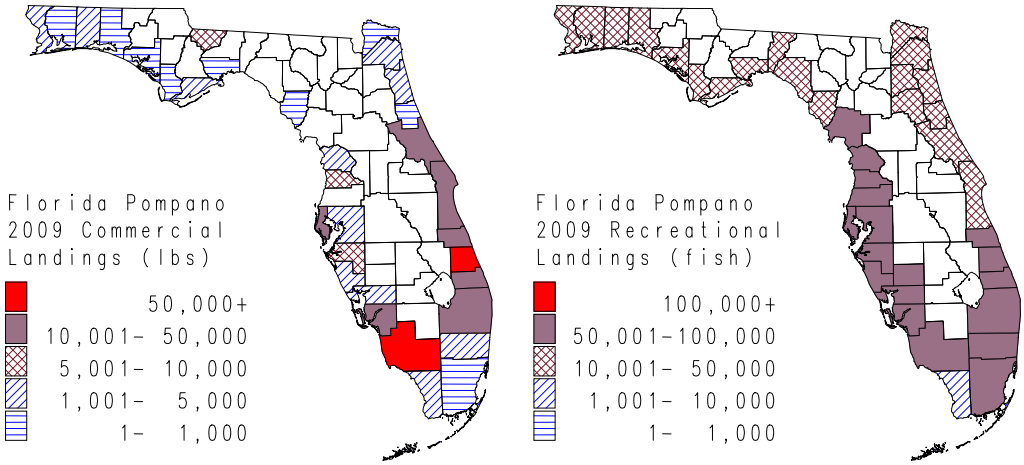

Figure 1. Geographic distribution of Florida pompano landed during 2009. Commercial landings (pounds) are by county (left) and recreational landings (numbers of fish) are by region (right).

Commercial landings reached their peak on the Atlantic coast in 1990 at about 400,000 pounds (Fig. 2). After 1990 the landings decreased steadily through the 1990s except for a short-lived increase to about 200,000 pounds due to expansion of the fishery into Federal waters in 1997 and 1998. The commercial landings have been steady for the past five years averaging at about 140,000 pounds annually. The Atlantic coast recreational landings varied around an increasing trend through the 1980s and 1990's, reaching nearly 580,000 pounds during 2003. The annual recreational landings have declined since 2005. The recent decline in landings could be the result of the regulations (11-inch and 6 fish bag limits) that were implemented in 2004. The annual recreational landings have averaged about 290,000 pounds during the past five years. The total annual landings of Florida pompano have averaged about 430,000 pounds in the past five years on the Atlantic coast.

On the Gulf coast, commercial landings were high during the 1980s and early 1990s, fluctuating between 400,000 and 600,000 pounds (Fig. 3). Commercial landings declined sharply in the mid-1990s after the implementation of the ban on the use of entangling gear. From the 1996 low level of about 150,000 pounds, landings increased due to expansion of the fishery into Federal waters, reaching over 505,000 pounds in 1998 before declining through the rest of the 1990's and early 2000's. Commercial landings have averaged about 245,000 pounds in the past five years. The Gulf coast recreational landings of Florida pompano showed a gradual increase during 1980s and 1990s, peaked in 2001 at about 440,000 pounds, and have fluctuated at about 235,000 pounds in the past five years. The total

annual landings of Florida pompano have averaged about 480,000 pounds in the past five years on the Gulf coast.

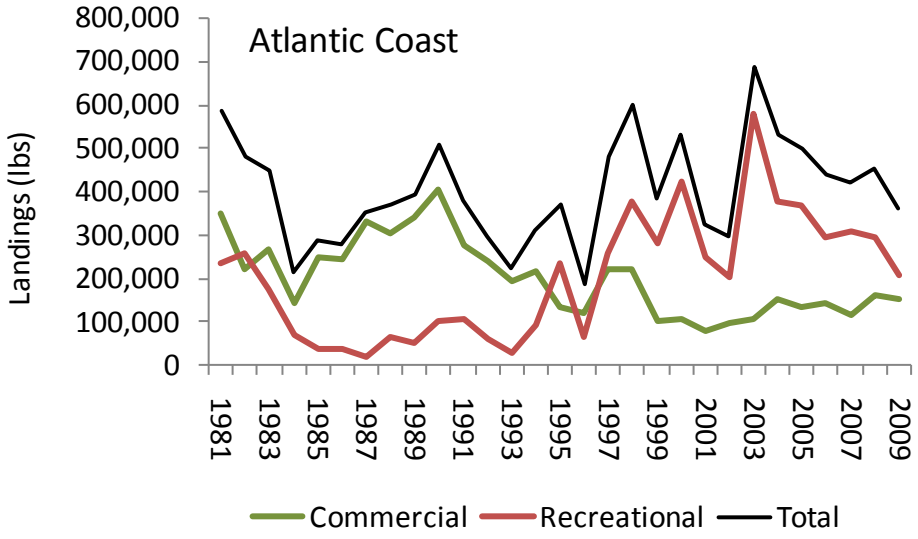

Figure 2.Annual commercial and recreational landings of Florida pompano on the Atlantic coast.

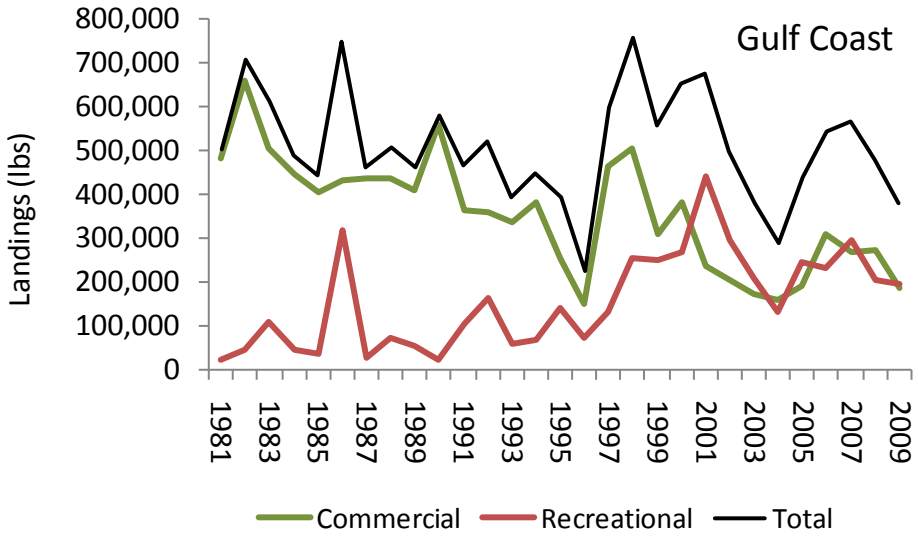

Figure 3.Annual commercial and recreational landings of Florida pompano on the Gulf coast.

The commercial pompano fishery changed after the elimination of entangling gears from Florida waters with the passage of the Constitutional amendment (Article X, Section 16). For example, in the three years prior to that regulation being implemented in July 1995, annual gill or trammel nets catches

accounted for most commercial Florida pompano landings, an average of 69% on the Atlantic coast each year and 78% on the Gulf coast (Figs. 4 and 5). During 2006-09 gill nets have accounted for 68% of landing during 2006-2009 on the Gulf coast while hook-and-line gear has accounted for 83% of the commercial landings on the Atlantic coast.

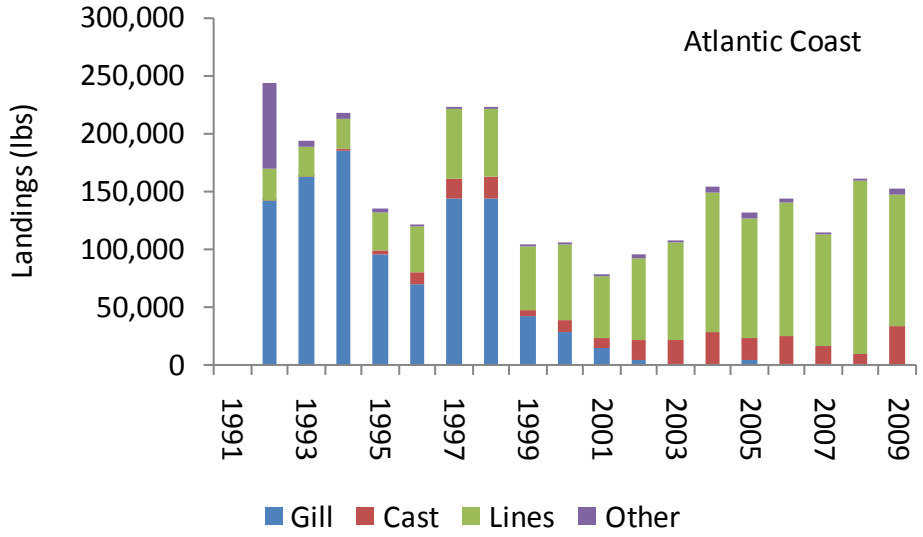

Figure 4.Commercial landings (by gear) on the Atlantic coast.

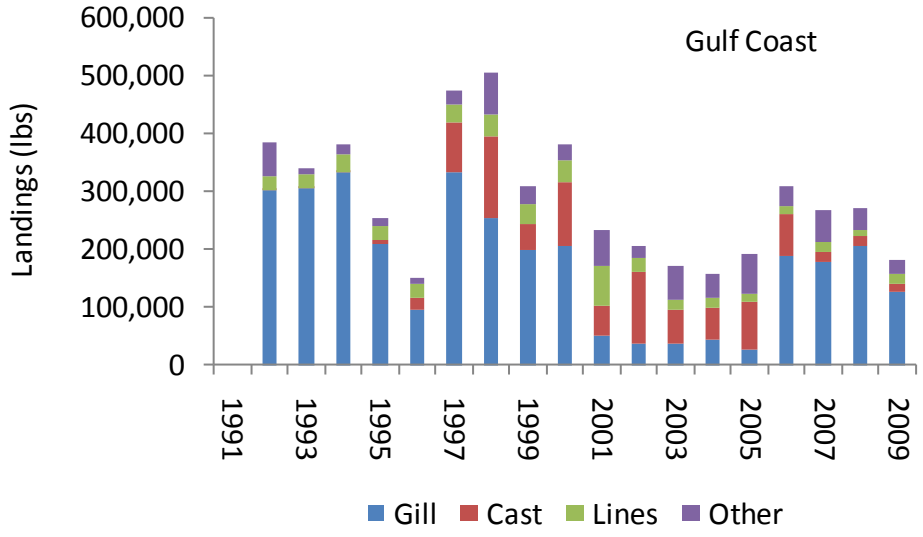

Figure 5.Commercial landings (by gear) on the Gulf coast.

The commercial pompano fishery varies seasonally suggesting either an annual migration or change in availability with season. On the Atlantic coast, landings (and often trips) were higher during December-January with a secondary peak in April (Fig. 6). The pattern is less clear on the Gulf coast because of the expansion of the fishery into offshore, federal waters but early spring and summer-fall peaks were observed in both the numbers of trips taken and the number of pounds landed (Fig. 7).

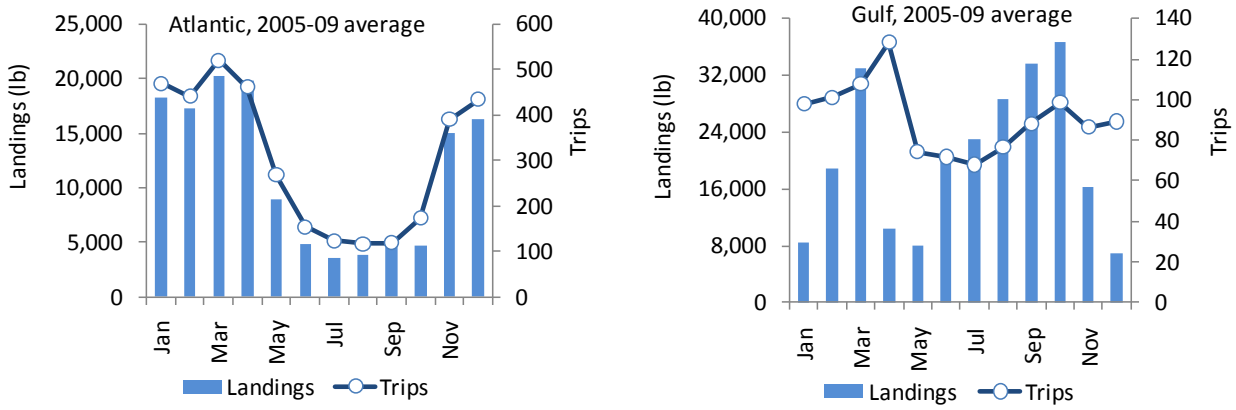

Figure 6.Average monthly number of fishing trips and commercial landings (pounds) of Florida pompano on the Atlantic and Gulf coasts of Florida.

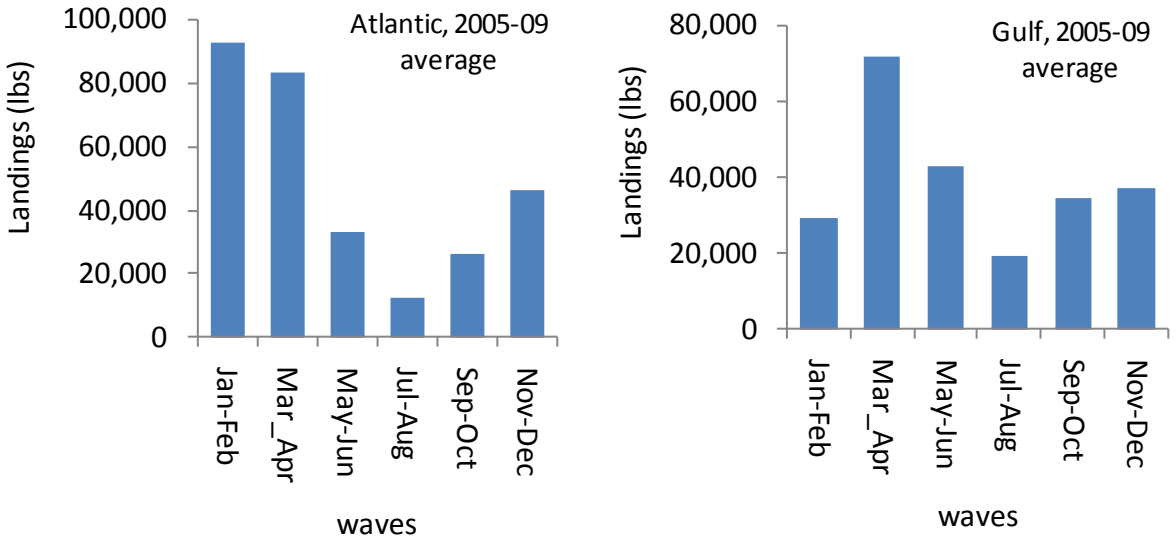

Figure 7.Average recreational landings by wave for the 2005-2009 period on the Atlantic and Gulf coasts of Florida.

Regulatory History

Florida pompano are currently managed under Chapter 68B-35 of the Florida Administrative Code. Several regulatory measures have been adopted for management of the Florida pompano fishery since the late 1980s. On July 1, 1989, the minimum size limit (10 inches FL) was established. In addition, the sale of Florida pompano larger than 20 inches FL was prohibited. Pompano larger than 20 inches are rarely encountered but occasionally permit, which get much larger, are mistaken for pompano and this provision was designed to prevent their sale. Other provisions state that fish must be landed whole and multiple hooks and snatch hooking are prohibited. In July 1995, Article X, Section 16 of the Florida Constitution was enacted which affected the commercial pompano fishery by prohibiting the use of entangling nets within 9 miles of the Gulf coast and 3 miles of the Atlantic coast. In January 1996, the Commission implemented a recreational 10-fish aggregate bag limit for Florida pompano, permit (*Trachinotus falcatus*), and African pompano (*Alectis ciliaris*), with the allowance of one fish over 20 inches FL. In November 2001, the Commission addressed the expanding offshore commercial fishery by allowing qualified fishermen to harvest pompano with gill nets in specified federal waters adjacent to state waters under certain conditions, which included a pompano endorsement or special activity license, vessel length, net specification, and landings requirements; allows eligible fishermen to possess a gill net and pompano in specified state and adjacent federal waters; provides that commercial fishermen who do not possess a restricted species endorsement but not a pompano endorsement or special activity license will be subject to existing gear limitations, as well as a daily harvest, possession and sale limit of 250 fish caught per vessel in state waters; and allows a bycatch of 100 pompano in legal nets targeting other legal species in federal waters. In January 2004, the Commission raised the minimum size from 10 inches FL to 11 inches FL for all harvesters, reduced the aggregate recreational bag limit from 10 fish to 6 fish for pompano and permit, applied the 250 fish per commercial vessel limit to fish caught in state waters, and eliminated the special activity license program. In July 2005, the Commission established a vessel possession limit of two permit and pompano larger than 20 in fork length in state waters. Trends in landings statistics seem to indicate that Florida pompano harvests have been impacted subsequent to the implementations of the regulatory measures in 1989, 1996, and 2004 (Fig. 8).

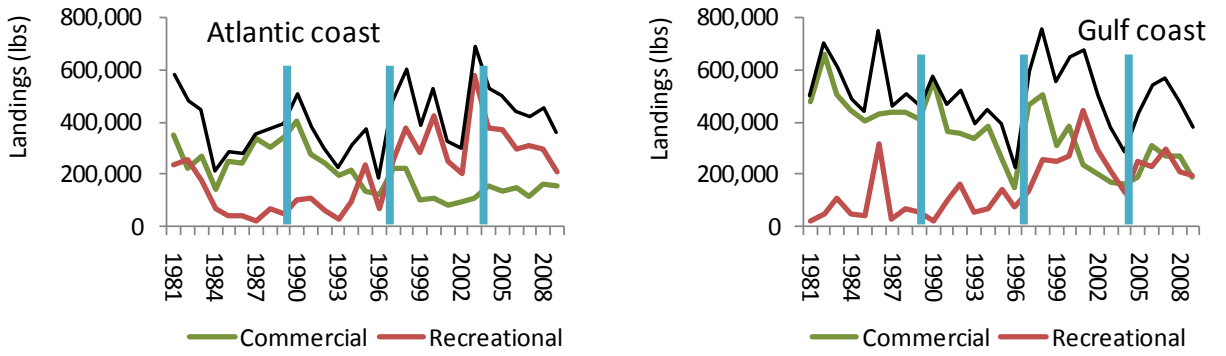

Figure 8.The Florida pompano landings trends in relation to the regulatory measures implemented in 1989, 1997, and 2004 on the Atlantic and Gulf coasts of Florida.

Assessment history

The last assessment of Florida pompano was conducted in 2006 (Murphy *el. al.* 2008). The 2006 assessment used a surplus production model, a modified DeLury model, and Stock Reduction Analysis. Results from these models indicated that while the 2004-2005 Gulf coast stock biomass was larger than the biomass needed to produce maximum sustainable yield, the Atlantic coast population's stock size was less than the stock-production-model estimate of this level in 2005. The fishing rates estimated for the Atlantic stock in 2005 were, for the most part, higher than the overfishing limit (F_{MSY}) but were less than this limit on the Gulf coast. Based on the DeLury model, the fishing mortality in 2005 was estimated at 0.56 yr^{-1} on the Atlantic coast and 0.43 yr^{-1} on the Gulf coast. It should be noted that the 2006 stock status determination was subject to a high level of uncertainty due to 1) fairly imprecise fishery-independent survey data (e.g., not having sufficient spatial and temporal coverage) used for tuning the production and DeLury models; and 2) lack of sufficient age composition data (specially from the recreational fishery) to develop a more precise age-structured model.

Minimum size limit analysis

The minimum size limit is one of the most common methods of regulations. This policy is designed to reduce fishing mortality and improve fish stocks. The evaluation of size limit regulations requires accurate landings statistics and representative length frequency samples from the fishery. Biological data, size selectivity, and current estimates of exploitation rates were also utilized for the evaluation. As stated previously, in January 2004, the Commission raised the minimum size limit from 10 inches FL to 11 inches FL for all harvesters in the Florida pompano fishery, reduced the aggregate recreational bag limit from 10 fish to 6 fish for pompano and permit, applied the 250 fish per commercial vessel limit to fish caught in federal waters as well as state waters, and eliminated the special activity license program. In this report, the impacts of raising the minimum size limit from 11 inches FL to 12 inches FL on the Florida pompano fishery and stock condition are evaluated. The analyses were conducted under the assumption that the impacts of all other existing regulatory measures remained unchanged.

Methods- Two estimation procedures were considered for evaluating the proposed 12-inch minimum size limit in the Florida pompano fishery: 1) a projection approach referred here as the catch-based projection estimation; and 2) an equilibrium yield-per-recruit approach. These methods generally require information on landings and bio-statistical data as well as information on life history parameters, size selectivity, and exploitation rate. The landings statistics used in this analysis were based on the commercial trip ticket and Marine Recreational Fisheries Survey (MRFSS) data bases from the Atlantic and Gulf coasts of Florida for the period 2006-09, a period after the 2004 regulations. The size composition of the landings was available from the Trip Interview Program (TIP) for the commercial sector and from the MRFSS program for the recreational fishery. The size-frequency data were generally sparse for the 2006-09 period (Table 2). On the Atlantic coast, the length-frequency data were mostly limited to samples from the hook-and-line gear and at low sample sizes. Size data were also sparse on the Gulf coast, limited to only one year (2006) of samples from the gill net fishery and low sample sizes from the hook-and-line gear. The life history parameters (e.g., growth parameters, size/age

at maturity, and natural mortality) were available from the 2006 stock assessment report (Murphy *et.al.* 2008). The 2006 assessment also provided information on size selectivity (from the un-tuned VPA) and fishing mortality estimates (from the Delury method).

Table 2.The Florida pompano fork length-frequency samples (by gear) from the commercial and recreational landings on the Atlantic and Gulf coasts of Florida.

Atlantic coast- size composition by gear, 2006-2009

	Commercial Cast Net				Commercial Gill Net				Commercial Line				Recreational Line			
	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009
5														1		
6														3		
7												1				
8													1			
9																1
10									2	10	35	6	3	7	2	3
11								1	21	11	14	59	25	18	29	17
12								1	30	10	10	59	15	16	38	14
13								2	32	7	2	37	11	9	28	10
14									25	3		15	7	8	11	6
15								1	3	1		2	11	8	9	6
16									1				1	3	1	1
17									2				1			
18																
19																
20																
21												1				
22																
	0	0	0	0	0	0	0	5	116	42	61	180	75	73	118	58

Gulf coast- size composition by gear, 2006-2009

	Commercial Cast Net				CommercialGill Net				Commercial Line				Recreational Line			
	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009
5																
6																
7																
8													1			1
9													2	1		
10	2				6				1	7	3	4	5	4	9	
11	6				86				7	47	14	32	11	25	13	20
12	3				57				16	59	10	30	20	35	19	32
13	3				11				13	17	4	23	18	32	12	11
14					2				5	13	3	6	5	11	7	10
15	1				3					3	4	1	6	7	7	9
16										2	1		2	2	1	2
17												1	1	3	2	1
18														1	2	
19													1			
20																
21																
22																
	15	0	0	0	165	0	0	0	42	148	39	97	72	121	72	86

Catch-based projection estimation- In this method, recent estimates of average catch (C_t) and fishing mortality rate (F_t) are used to calculate an initial population size (N_t) and recruitment (R_t) values using equations 1 and 2.

$$N_t = C_t*(M+F_t)/(F_t*(1-e^{(-M-Ft)})) \quad (1)$$

$$R_t = N_t*(1-e^{(-M-Ft)}) \quad (2)$$

The N_t and R_t values were then used to project population size and catch estimates forward in time using equations 3 and 4.

$$N_{t+1} = N_t * e^{(-M-Ft) + Rt} \quad (3)$$

$$C'_t = N_t * (F_t / M+F_t) * (1-e^{(-M-Ft)}) \quad (4)$$

The input data for the projection estimation included annual total (commercial and recreational) landings (in numbers by coast and by gear) for 2006-09, annual size frequency (by coast and by gear) for 2006-09, and estimates of natural mortality (*M*) and recent fishing mortality (*F*). The commercial landings (in pounds) were converted to numbers using length-weight information from the TIP sampling program. The recreational landings (in numbers) were based on MRFSS estimates of A+B1+ 15%B2 (accounting for 15% release mortality rate). As is illustrated in Table 2, the size composition data used in this analysis was mostly limited to the hook-and-line samples from the commercial and recreational fisheries. The total landings and size-frequency data were used to: 1) calculate the average landings at size for the 2006-09 period; 2) calculate potential reduction rates in landings based on the proposed 12-inch minimum size limit (Table 3); and 3) generate a new landings estimates for the projection. The estimates of natural and fishing mortality rates were obtained from the 2006 stock assessment report (Murphy *et. al*. 2008).

The following calculations steps were made to project changes in population abundance and fishery yield under the proposed 12-inch minimum size limit: 1) estimates of the 2006-09 average landings (C_t) and fishing mortality rate (F_t) were used to make estimates of the average population size (C_t /F_t), initial population size (equation 1), and recruitment (equation 2); 2) the estimates of new landings and the average population size were used to calculate a new fishing mortality rate (F_{new}). The F_{new}, *M,* and R_t estimates were then used to make forward calculations of the population size (N_{t+1}) and catch (C'_t) using equation 3 and 4. Projection runs were made allowing for recruitment, recruitment and natural mortality, and recruitment, natural mortality, and fishing mortality to vary. These parameters were allowed to vary based on distributions that were generated with Monte Carlo simulations of 500 outcome using random, normal deviates (Std=0.5). Changes in population abundance on each coast were projected for four different compliance rates (100%, 95%, 90%, and 85%).

The catch-based projections were also made for the 11-inch minimum size limit that was implemented in 2004 using the landings-at-size data for the 2001-2004 periods. This analysis allowed for evaluating the robustness of the catch-based forward projections and the potential impact of the 11-inch minimum size limit on the landings during 2006-09.

Table 3. Average total annual landings-at-size (2006-09) on the Atlantic and Gulf coasts of Florida. These tables were used for calculating potential reduction rates in landings associated with the proposed 12-inch minimum size limit for four different compliance rates.

Atlantic coast		
Inches	Avg. Landings (numbers), 2006-09	Size Proportion
5	958	0.3%
6	3,107	1.1%
7	595	0.2%
8	1,167	0.4%
9	7,133	2.5%
10	40,830	14.4%
11	75,592	26.7%
12	65,635	23.1%
13	41,797	14.7%
14	23,524	8.3%
15	18,597	6.6%
16	3,361	1.2%
17	850	0.3%
18	116	0.0%
19	0	0.0%
20	116	0.0%
21	145	0.1%
22	0	0.0%
Total Landings		283,522
Percent landings reduction- 100% compliance		45.6%
Percent landings reduction- 95% compliance		40.6%
Percent landings reduction- 90% compliance		35.6%
Percent landings reduction- 85% compliance		30.6%

Gulf coast		
Inches	Avg. Landings (numbers), 2006-09	Size Proportion
5	473	0.2%
6	1262	0.4%
7	315	0.1%
8	1564	0.5%
9	1983	0.6%
10	21380	6.8%
11	100560	31.9%
12	95850	30.4%
13	47502	15.1%
14	20852	6.6%
15	15159	4.8%
16	3559	1.1%
17	2917	0.9%
18	1190	0.4%
19	584	0.2%
20	0	0.0%
21	158	0.1%
22	0	0.0%
Total Landings		315,308
Percent landings reduction- 100% compliance		40.4%
Percent landings reduction- 95% compliance		35.4%
Percent landings reduction- 90% compliance		30.4%
Percent landings reduction- 85% compliance		25.4%

Table 4. Average total annual landings-at-size (2001-04) on the Atlantic and Gulf coasts of Florida. These tables were used for calculating potential reduction rates in landings associated with the 11-inch minimum size limit implemented in 2004 for four different compliance rates.

Atlantic coast				Gulf coast		
Inches	Avg. Landings (numbers), 2001-04	Proportion		Inches	Avg. Landings (numbers), 2001-04	Proportion
5	530	0.1%		5	479	0.1%
6	1,945	0.5%		6	1,278	0.4%
7	1,658	0.4%		7	402	0.1%
8	10,523	2.8%		8	1,814	0.6%
9	41,747	11.1%		9	11,141	3.5%
10	78,099	20.8%		10	78,267	24.3%
11	89,158	23.7%		11	92,564	28.7%
12	86,979	23.1%		12	65,511	20.3%
13	35,245	9.4%		13	35,761	11.1%
14	15,126	4.0%		14	19,130	5.9%
15	5,679	1.5%		15	10,924	3.4%
16	3,173	0.8%		16	3,014	0.9%
17	2,773	0.7%		17	866	0.3%
18	1,365	0.4%		18	432	0.1%
19	471	0.1%		19	498	0.2%
20	648	0.2%		20	0	0.0%
21	177	0.0%		21	160	0.0%
22	471	0.1%		22	0	0.0%
Total Landings		375,769		Total Landings		322,241
Percent landings reduction- 100% compliance		35.8%		Percent landings reduction- 100% compliance		29.0%
Percent landings reduction- 95% compliance		30.8%		Percent landings reduction- 95% compliance		24.0%
Percent landings reduction- 90% compliance		25.8%		Percent landings reduction- 90% compliance		19.0%
Percent landings reduction- 85% compliance		20.8%		Percent landings reduction- 85% compliance		14.0%

Results- During 2006-09, the average annual landings in the 11-inch size category were approximately 27% of the average total landings on the Atlantic coast and 32% of the average total landings on the Gulf coast. The proportion of the average total landings in the size categories of 11-inch and smaller was 45% on the Atlantic coast and 40% on the Gulf coast (Table 3).

The projections from the base-runs (allowing only for the variation in the recruitment) predicted that the annual landings of Florida pompano could drop between 12% and 24% on the Atlantic coast and drop between 10% and 21% on the Gulf coast with the implementation of the 12-inch minimum size limit under four different compliance rates (Fig. 9). The population abundance was estimated to increase by 19-25% on the Atlantic coast and increase by 14-22% on the Gulf coast (Figure 10). The non-compliance rate could be fairly high in the pompano fishery. The landings-at-size table (Table 3) indicates that noncompliance rate was about 9% on the Gulf coast and 19% on the Atlantic coast during 2006-09, roughly 15% on average. The estimates of reduction rates in landings under the 15% noncompliance rate (or 85% compliance rate) were 12% on the Atlantic coast and 10% on the Gulf coast. The stock abundance was predicted to increase by 19% on the Atlantic coast and 14% on the Gulf coast under the 15% noncompliance rate. Results from alternative projection runs (allowing for variability with natural and fishing mortality rates) were fairly similar to the base-run results (Fig. 10).

To evaluate the potential accuracy of the projections, I used the same procedure to estimate the impact of the 11-inch minimum size limit (implemented in 2004) using the 2001-04 landings-at-size data (Table 4). The proportion of the average landings in the 10-inch-and-smaller size categories to the average total landings was estimated to be 36% on the Atlantic coast and 29% on the Gulf coast. The

landings were projected to drop between 8% and 16% on the Atlantic coast and drop between 4% and 12% on the Gulf coast with the implementation of the 11-inch minimum size limit (Fig. 11). On the Atlantic coast, the actual total number of fish landed declined from an annual average of 375,769 fish during 2001-04 to an annual average of 283,522 fish during 2006-09, a 25% reduction. On the Gulf coast, the actual total landings of Florida pompano declined from an annual average of 322,241 fish during 2001-04 to an annual average of 315,308 fish during 2006-09, a 2% reduction. The projection model estimated a larger reduction in landings than actually occurred on the Atlantic coast and a slightly smaller reduction on the Gulf coast. The projected population size under the 11-inch minimum size limit for the four different compliance rates are shown in Figure12. The stock size was projected to increase between 12 and 21% on the Atlantic coast and between 9 and 16% on the Gulf coast under the 11-inch minimum size limit regulation that went into effect in 2004.

Results from the projection runs indicate that the impact of the 12-inch minimum size limit on the total harvest of Florida pompano in Florida could be significant. For example, at 85% compliance, the total landings could potentially be reduced by 12% on the Atlantic coast and by 10% on the Gulf coast. These results, however, must be viewed with caution. The size composition data used in the analysis was limited mostly to the hook-and-line fishery low sample sizes. There was little size information available from the commercial gill-net fishery, which constitutes a large proportion of the total landings on the Gulf coast. The model incorporated a number of simplifying assumptions: 1) no stock-recruitment feedback was included in the projections; 2) variability associated with recruitment, natural mortality, and fishing mortality were based on random, normal distributions (Std=0.5); 3) assumed knife-edge maturity at 11-inch; and 4) constant fishing catchability and selectivity. It has to be pointed out that these projections only took into account the impact of the size-limit and did not include the effects of the other management measures (e.g., bag-limit, commercial vessel limit) already in place in the pompano fishery. The analysis assumed no interplay between the minimum size limit and other management measures in place in the fishery.

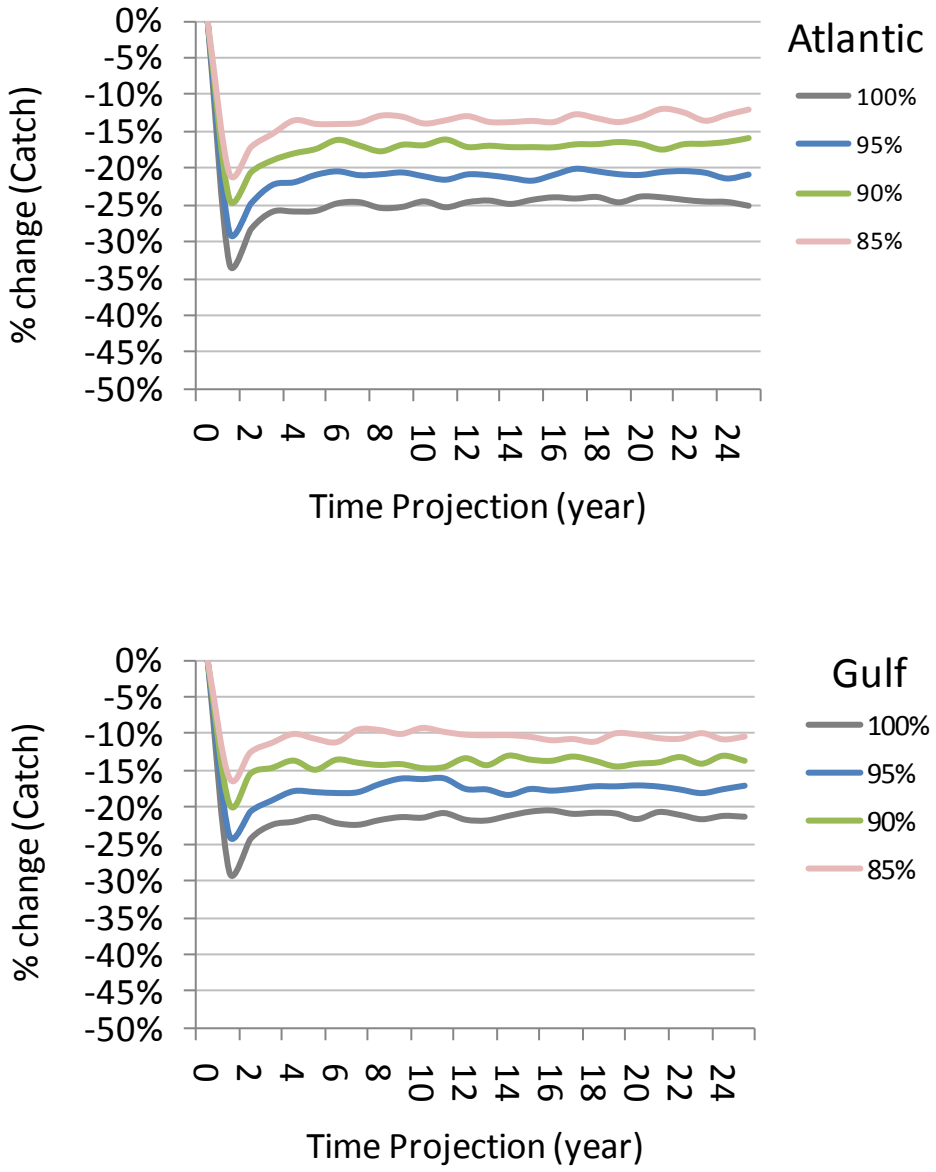

Figure 9. Predicted percent change in landings (numbers) of Florida pompano on the Atlantic and Gulf coasts of Florida under the proposed 12-inch minimum size limit for four different compliance rates, 85%-100%.

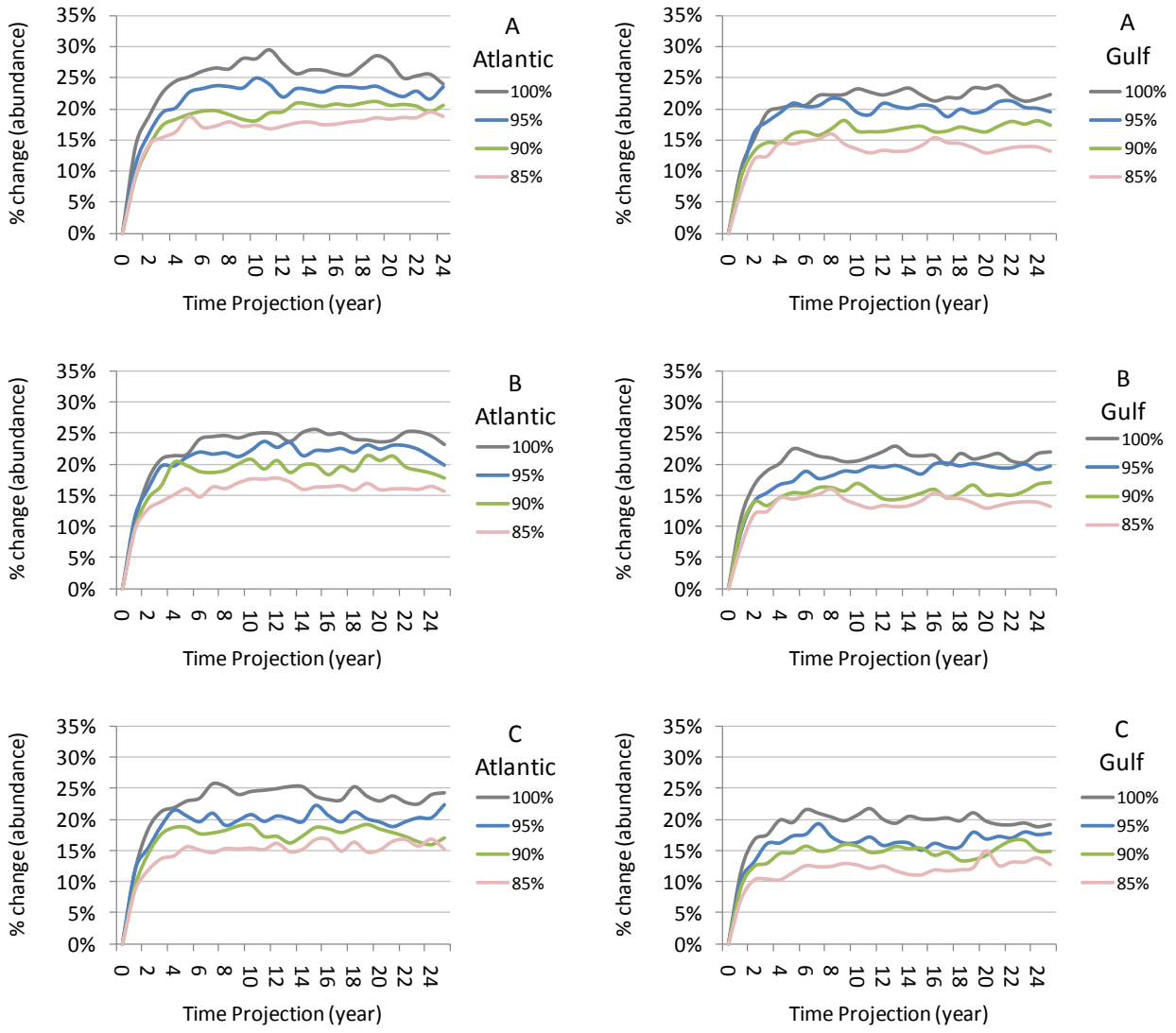

Figure 10. Predicted percent change in stock abundance of Florida pompano on the Atlantic (left panel) and Gulf (right panel) coasts under the proposed 12-inch minimum size limit for four different compliance rates, 85%-100%. Projection runs were made allowing for variations in recruitment (A), recruitment and natural mortality (B), and recruitment, natural mortality, and fishing mortality (C).

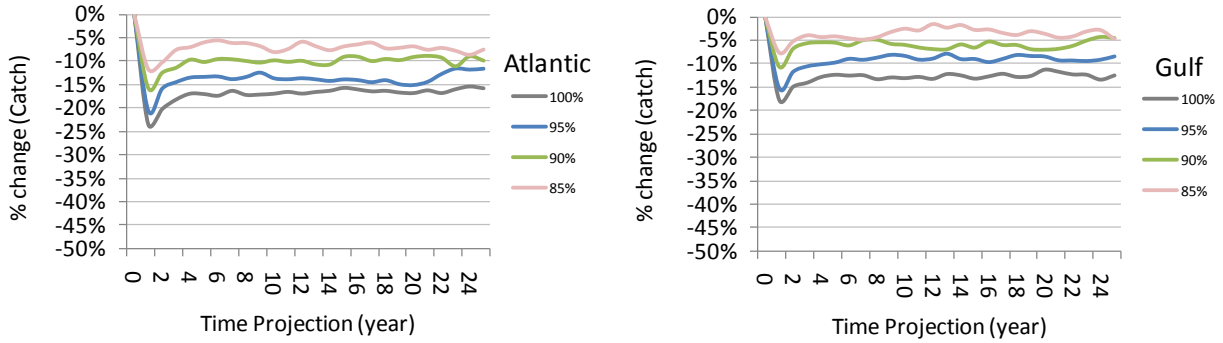

Figure 11. Predicted percent change in landings (numbers) of Florida pompano on the Atlantic and Gulf coasts of Florida under the 11-inch minimum size limit (implemented in 2004) for four different compliance rates.

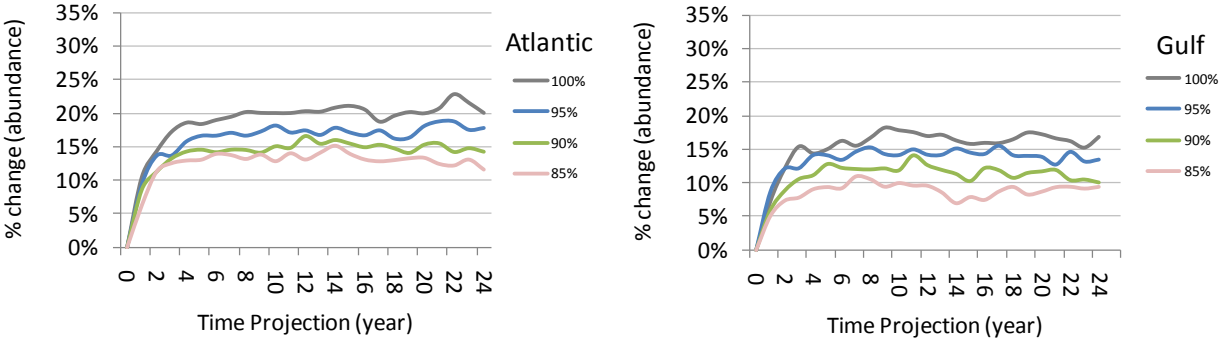

Figure 12. Predicted percent change in stock size of Florida pompano on the Atlantic and Gulf coasts of Florida under the 11-inch minimum size limit (implemented in 2004) for four different compliance rates.

Length-based yield per recruit method- The yield per recruit (YPR) model is one of the most commonly used methodologies for stock assessment when there is insufficient data for more advanced age-structured modeling. Given the life history information (growth rate, size/age at maturity, natural mortality), the YPR formulations predict the life-time yield of a cohort, and the spawner biomass remaining, under different combinations of fishing mortality and age/size-at-first capture. Thus, it is a useful tool to examine the effects of minimum size-limit regulation and fishing mortality on the yield and stock size on a per-recruit basis (from a fixed number of individuals that enter the fishery). The YPR formulations are also used to derive biological reference points such as $F_{0.1}$ (rate of fishing that corresponds to a point on the YPR curve where the slope is 10% of that at the origin) and fishing

mortality rates corresponding to various levels of spawning potential ratio (SPR, ratio of current spawner biomass-per-recruit to the pristine unfished spawner biomass ($SB/R)_{F=0}$,), i.e., $F_{30\%SPR}$, $F_{35\%SPR}$, and $F_{40\%SPR}$.

The length-based approach differs from the traditional age-based YPR model principally in the way in which the fishery selectivity and life history parameters are related to length, there by extension to age. In the traditional age based approach a number of age classes, selectivity, maturity and weight for each integral age class are explicitly specified. However, in the length-based approach, the calculations are performed in small relative age steps from zero to the specified maximum age. Each age step is converted into a length based on the starting length at relative time zero and the growth equation parameters. Selectivity, maturity and weights are functions of length. The length at each relative age step can be derived directly from the growth equation, and the fishing selectivity, natural mortality, maturity, and weight is calculated as a function of length. For this analysis I used the length-base yield-per-recruit software (YPRLEN) developed by the NMFS-Northeast Fisheries Science Center and available from the NOAA Tool Box (http://nft.nefsc.noaa.gov/Download.html). The input biological and fishery parameters used in the YPRLEN analysis are presented in Table 5. These parameters estimates were obtained primarily from the 2006 stock assessment report (Murphy *el. al.* 2008).

Table 5. Summary of parameters used in the length-based YPR analysis for Florida pompano.

	Atlantic coast		Gulf coast	
Parameters	11-inch Model	12-inch Model	11-inch Model	12-inch Model
Von Bertalanfy Growth Parametrs	0.27	0.27	0.63	0.63
K	461	461	379	379
L(inf)-mm	-2.4	-2.4	-1.38	-1.38
T(0)				
Length-Weight				
alpha	0.000347	0.000347	0.00003	0.00003
beta	2.53	2.53	2.935	2.935
Natural mortality	0.4	0.4	0.4	0.4
Fishing selectivity				
Selectivity is zero below this length (inch	10	11	10	11
Fully selected at minimum length (inch)	11	12	11	12
Length at maturity (inch)	12	12	12	12
Maximum age	8	8	8	8
Current fishing mortality	0.48	0.48	0.4	0.4

Results- The YPRLEN models results are shown for both the ascending and knife-edge selectivity patterns for the 11-inch and 12-inch minimum size limit calculations (Figure 13 and 14). Results indicate that, at current level of fishing mortality, raising the minimum size limit from 11 inches FL to 12 inches FL in the Florida pompano fishery would result in an increase in the spawning biomass per recruit (*SB/R*) on both coasts of Florida. The *SB/R* was predicted to increase by 29% on the Atlantic coast and by 18% on the Gulf coast based on the ascending selectivity pattern (Figure 13). Slightly higher gains were estimated for the *SB/R* from the model runs based on the knife-edge selectivity pattern (Figure 14).

Estimates of the Spawning Potential Ratio (*SPR*) for different combinations of size-at first capture (minimum size limits) and fishing mortality in the Florida pompano fishery on the Atlantic and

Gulf coasts of Florida are shown in Figure 15. These estimates show 1) The SPR generally increased with increase in minimum size limit; and 2) The risk of the SPR dropping below 20% was reduced significantly under the 12-inch minimum size limit if the fishing mortality increased above the existing rates.

Literature Cited

Murphy, M. D., R. G. Muller, and K Guindon. 2008. A stock assessment of Florida pompano, *Trachinotus carolinus*, in Florida waters through 2005. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute. St. Petersburg, FL. Revised January, 2008.

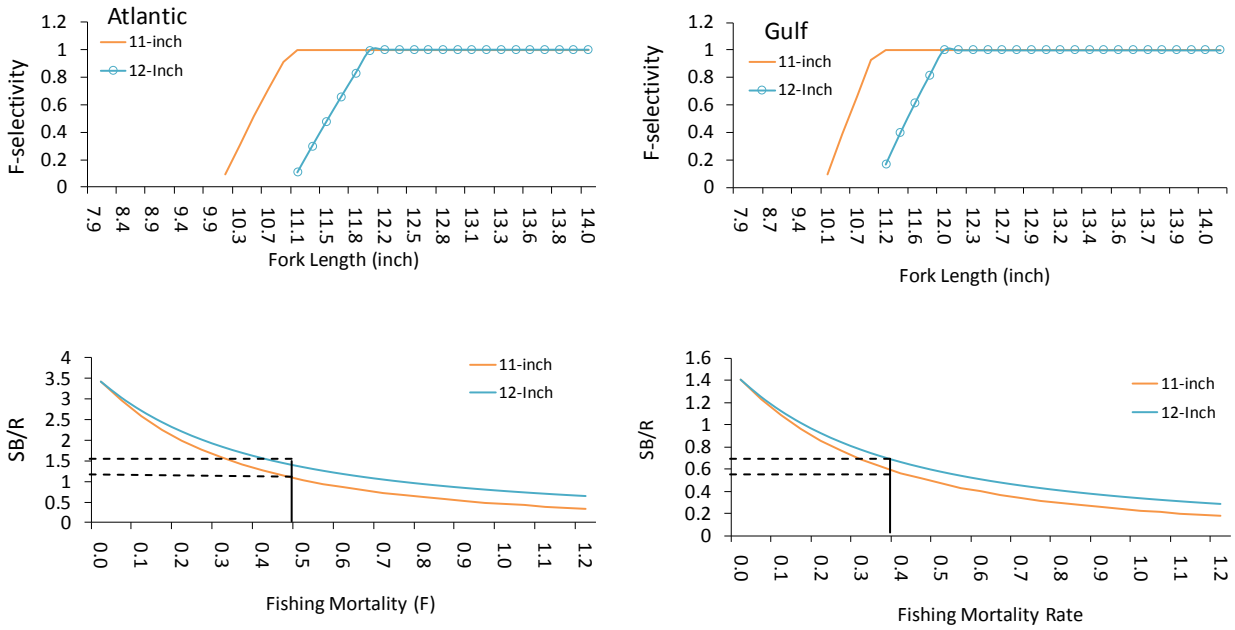

Figure 13. The YPRLEN model estimates of spawning biomass per recruit (*SB/R*) based on the ascending selectivity patterns for the 11- inch and 12- inch minimum size limits in the Florida pompano fishery on the Atlantic and Gulf coasts of Florida. Estimated change for *SB/R* at the current fishing mortality is shown with dashed lines.

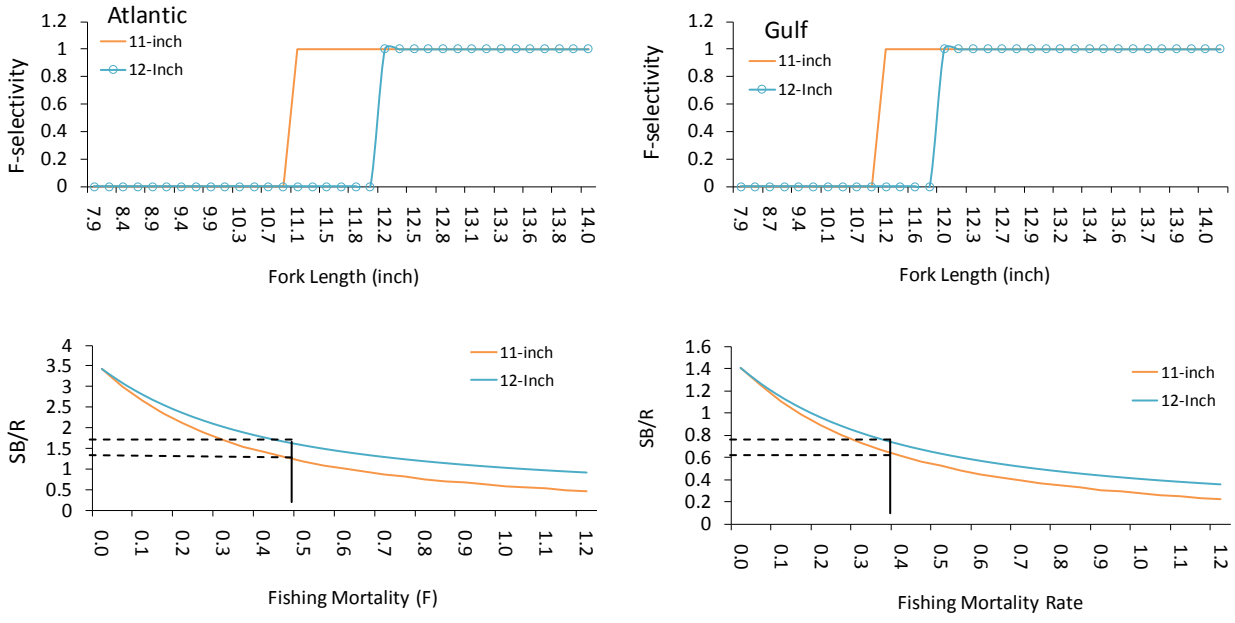

Figure 14. The YPRLEN model estimates of spawning stock per recruit (*SB/R*) based on the knife-edge selectivity pattern for the 11- inch and 12- inch minimum size limits in the Florida pompano fishery on the Atlantic and Gulf coasts of Florida. Estimated change for *SB/R* at the current fishing mortality is shown with dashed lines.

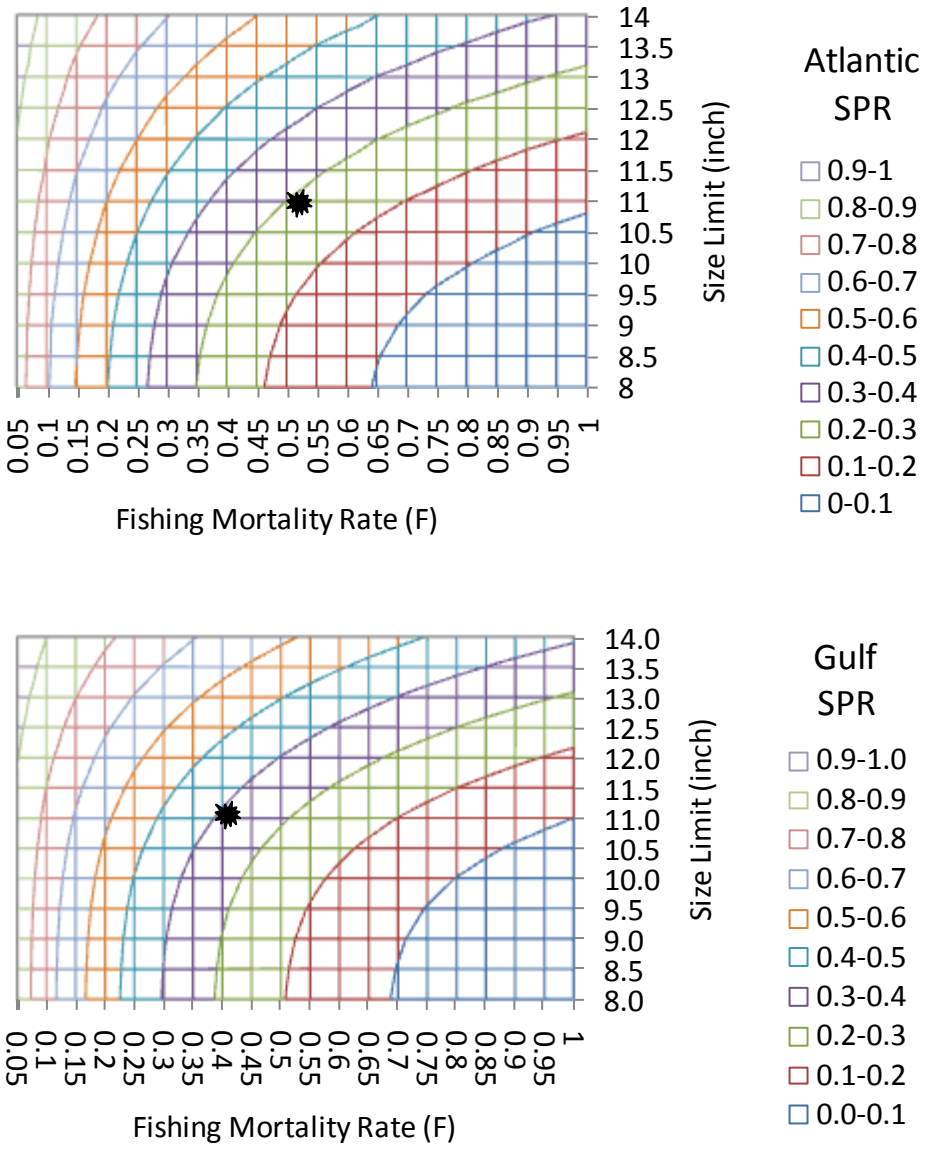

Figure 15. Isopleths of spawning potential ratio (SPR) response to different combination of age-at first capture (minimum size limits) and fishing mortality rates for the Florida pompano fishery in the Atlantic and Gulf coasts of Florida. Black dots indicate the SPR levels at the current fishing mortality rates.