Snook Cold Kill Report

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Fish and Wildlife Research Institute
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Introduction

The unseasonably cold temperatures experienced in January 2010 resulted in widespread fish kills throughout the state of Florida. Concerns over the high numbers of common snook reported dead prompted the Florida Fish and Wildlife Conservation Commission (FWC) to issue an executive order on Jan. 15 that temporarily extended closed harvest seasons for snook statewide until Sept. 1. The closure provided a proactive, precautionary measure aimed at protecting surviving snook during their spring/summer reproductive season as well as providing additional time for FWC biologists to evaluate the extent of the damage caused by the prolonged cold weather. This report presents a summary of the analyses conducted by FWC's Fish and Wildlife Research Institute (FWRI) to assess the impact of the 2010 cold kill event on Florida's common snook populations.

Methods

A number of scientific studies have been conducted to evaluate the effectiveness of different survey methods for estimating the magnitude of fish kills caused by severe environmental impacts—such as red tides and cold kills. Results from these studies clearly show that on-going fisheries monitoring programs provide a much more accurate picture of the population-level impacts of fish kills than the use of "dead fish counts." Surveys for dead fish—either washed on beaches and other shoreline or floating—may severely underestimate actual mortality, in part, because only a fraction of the dead fish are ever observed or counted (many decompose on the bottom or are eaten by scavengers). Therefore, this report was based mainly on data collected by three long-term monitoring programs: (1) the FWC-FWRI Fisheries Independent Monitoring program (FIM) in four Florida estuaries where common snook are typically abundant: Tampa Bay, Charlotte Harbor, and the southern and northern portions of the Indian River Lagoon, (2) the Marine Recreational Fisheries Statistics Survey (MRFSS), and (3) the Everglades National Park's (ENP) recreational creel survey. Additional information on the impact of the cold kill event on adult snook was also obtained by examining the relocation rates of snook tagged with ultrasonic tags through FWC's Snook Acoustic Tagging Program. This program monitors the movements, habitat utilization, and survival of adult snook in southeast Florida (Sebastian Inlet to Palm Beach Inlet) and supplements information on adult snook obtained by recreational fisheries monitoring programs.

The FWC-FWRI Fisheries Independent Monitoring program has collected monthly information on common snook abundance, distribution and size frequency using 183-m haul seines in Tampa Bay and Charlotte Harbor since April 1996 and in the Northern and Southern Indian River Lagoon since January 1997. This seine typically targets finfish (including snook) which are of juvenile to adult sizes (typically sizes ≥200 mm standard length). Trends in common snook monthly abundance, annual abundance, and length-frequency were compared between 2010 and the historic period of record (1997 – 2009). Annual abundance was calculated for the period January-June using Analysis of Covariance (ANCOVA) which reduces the noise caused by spatial and temporal variability in the data. Sampling location, time, and environmental variables were treated as classification variables (zone, year, month, sediment type, SAV presence/absence) or covariates (water temperature, salinity, depth) in the ANCOVA analysis which was run using the General Linear Model procedure in SAS. All covariates and the abundance of common snook were natural log-transformed (ln(x+1)) prior to analysis. With the exception of year, all variables that were not significant (P>0.05) were removed from the analysis and the analysis re-run. When only significant variables remained, least-square adjusted means and standard errors were calculated for each year. The results from the ANCOVA are presented as box and whisker plots developed by adding the least squares mean to the standard error multiplied by a random normal deviate (μ=0, σ=1) and then back-transforming the value (e^x-1). Annual length-frequency distributions were compared using the Kruskal-Wallis test and are presented as box and whisker plots.

Recreational fisheries data collected by the MRFSS were used to develop snook annual catch rates (i.e., the total number of snook caught per angler hour per fishing trip) for the Atlantic and Gulf coasts of Florida during the period 2002-2010 (data from January to June only). The trips from the southern half of Florida (Pinellas to Volusia counties) used for analysis were selected using the Stephens and MacCall logistical regression method (Stephens and MacCall 2004). Catch rates were standardized by generalized linear models using a binomial distribution for the proportion of positive trips (at least one snook was caught on the trip) and a gamma distribution for the number of snook caught on positive trips.

For Everglades National Park, recreational fisheries interview data from Flamingo and Everglades City were used to develop annual catch rates for the period 2002-2010 (data from January to June only). As with the MRFSS data, the trips used for analysis were selected using the Stephens and MacCall method (Stephens and MacCall 2004). Catch rates were standardized by generalized linear models using a delta-log-normal distribution.

Results and Discussion

<u>FWC-FWRI Fisheries Independent Monitoring Program</u>

Average water temperature was much lower than normal during January to April 2010 in each of the estuaries sampled by the FIM program but was higher in May and June 2010 than the historic average water temperatures for these months. The numbers of common snook collected each month during 2010 (Tables 1-4) and the average number of common snook collected per haul (Figures 1-4) were lower than historic values in each of the estuaries with the exception of April and May in the Southern Indian River Lagoon.

The ANCOVA results for each of the estuaries were significant (P<0.001) with 16% to 25% of the variability in the data being accounted for by the model. Temperature was a significant covariate in the final ANCOVA model for each of the four estuaries. The annual indices of abundance (January to June) for each of the estuaries were lower in 2010 than during any time in the previous thirteen years of sampling by the FIM program (Figure 5). Tukey post-hoc tests indicated that the 2010 abundance was significantly lower than several of the higher abundance years in each of the estuaries; for example, in the Tampa Bay model, abundance of common snook in 2010 was significantly (P<0.05) lower than abundance in 1997, 1999, 2000, 2001, 2002, 2003, 2005, 2006, and 2008.

Length frequency distributions showed a trend of larger common snook being collected by the FIM program in 2010 than in the historic data (Figures 6, 7, 8 and 9). In each of the four estuaries the median, and the 25^{th} and 75^{th} percentiles are significantly higher in 2010 than in any of the previous years of sampling (Kruskal-Wallis test, P<0.001). This can be attributed to the low numbers of smaller fish (<400 mm SL) observed in January-June 2010 samples (i.e., post January 2010 cold kill) and suggests a greater vulnerability of smaller-sized common snook to low water temperatures.

Recreational Fisheries Surveys

Recreational fisheries data suggest adult snook (i.e., fish large enough to be available to the fisheries) in different parts of Florida were impacted differently by the cold kill. On the Atlantic coast, 2010 MRFSS catch rates were level with catch rates for the same time period over the past few years (Figure 10) suggesting a smaller impact from the cold kill on adult, exploitable-sized snook there. MRFSS catch rates from the Gulf coast were more variable but in general showed a proportionally larger drop in snook abundance during the first half of 2010 (Figure 10) suggesting snook on the Gulf coast were more severely impacted by the cold kill than Atlantic coast snook.

Recreational fisheries data from Everglades National Park indicate the 2010 cold kill also impacted adult snook there (Figure 11). Annual catch rates in ENP showed an increasing trend during the period 2002-2009 followed by a sharp decline in 2010.

FWC-FWRI Snook Acoustic Tagging Program

The potential impact of the 2010 winter cold kill event on adult snook was also evaluated by examining the relocation rates of snook tagged with ultrasonic tags through FWC's Snook Acoustic Tagging Program. This program monitors the movements, habitat utilization, and survival of adult snook in southeast Florida (Sebastian Inlet to Palm Beach Inlet) and supplements information on adult snook obtained through recreational fisheries monitoring programs. Results show that the relocation rates of adult snook at east coast inlet spawning sites in the spring of 2010 (i.e., post-winter cold kill event) were comparable to relocation rates observed in previous years. This indicates that although Atlantic coast snook suffered some level of mortality from the cold kill a significant proportion of reproductive-sized fish survived to spawn

References

Stephens, A. and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fish. Res. 70:299-310.

Table 1. Number of common snook collected in Tampa Bay with 183-m haul seines by year and month.

Year	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Totals***
1997	2	25	118	84	104	226	***559***
1998	54	30	27	50	215	67	***443***
1999	13	51	62	142	128	159	***555***
2000	53	113	68	133	69	340	***776***
2001	31	101	176	141	165	179	***793***
2002	1	47	64	97	155	425	***789***
2003	61	6	46	171	538	149	***971***
2004	12	44	58	151	145	96	***506***
2005	12	54	78	126	47	277	***594***
2006	7	27	147	98	49	82	***410***
2007	95	54	36	27	27	93	***332***
2008	76	81	186	178	43	75	***639***
2009	77	58	92	73	25	22	***347***
2010	7	0	0	46	25	12	***90***
Totals	***501***	***691***	***1,158***	***1,517***	***1,735***	***2,202***	***7,804***

Table 2. Number of common snook collected in Charlotte Harbor with 183-m haul seines by year and month.

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Totals*
1997	31	12	34	82	36	53	***248***
1998	18	33	17	33	21	11	***133***
1999	55	35	68	20	8	141	***327***
2000	35	154	21	41	43	39	***333***
2001	41	32	121	86	92	95	***467***
2002	41	24	99	75	72	70	***381***
2003	4	1	55	119	27	29	***235***
2004	11	52	21	69	61	59	***273***
2005	24	17	10	55	86	58	***250***
2006	29	40	15	24	26	44	***178***
2007	39	13	35	15	76	33	***211***
2008	6	67	53	62	27	8	***223***
2009	13	15	16	27	35	17	***123***
2010	1	6	1	10	3	7	***28***
Totals	***348***	***501***	***566***	***718***	***613***	***664***	***3,410***

Table 3. Number of common snook collected in the Northern Indian River Lagoon with 183-m haul seines by year and month.

Year	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Totals***
1997	9	4	41	36	41	45	***176***
1998	13	5	11	6	24	79	***138***
1999	4	17	2	8	3	87	***121***
2000	102	0	18	45	22	50	***237***
2001	0	1	5	15	50	38	***109***
2002	0	3	1	21	25	38	***88***
2003	0	0	17	18	44	15	***94***
2004	1	7	8	25	20	141	***202***
2005	9	1	2	25	21	57	***115***
2006	2	2	8	25	30	24	***91***
2007	6	20	25	23	34	18	***126***
2008	10	16	38	27	18	81	***190***
2009	1	0	11	47	39	46	***144***
2010	0	0	0	8	6	16	***30***
Totals	***157***	***76***	***187***	***329***	***377***	***735***	***1,861***

Table 4. Number of common snook collected in the Southern Indian River Lagoon with 183-m haul seines by year and month.

Year	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Totals***
1997	115	239	184	193	136	66	***933***
1998	26	44	91	377	194	447	***1,179***
1999	65	70	133	116	91	79	***554***
2000	58	57	170	54	105	47	***491***
2001	22	85	45	69	60	25	***306***
2002	64	38	82	34	53	31	***302***
2003	30	74	90	37	103	94	***428***
2004	102	76	96	85	70	79	***508***
2005	31	28	66	56	64	52	***297***
2006	93	11	46	29	56	108	***343***
2007	97	37	33	76	59	39	***341***
2008	32	68	57	44	58	82	***341***
2009	83	80	88	38	102	58	***449***
2010	4	11	18	31	72	18	***154***
Totals	***822***	***918***	***1,199***	***1,239***	***1,223***	***1,225***	**6,626**

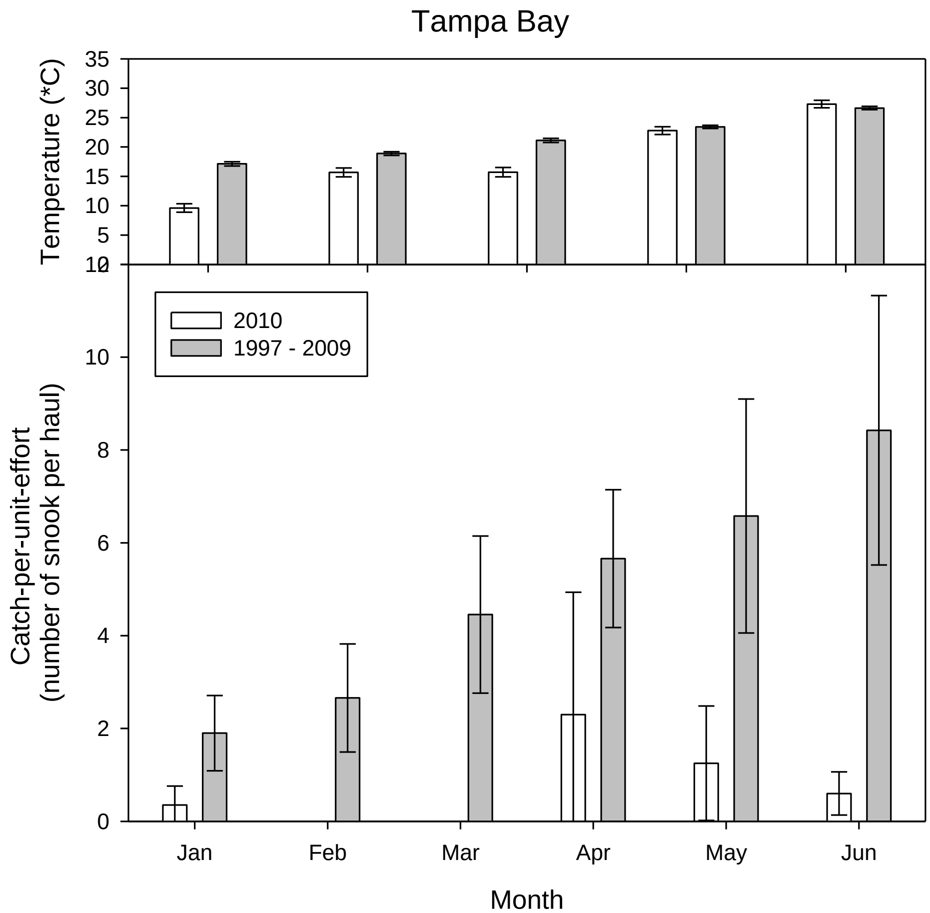

Figure 1. Average monthly temperature and abundance of common snook from the 183-m haul seine surveys conducted by the Fisheries-Independent Monitoring program in Tampa Bay. Gray and white fills represent the historical period (1996 – 2009) and current year (2010), respectively. Error bars represent the 95% confidence interval.

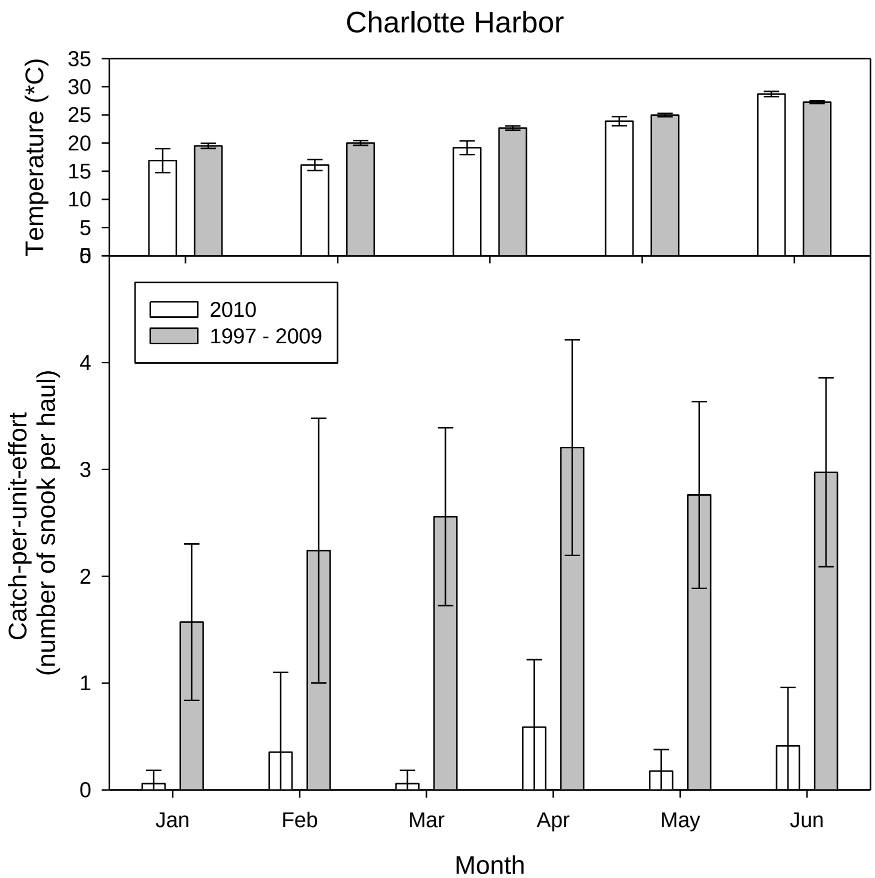

Figure 2. Average monthly temperature and abundance of common snook from the 183-m haul seine surveys conducted by the Fisheries-Independent Monitoring program in Charlotte Harbor. Gray and white fills represent the historical period (1996 – 2009) and current year (2010), respectively. Error bars represent the 95% confidence interval.

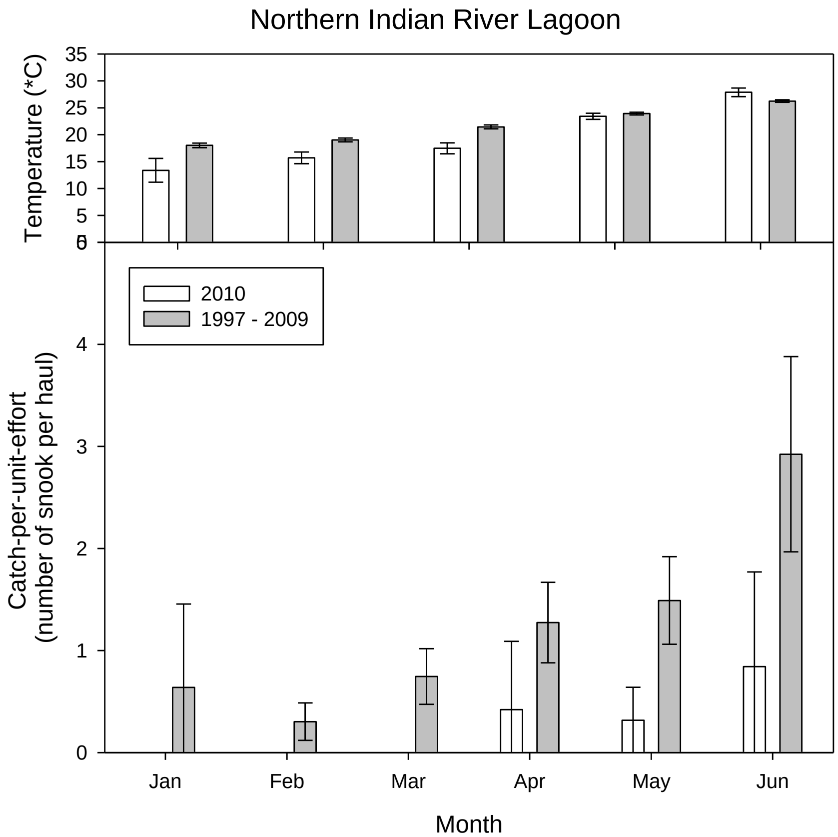

Figure 3. Average monthly temperature and abundance of common snook from the 183-m haul seine surveys conducted by the Fisheries-Independent Monitoring program in Northern Indian River Lagoon. Gray and white fills represent the historical period (1997 – 2009) and current year (2010), respectively. Error bars represent the 95% confidence interval.

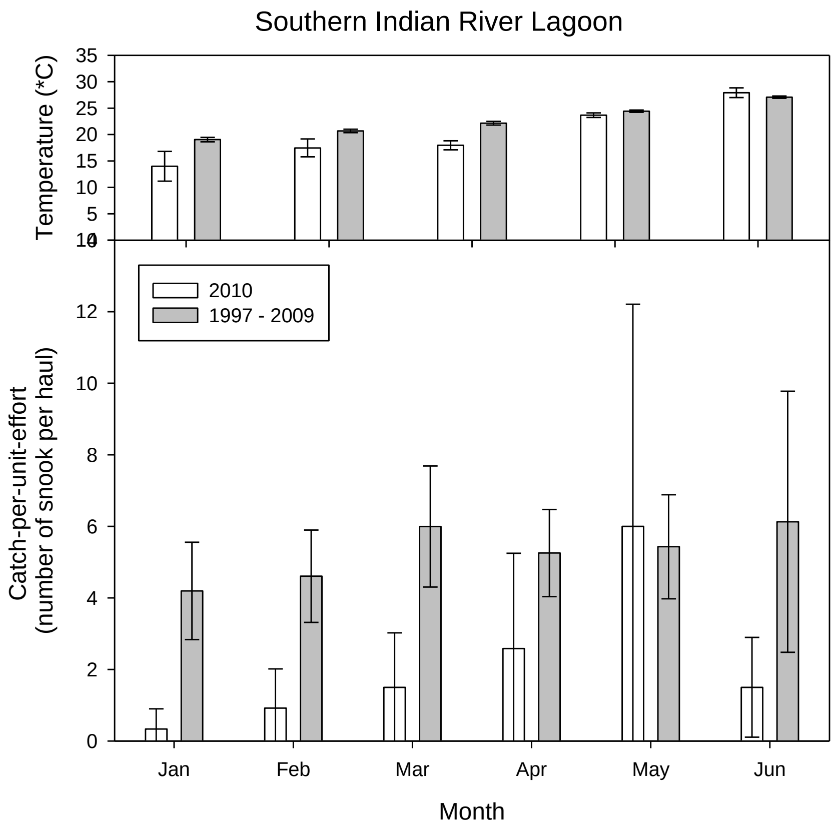

Figure 4. Average monthly temperature and abundance of common snook from the 183-m haul seine surveys conducted by the Fisheries-Independent Monitoring program in Southern Indian River Lagoon. Gray and white fills represent the historical period (1996 – 2009) and current year (2010), respectively. Error bars represent the 95% confidence interval.

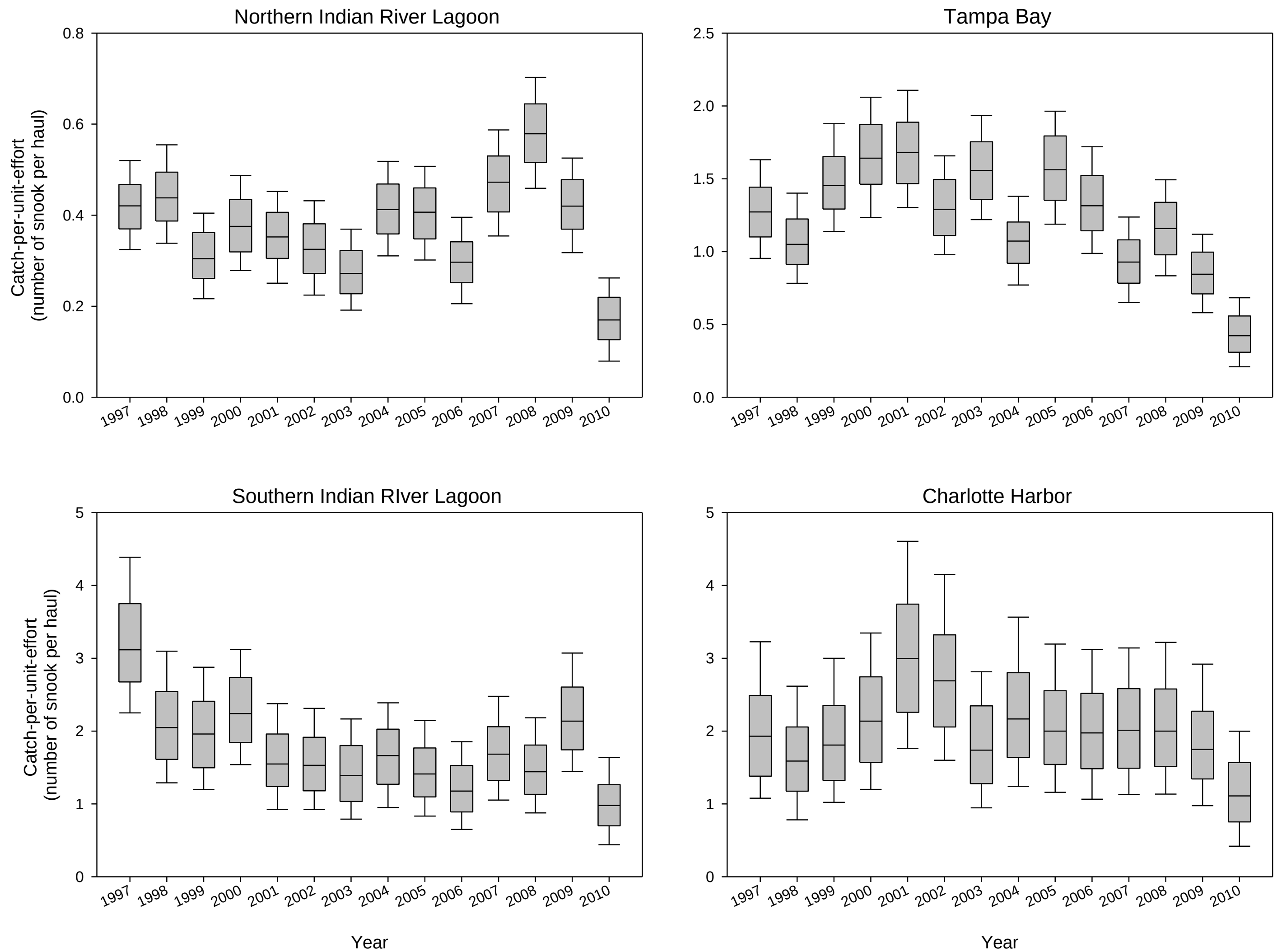

Figure 5. Annual indices of relative abundance for common snook collected with 183-m haul seines (January to June data only) in the Northern and Southern Indian River Lagoon, Tampa Bay, and Charlotte Harbor. The box represents the 25th to 75th percentile, the vertical line extends from the 10th to 90th percentiles, and the horizontal line indicates the median.

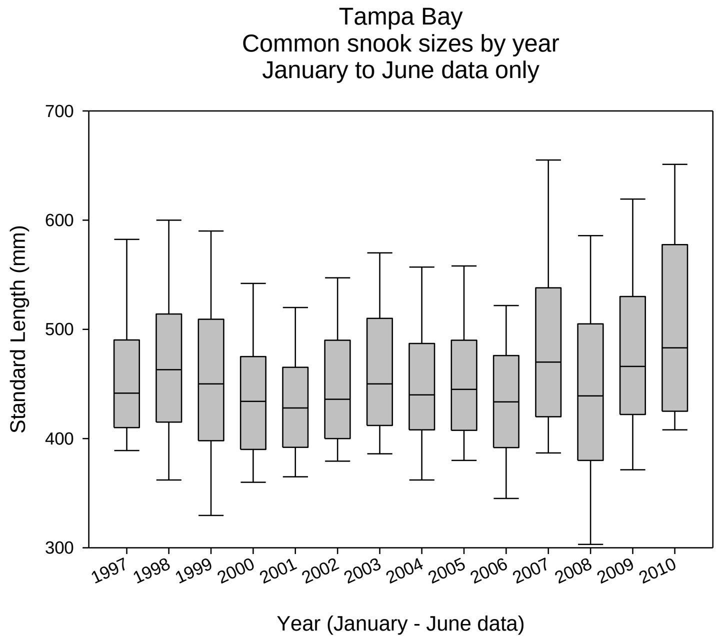

Figure 6. Comparison of annual (January to June) length-frequency distributions for common snook collected with 183-m haul seines by the Fisheries-Independent Monitoring program in Tampa Bay. The box represents the 25th to 75th percentile, the vertical line extends from the 10th to 90th percentiles, and the horizontal line indicates the median.

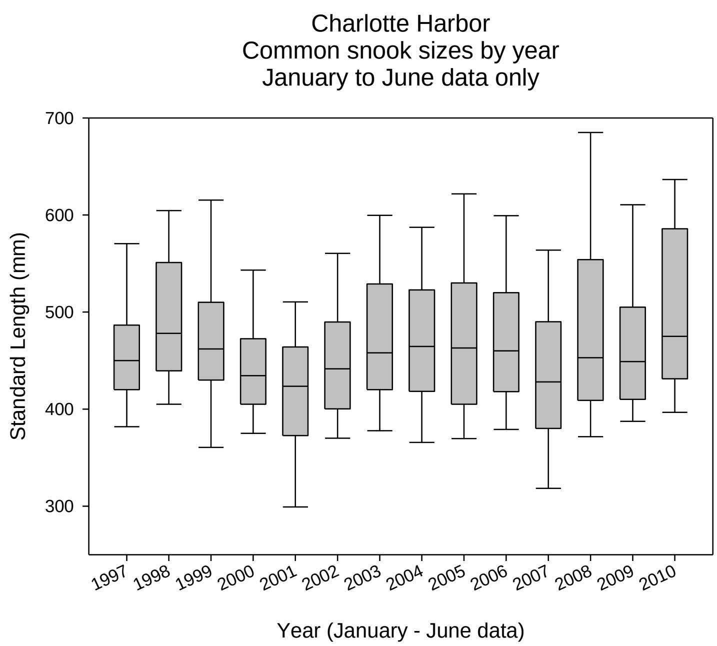

Figure 7. Comparison of annual (January to June) length-frequency distributions for common snook collected with 183-m haul seines by the Fisheries-Independent Monitoring program in Charlotte Harbor. The box represents the 25th to 75th percentile, the vertical line extends from the 10th to 90th percentiles, and the horizontal line indicates the median.

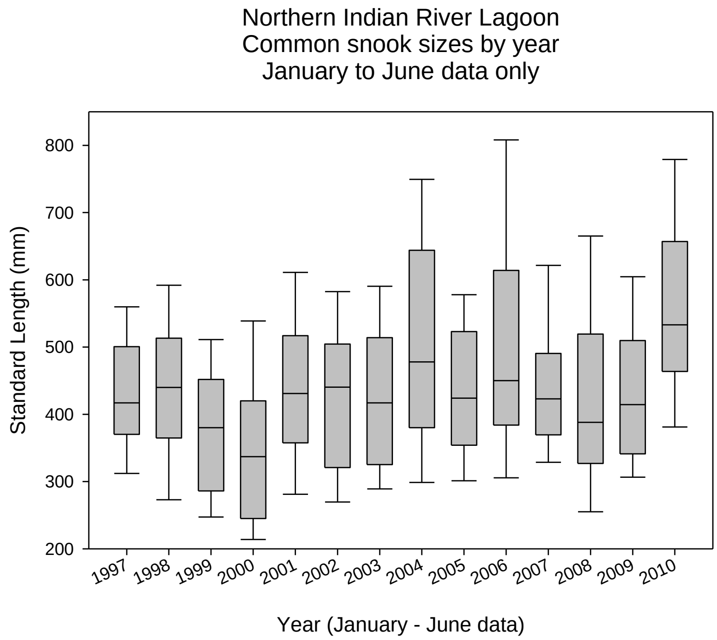

Figure 8. Comparison of annual (January to June) length-frequency distributions for common snook collected with 183-m haul seines by the Fisheries-Independent Monitoring program in the Northern Indian River Lagoon. The box represents the 25th to 75th percentile, the vertical line extends from the 10th to 90th percentiles, and the horizontal line indicates the median.

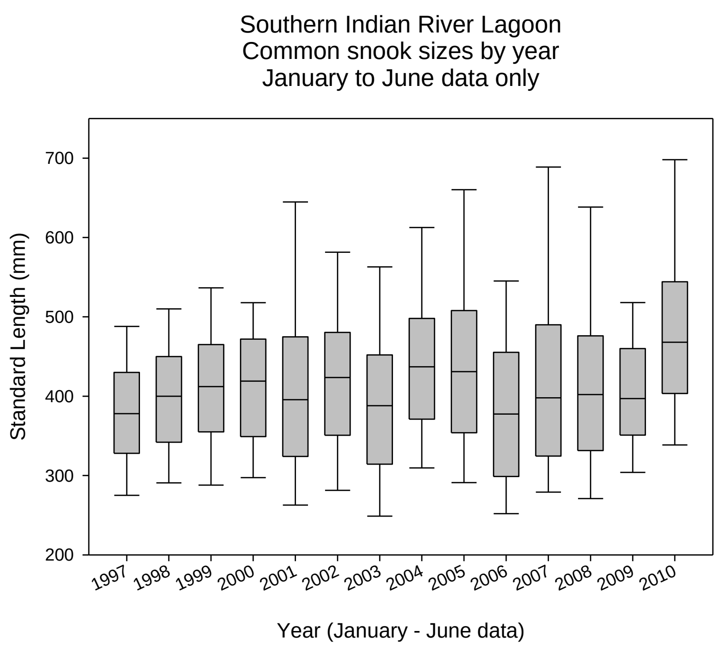

Figure 9. Comparison of annual (January to June) length-frequency distributions for common snook collected with 183-m haul seines by the Fisheries-Independent Monitoring program in Southern Indian River Lagoon. The box represents the 25th to 75th percentile, the vertical line extends from the 10th to 90th percentiles, and the horizontal line indicates the median.

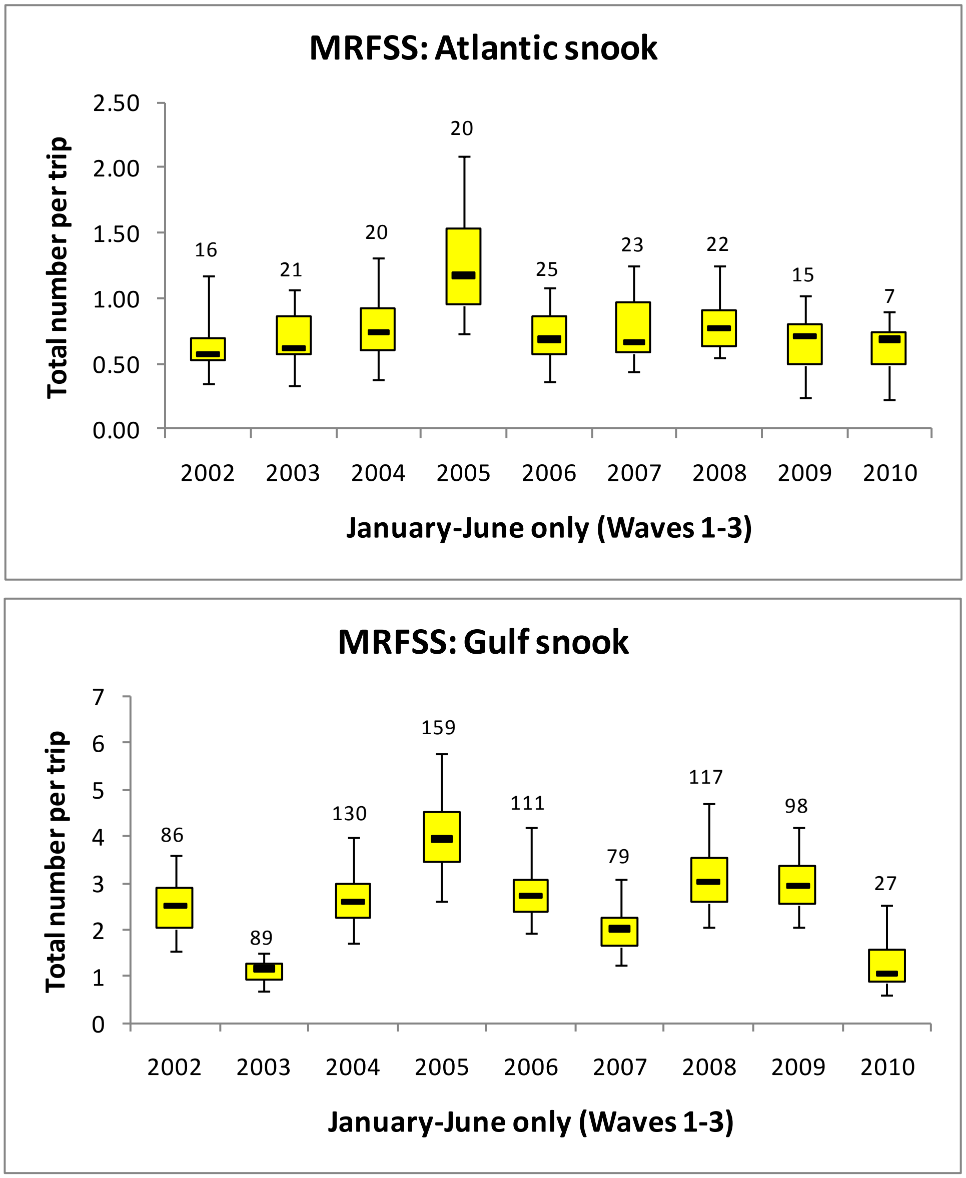

Figure 10. Annual recreational catch rates (i.e., the total number of snook caught per angler hour per fishing trip) for common snook collected by the Marine Recreational Fisheries Statistic Survey (MRFSS) in the Atlantic and Gulf coasts of Florida during the period 2002-2010 (data from January to June only). The number above each data symbol is the number of fishing trips identified as targeting snook; the box represents the 25th to 75th percentile, and the vertical line is the 95% confidence interval.

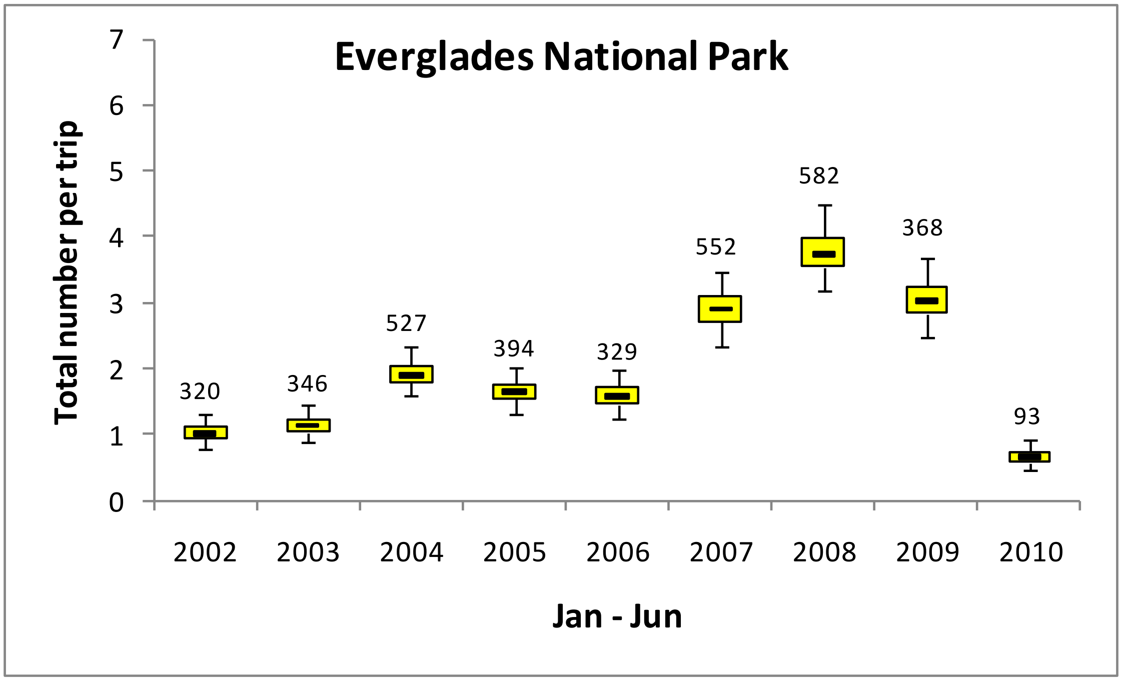

Figure 11. Annual catch rates (i.e., the total number of snook caught per angler hour per fishing trip) for common snook in Everglades National Park during the period 2002-2010 (data from January to June only). The number above each data symbol is the number of fishing trips identified as targeting snook; the box represents the 25th to 75th percentile, and the vertical line is the 95% confidence interval.