UPDATE TO 2012 ON SPAWNER ABUNDANCE AND BIOLOGICAL CHARACTERISTICS FOR STRIPED BASS (*MORONE SAXATILIS*) IN THE SOUTHERN GULF OF ST. LAWRENCE

Context

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) first assessed the Striped Bass population of the southern Gulf of St. Lawrence (southern Gulf) in 2004. The COSEWIC concluded that southern Gulf Striped Bass comprised a single Designatable Unit (DU) and assessed it as 'Threatened' mostly because of a single spawning location and small area of occupancy (COSEWIC 2004). In 2006, a Recovery Potential Assessment proposed recovery objectives for the population, and in 2011, an Allowable Harm Assessment reviewed threats to the population (DFO 2006, 2011). In 2012, the recommendation to not list this population under the Species at Risk Act was published in Part 1 of the Canada Gazette (Canada Gazette 2012). The status of Striped Bass was reviewed in 2011 to support the COSEWIC's re-assessment of the species (Douglas and Chaput 2011a, 2011b). The COSEWIC affirmed that the population in the southern Gulf was a single DU and assessed it as 'Special concern', a lower risk category than previously and largely a consequence of the increased spawner abundance in recent years (COSEWIC 2012).

The increased abundance of Striped Bass in the southern Gulf has resulted in requests by aboriginal groups and the recreational angling community to re-open fisheries. In consideration of potentially new management options for the future, DFO Ecosystems and Fisheries Management has requested an update on the abundance of the southern Gulf Striped Bass spawning stock and biological characteristics to 2012.

This science response report is the result of the Science Special Response Process of February 14, 2013 and provides an update of the Striped Bass spawner abundance in the Northwest Miramichi estuary for the 2011 and 2012 spawning seasons. The estimated spawner abundance in the Northwest Miramichi in 2011 was 203,100 fish (median value, 2.5 to 97.5 percentile range of 90,080 to 438,400) and enough to meet the population's recovery objective for the first time since 1993. While no spawner abundance estimate could be derived for 2012 due to an early spawning period that preceded the assessment activity, the recovery objective was considered to have been met for the second time. As the abundance of Striped Bass has increased, those with fork lengths greater than 60 cm and older than five years of age have also increased but remain a small proportion of the spawning population. Relative to the length metric in the Maritimes Fisheries General Regulations, a total length of 68 cm is equivalent to a fork length of 62 cm.

Background

Striped Bass (*Morone saxatilis*) in the southern Gulf of St. Lawrence (sGSL) are considered to belong to a single population (Bradford and Chaput 1996) and designatable unit (DU) (COSEWIC 2004). The population is genetically distinct and geographically isolated from other extant Striped Bass populations in the Bay of Fundy and the USA, and geographically isolated from the extirpated St. Lawrence River estuary population (Wirgin et al. 1993, 1995; Diaz et al. 1997; Robinson 2004; COSEWIC 2004). Striped Bass are widespread throughout southern Gulf estuaries year round but fish aggregate to spawn in the Miramichi estuary during May and June annually. Despite numerous attempts to collect Striped Bass eggs or larvae in other estuaries, the Northwest Miramichi estuary remains the only confirmed location in the southern Gulf of St. Lawrence where Striped Bass spawn successfully (Robichaud-LeBlanc et al. 1996; Douglas et al. 2011b).

As a result of the low abundance of Striped Bass during the early 1990s, restrictive fisheries management measures were introduced including the closure of the commercial fishery in 1996, the closure of the recreational fishery in 2000, and the suspension of fisheries for food, social and ceremonial purposes to First Nations in 2000. Access to Striped Bass incidentally captured in food, social, and ceremonial fisheries was reinstituted for some First Nations in 2012.

The commercial gaspereau fishery of the Miramichi River has provided the platform from which the Striped Bass population of the southern Gulf has been assessed since 1993. The spawner abundance has generally been estimated from a mark and recapture experiment where adult Striped Bass were tagged early in May and followed throughout June as they were captured and released as bycatch in the gaspereau fishery of the Northwest Miramichi estuary (Bradford and Chaput 1996; Douglas and Chaput 2011a). An analysis of catch per unit of effort from this fishery has also been used as an index of abundance for Striped Bass since 1993 (Douglas and Chaput 2011a)

Analysis and Response

The four-week gaspereau season in the Northwest Miramichi estuary occurred between May 30 and June 27 in 2011 and between May 31 and June 28 in 2012. In 2011, 67 trapnet fishing events of a possible 168 (40%) were sampled, while in 2012, 58 trapnet catches of a possible 119 (49%) were sampled.

Similar to previous years, catches of Striped Bass in 2011 were highest early in the season and had diminished significantly by mid-June (Appendix Figure 1; Douglas and Chaput 2011a). The peak catches occurred on June 1 when standardized catches of Striped Bass (bass per net per day) exceeded 2,600 fish in two individual trapnets. These Striped Bass catches were the highest on record since the bycatch monitoring of this fishery began in 1993.

No assessment of spawner abundance is available for 2012. The monitoring activity in 2012 began after the majority of Striped Bass had spawned and left the sampling area. The gaspereau season which is negotiated annually between commercial fishermen and DFO Fisheries Management began on May 31 with first potential catches to sample occurring on June 1. Numerous observations of Striped Bass spawning along the NW Miramichi estuary between Whitneyville and Red Bank during the May 16 to May 23 period were reported to DFO Science and Conservation and Protection (C&P) staff. The spawning activity during this time

coincided with an increasing trend in water temperature (from 12ºC to 19ºC) which has been previously shown to initiate spawning for this population (Appendix Figure 1, Douglas et al. 2009). It has also been demonstrated with the use of acoustic telemetry that Striped Bass, particularly females, remain in the spawning area for a 7 to 14 day period then leave the estuary immediately (Douglas et al. 2009). Striped Bass catches in the gaspereau fishery were low (most < 50 per net per day) throughout the 2012 sampling season and decreased to negligible levels after June 16 (Appendix Figure 1).

The Bayesian hierarchical mark and recapture model used in the most recent peer reviewed assessment was applied to the 2011 data (Chaput and Douglas 2011). The median estimate of Striped Bass spawner abundance in 2011 was 203,100 (5th to 95th percentile range of 90,080 and 438,400) (Figure 1; Appendix Table 1). This estimate represents the highest of the time series and is at least 100,000 more fish than the previous highest estimate in 2008.

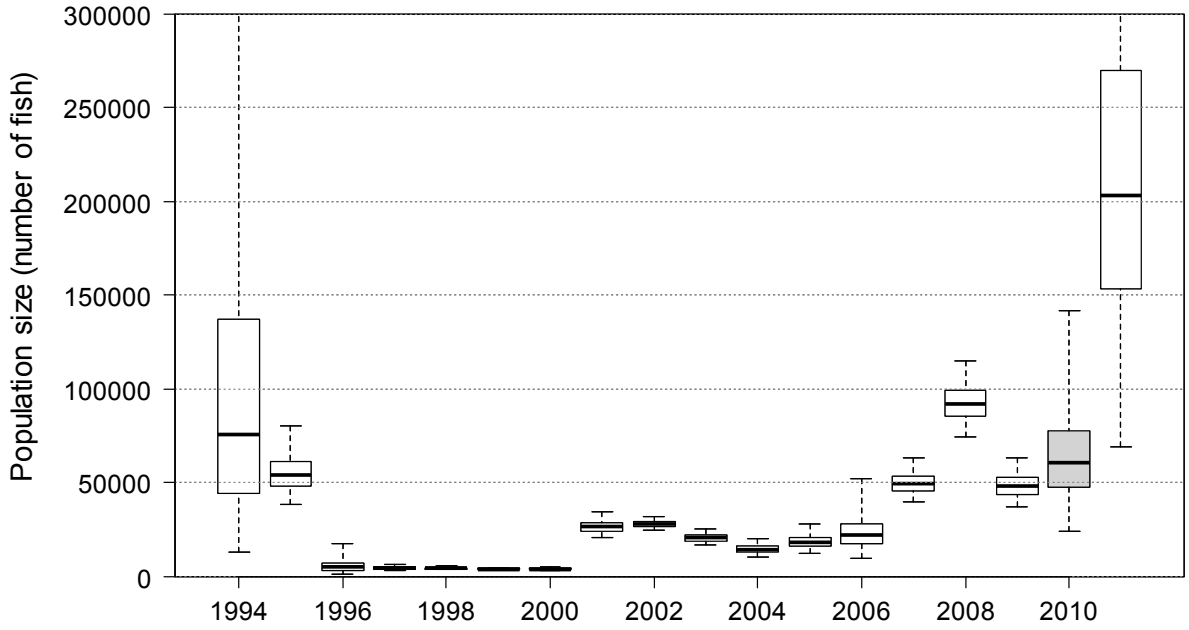

Figure 1. Estimated abundance of Striped Bass spawners in the Northwest Miramichi estuary between 1994 and 2011. The estimate for 2010 is considered to be an underestimate due to the earlier timing of the spawning events (Douglas and Chaput 2011a). Box plots are interpreted as: dash is the median, boxes are the interquartile range, and the vertical dashes are the 2.5 to 97.5 percentile ranges.

Spawner abundance relative to recovery objectives

The Recovery Potential Assessment proposed a recovery limit and target for the southern Gulf Striped Bass population based on the abundance of spawners returning to the NW Miramichi estuary (DFO 2006). The proposed recovery limit was an abundance of at least 21,600 spawners in five of six consecutive years. Once that was achieved, then the proposed recovery target for considering fisheries access was when total spawners were ≥ 31,200 in three of six consecutive years. It was also suggested that the lower confidence interval of the spawner abundance estimate be used to assess status relative to the recovery objectives (DFO 2006; Douglas et al. 2006).

In 2011, both the recovery limit and target were met for the first time (5 of 6 years). Although no estimate is available for 2012, the indications were that the abundance was high and that the recovery objective was likely met for the second time (6 of 6 years) (Figure 2). Although the population estimate was considered to be incomplete in 2010 due to an early spawning period that preceded the assessment activity, the conclusion was that the spawning stock abundance exceeded the recovery objectives for that year (Douglas and Chaput 2011a).

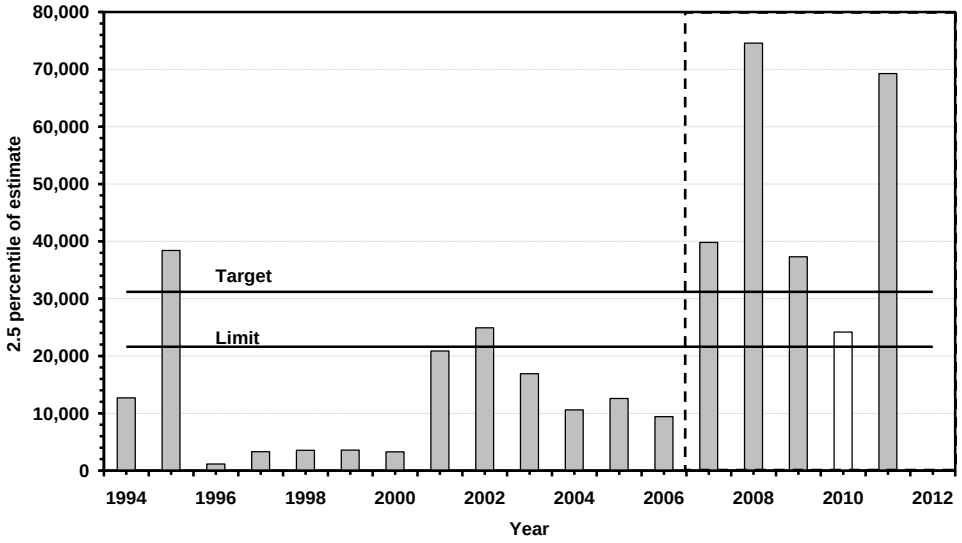

Figure 2. The lower confidence limit of spawner abundance estimates for 1994 to 2011 relative to the recovery limit of 21,600 spawners (bottom horizontal line) and recovery target of 31,200 spawners (top horizontal line). The hatched box represents the six year sliding compliance window for the recovery objectives (DFO 2006). The estimate for 2010 was inconclusive but considered to be above the recovery target.

Biological characteristics

Striped Bass were sampled from the DFO index trapnets operated in the Northwest Miramichi estuary at Cassilis and the Southwest Miramichi estuary at Millerton. Complete catches of Striped Bass were counted, and on average, 90% of the daily catch at both trapnets was measured for fork length, checked for sex, and had scales removed to determine age.

Similar to previous years, Striped Bass sampled in 2011 ranged in age between 1 and 11 years and in 2012 between 0 and 12 years. Since 1994, 90% of adult Striped Bass sampled during their spawning migration have been age 3 to 5 years with fish aged 6 to 15 years making up the remainder (10%) of samples (Table 1, Douglas and Chaput 2011a).

Striped Bass sampled in 2011 ranged in fork length between 16 cm and 83 cm and between 15 cm and 85 cm in 2012 (Appendix Figure 2a and 2b). Fork length distributions of adult Striped Bass during spawning time were similar to previous years where the majority (> 90%) have been less than 60 cm fork length (Table 1, Douglas and Chaput 2011a).

Table 1. Summary statistics of fork length (cm) at age for Striped Bass sampled during May and June from the gaspereau fishery of the Northwest Miramichi estuary (1994-2009) and at DFO index trapnets at Cassilis and Millerton (2010-2012).

	Fork length (cm)									
Age (years)	Mean	Std. dev.	N	Median	Mode	5th perc.	95th perc.	Min.	Max.	Range
1	17.6	2.0	77	17.8	17.8	14.6	19.9	11.5	24.3	12.8
2	27.7	3.2	591	27.1	26.3	23.6	33.3	20.0	41.4	21.4
3	40.1	3.5	3,614	40.5	41.5	34.3	45.3	25.7	55.0	29.3
4	46.8	3.9	3,140	47.0	48.5	40.3	52.9	29.0	59.2	30.2
5	53.0	4.2	1,371	53.1	55.5	46.0	59.8	35.7	66.0	30.3
6	59.0	4.1	468	59.0	61.5	52.8	65.7	44.5	72.6	28.1
7	62.7	5.0	177	62.4	59.7	54.8	71.2	48.0	72.4	24.4
8	66.5	5.6	123	66.2	68.0	58.0	75.7	51.5	82.0	30.5
9	71.2	5.3	80	71.1	63.2	63.2	79.7	61.4	82.8	21.4
10	75.3	7.3	25	74.0	83.3	64.5	84.6	60.3	85.8	25.5
11	77.4	6.4	11	77.1	86.1	69.1	86.1	68.0	86.1	18.1
12	83.2	5.3	9	84.6		74.8	88.1	71.2	88.5	17.3
13	80.9		1							
14										
15	96.4		2	96.4				95.8	97.0	1.2

The fork length distributions of Striped Bass sampled at DFO index trapnets throughout the ice-free season demonstrates the use of the estuary by different life stages at different times of the year. Striped Bass captured during May, June, and October are almost exclusively adult sized fish (> 30 cm) (Appendix Figure 2a and 2b). This is consistent with their estuarine spawning behaviour in the spring, their coastal migrations in the summer, and their return to estuaries in the fall to overwinter. Juvenile Striped Bass (fork lengths < 30 cm) are captured in the spring, mostly in the summer but not in the fall (Appendix Figure 2a and 2b). The complete distribution of juvenile bass is unknown but these fish are presumed to be widespread in estuaries of the entire southern Gulf of St. Lawrence year round.

The catch of over 900 Striped Bass during the first 15 days of October in 2012 at the Millerton trapnet in the Southwest Miramichi estuary provided the most current sample of biological characteristics for adult bass. Adult Striped Bass (assumed to be fish with fork lengths greater than 30 cm) sampled in October had a mean fork length of 54.2 cm. Five percent of samples had fork lengths between 31-40 cm, 25% between 41-50 cm, 47% between 51-60 cm, 18% between 61-70 cm, 4% between 71-80 cm, and 0.2% between 81-90 cm (Appendix Figure 2b).

The length and weight data from 179 Striped Bass sampled in October 2012 from the Southwest Miramichi are shown in Appendix Figure 3. A fish measuring 60 cm fork length at the end of the 2012 growing season weighed on average 3.3 kg.

In the Maritimes Fisheries General Regulations, the length regulation for Striped Bass is presented as a total length. The length data collected during the assessment program in the southern Gulf is in fork lengths. Comparable fork length and total length data are not available for the southern Gulf population. The relationship between total length and fork length for Striped Bass sampled in the Shubenacadie River were highly correlated ($r^2 = 0.98$) and the equation (Total length = 1.0381 X Fork length) + 3.8598) would be suitable for use until this information can be collected from Striped Bass in the southern Gulf (R. Bradford, DFO, pers. comm.). A fork length of 62 cm is approximately equivalent to a total length of 68 cm. The proportion of Striped Bass from the October 2012 sample in the Southwest Miramichi River that had a fork length ≥ 62 cm was 16%.

Life history characteristics specific to striped bass in the southern Gulf of St. Lawrence

Biology

The Striped Bass population in the southern Gulf is at the northern limit of the species distribution. Male Striped Bass in the southern Gulf mature first at age 3 and 4 years with corresponding fork lengths ranging between 26 to 59 cm. Females mature first at ages 4 and 5 years with corresponding fork lengths between 37 to 66 cm. Egg production scales allometrically with body size, a female bass of 60 cm fork length produces about 80 thousand eggs while a female bass of 80 cm will produce about 600 thousand eggs (Douglas and Chaput 2011b).

The high fecundity, early age at maturity, repeat spawning, and long life span (> 20 years in some populations) features of Striped Bass are adaptive traits indicative of high early life stage mortality. Year-class variability in Striped Bass has been observed to be high and largely determined during the egg and larval stages and influenced by environmental factors (Richards and Rago 1999). For the southern Gulf population, strong year classes were estimated to have been produced in 1991, 2003, 2004, and 2005. Very weak year classes were estimated for 1993 to 1996 and 2002 (Figure 3).

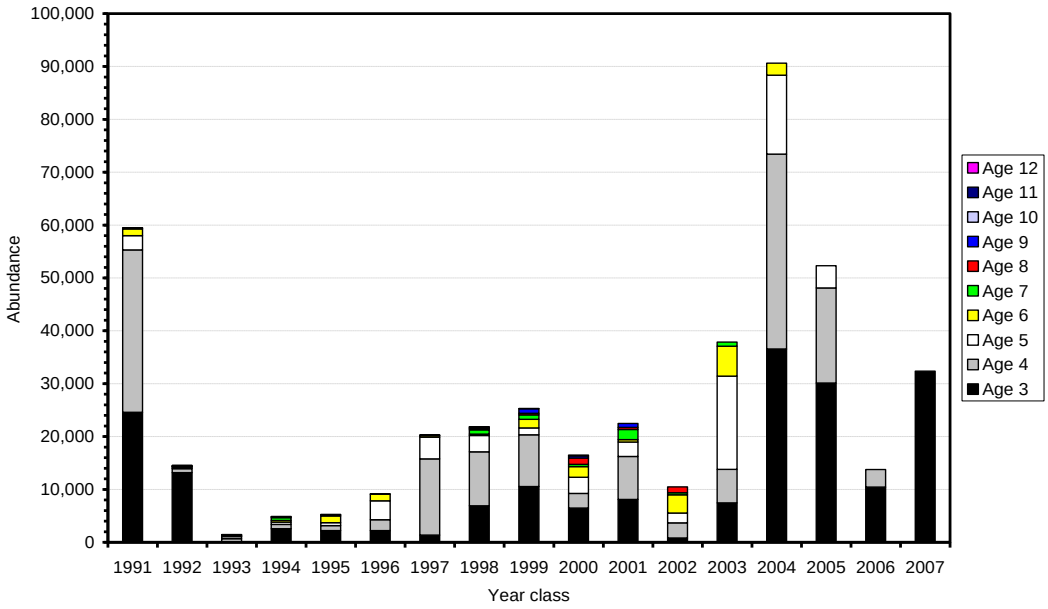

Figure 3. Striped Bass abundance at age and lifetime contributions of year classes (1991-2007) as spawners (Figure 10 from Douglas and Chaput 2011a; DFO 2011).

Spawning and staging areas

The Northwest Miramichi estuary is the only confirmed spawning location for Striped Bass in the southern Gulf of St. Lawrence. There have been numerous but unsuccessful attempts to collect Striped Bass eggs or larvae in a number of other southern Gulf estuaries (the Tabusintac in 2001, unpublished; Cascapedia and Baie de Chaleurs in 2010, (ZIP 2010); Hillsborough in

2003, (AVC Inc. 2003), Kouchibouguac and Richibucto in 1997 and 1998, (Robinson et al. 2004)). Parallel programs to sample young of the year Striped Bass in early summer have consistently confirmed that they are first observed in the Miramichi River followed by neighbouring estuaries further north and east as the summer progresses. This suggests that young fish gradually spread along the coast from the Miramichi and can then be found in a large number of estuaries as far as Nova Scotia by early fall (Robichaud-LeBlanc et al. 1996; Robinson et al. 2004; Douglas et al. 2001; M. Thistle and S. Douglas report in preparation).

The Striped Bass spawning area of the Northwest Miramichi has been delineated based on an egg and larval study (Robichaud-LeBlanc 1996) and an acoustic tracking survey (Douglas et al. 2009) (Figure 4). The spawning area covers the length of the Northwest Miramichi estuary from just above its confluence with the Southwest Miramichi River to Red Bank. These observations were supported with the results of the acoustic tracking study which also demonstrated that bass remained almost exclusively in the spawning area for a period of one to two weeks (depending on the year) and then exited the estuary quickly (particularly females) to begin summer coastal movements (Douglas et al. 2009).

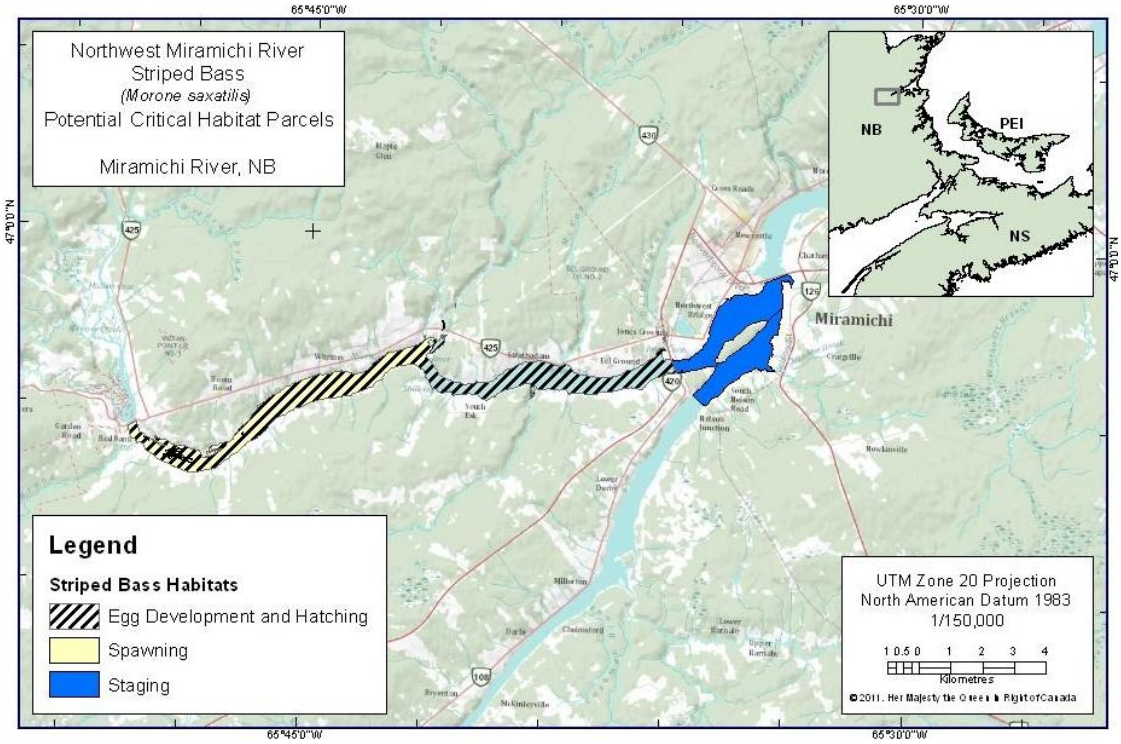

Figure 4. Important Striped Bass habitat for staging, spawning and egg development in the Miramichi River (Figure 4 from McGarrigle and LeBlanc, unpublished manuscript).

The Striped Bass staging area of the Miramichi system has been delineated based on an acoustic tracking study between 2003 and 2005 (Douglas et al. 2009). The staging area is geographically small and encompasses the area around Beaubear's Island at the confluence of the Southwest and Northwest Miramichi rivers (Figure 4). This area is locally known as Strawberry Marsh and is the location of an intense angling fishery during April and May. Striped Bass implanted with transmitters exhibited limited movements in and out of this area during May and not until spawning conditions became suitable did they move upriver for an extended period of time (Douglas et al. 2009).

Migration and distribution

Striped Bass were abundant throughout the southern Gulf in 2012, including in several estuaries and coastal areas of the north shore of Chaleur Bay and in Gaspe. The increased abundance of bass along the north shore of the Chaleur Bay area in late June and July (V. Bujold, MRN, province of Quebec, pers. comm.) corresponds to the increased abundance of the spawning population in the southern Gulf and the known migration and distribution of post-spawned Striped Bass from the Miramichi (S. Douglas, DFO, unpubl. data). However, the detection of adult bass in the lower portion of the St. Lawrence estuary in 2012, north and west of Gaspe, suggests that the mixing of the newly introduced St. Lawrence estuary population with the southern Gulf population in that area cannot be ruled out.

Mortality

Estimated mortality of Striped Bass in the southern Gulf is high and in the order of 40% to 50% annually (DFO 2011; Douglas and Chaput 2011a). Some of the mortality occurs from the incidental capture of Striped Bass in various commercial fisheries (gaspereau, Atlantic Herring, Rainbow Smelt, American Shad, American Eel, and Atlantic Silverside), and food social and ceremonial fisheries (gillnets for salmon). The impact on the population from these fisheries is believed to be considerably less than what occurs from illegal activities and recreational fisheries that target species other than Striped Bass (DFO 2011). Nearly 70% of adult Striped Bass losses have been estimated to occur in illegal (55%) and recreational (14%) fisheries throughout the southern Gulf. DFO C&P personnel estimated that in recent years, over 150,000 Striped Bass were handled annually and that over 60,000 died as a consequence (DFO 2011) (Appendix Table 2).

Mortality from catch and release angling

There are no mortality estimates specific to the catch and release of Striped Bass in the southern Gulf of St. Lawrence by rod and reel (Douglas and Chaput 2011b). Where this has been studied, estimates of hook and release mortality varied widely and were dependent on environmental variables (water temperature, salinity), type of bait, type of hook, hook placement, and angler experience (Diodati and Richards 1996; Wilde et al. 2000; Millard et al. 2005). The Atlantic States Marine Fisheries Commission currently assumes a hooking mortality factor of 9% for Striped Bass caught and released (ASMFC 2011). Until these types of studies can be performed on southern Gulf Striped Bass, a range of catch and release mortality rates between 10% to 40% would be appropriate based on previous literature (Diodati and Richards 1996; Wilde et al. 2000; Millard et al. 2005). Hook and release mortality rates for southern Gulf Striped Bass would be variable and depend on many things including angling methods, season, and location (fresh versus salt water).

The re-opening of any recreational Striped Bass fishery will add to the current anthropogenic mortality on the population because those currently abstaining from the practice will begin to fish (DFO 2011). The net effect on mortality of opening a directed recreational fishery is unknown because of the uncertainty in the total effort from new participants and the change in behaviour of those currently participating in the illegal fishery. Striped Bass are very easy to catch and individual anglers reported catching hundreds to thousands in 2012.

Knowledge gaps and uncertainties

The best estimates of year class abundance for the southern Gulf stock indicate that there have been very few (perhaps five) strong year classes produced since 1991. The current high

abundance of Striped Bass is likely maintained by at least the strong year classes of 2005 and 2007. The indications were that the 2006 year class was only of average strength. If the present high abundance of Striped Bass is being sustained by only a few year classes, the spawning stock abundance may decline again below the reference levels, particularly if annual mortality rates remain as high as estimated in recent years (Douglas and Chaput 2011a).

The Striped Bass monitoring program of the Northwest Miramichi estuary predominantly samples mature fish in the spring that are about to spawn. There is no information on length and age at 50% maturity, or minimum length at which all fish have spawned at least once. There is currently no method to evaluate the total abundance of Striped Bass in the southern Gulf of St. Lawrence. Similarly, DFO index trapnets only sample a portion of the total population as shown by the October 2012 samples of adult bass returning to the estuary to overwinter. Juvenile Striped Bass, less than 30 cm fork length, are most often sampled in the summer months. The overall abundance and distribution of juvenile bass is unknown but they are presumed to be widespread in estuaries of the entire southern Gulf of St. Lawrence.

The assessment platform for the spawning stock of Striped Bass is subject to annual variations in the timing of spawning and the commercial gaspereau fishing seasons. Since 1993, there were only two years, 2010 and 2012, when spawning occurred early and precluded a robust assessment using the commercial gaspereau fishery. The gaspereau fishers have opted for later openings of their seasons in recent years to provide for a better chance of fishing during the most important portion of the gaspereau (alewife and blueback herring) runs. Alternative sampling programs need to be considered to hedge against earlier spawning events as observed in 2010 and 2012.

There is no information with which to assess if there is size-selection for bass in the gaspereau nets. However, large bodied (almost one metre in fork length) and old bass (15 years old) were sampled from these trapnets as recently as 2007 but they are rare despite an intensive sampling effort. Catches at DFO index trapnets (trapnets designed to capture and sample adult Atlantic salmon ranging in size to over one metre in length), sampled a similar size range of Striped Bass in the fall as was observed on the spawning grounds in the spring.

Striped Bass were abundant throughout the southern Gulf in 2012, including in several estuaries and coastal areas of the north shore of Chaleur Bay and in Gaspe. The increased abundance of bass in those areas in late June and July corresponds to the increased abundance of the spawning population and the known migration and distribution of post-spawned individuals from the Miramichi (S. Douglas, DFO, unpubl. data). However, the mixing of the newly introduced St. Lawrence estuary Striped Bass with those of the southern Gulf in the area north of Gaspe cannot be excluded. Further work is required to determine the origin of the bass in this area.

Striped Bass fisheries occur in estuaries, tidal waters and along the coasts of the entire southern Gulf of St. Lawrence. Recreational fisheries for several other marine fish species also occur in these areas. There is presently no program to monitor fishing effort and catches in these fisheries and as a result there is no information with which to assess the impacts of these fisheries on the Striped Bass population.

Hook and release mortality estimates specific to Striped Bass fisheries of the southern Gulf of St. Lawrence are not available.

Conclusions

The spawner abundance of Striped Bass in the Northwest Miramichi in 2011 was at the highest level observed since monitoring began in 1993. The recovery objective for southern Gulf Striped Bass was met for the first time in 2011 and for the second time in 2012.

Male striped bass first mature at age 3 and females at age 4. Striped bass aged 3 to 5 continue to be the most abundant age classes sampled during the spawning migration to the Northwest Miramichi estuary.

Relative to the length metric in the Maritimes Fisheries General Regulations, a total length of 68 cm is equivalent to a fork length of 62 cm.

As the spawner abundance of Striped Bass has increased, the abundance of fish with fork lengths greater than 60 cm and older than five years of age has also increased but these fish are a small proportion of the overall spawning population.

The mortality on the Striped Bass population in the southern Gulf is considered to be at a high level and caused primarily by illegal fisheries that catch and harvest or catch and release Striped Bass. There will be new effort directed on Striped Bass resulting from a legal fishery as individuals currently abstaining from fishing due to the closure would be expected to participate if a legal fishery is re-instated. The net effect on mortality of opening a directed recreational fishery is unknown because of the uncertainty in the total effort of new participants and the change in behaviour of those currently participating in the illegal fishery.

There are presently no requirements for catch and effort reporting from any tidal or coastal angling fisheries. These data are critical for evaluating future management options.

Contributors

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Approved by

Ghislain Chouinard	Date
Regional Director Science Gulf Region	March 26,2013

Sources of information

This Science Response Report results from the Science Special Response Process of February 14, 2013 which provided an update on status of Striped Bass from the Southern Gulf of St. Lawrence to 2012. Additional publications from this process will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

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Appendices

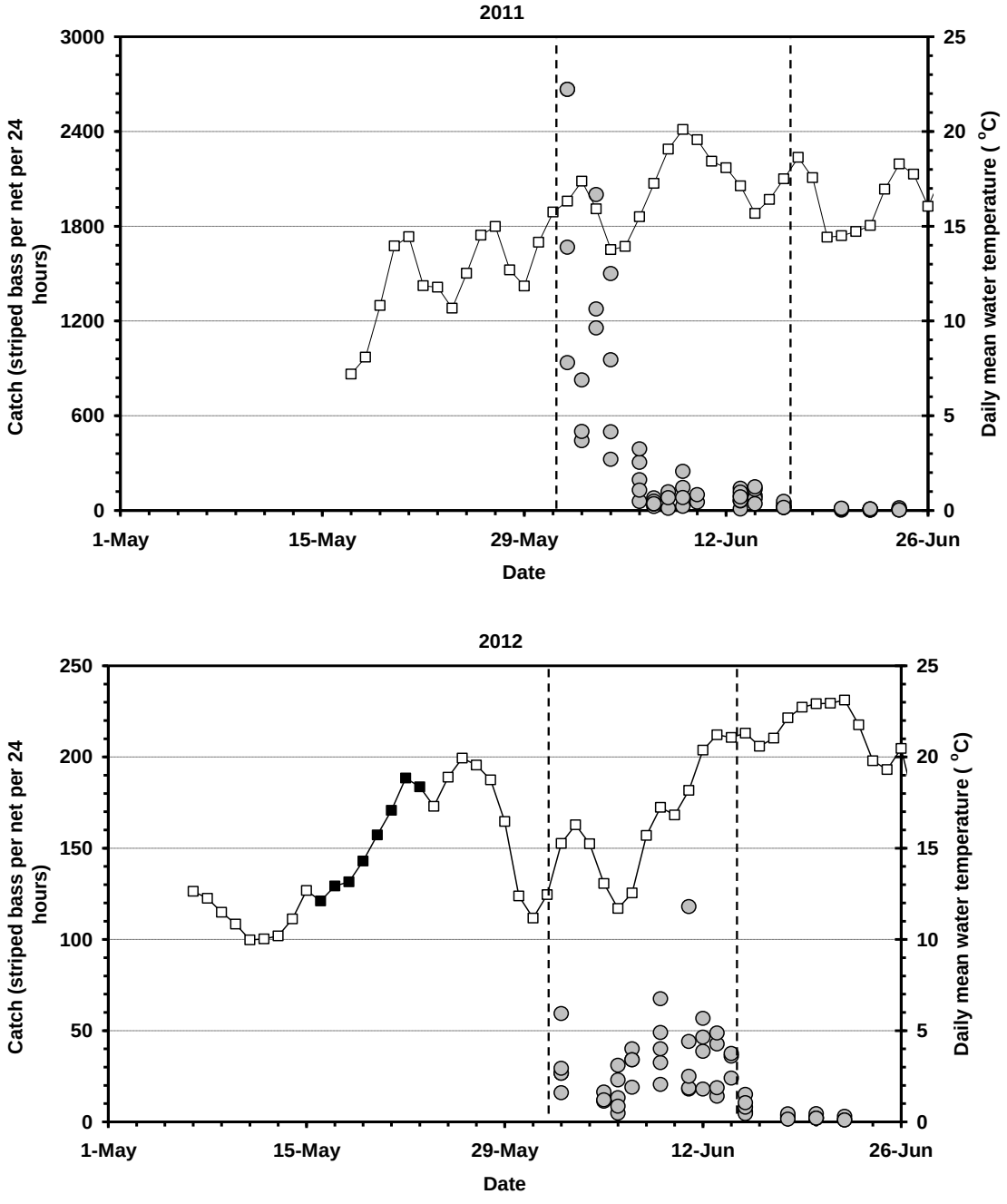
Appendix Table 1. Comparison of previous spawner abundance estimates from Chaput and Douglas (2011) and estimates from the same model with a revised prior structure.

	Previous estimate			New estimate			% change
Year	Median	2.5	97.5	Median	2.5	97.5	in median
1994	55,200	7,392	604,200	75,960	12,690	609,600	38%
1995	52,910	35,730	83,500	54,230	38,400	80,540	2%
1996	3,675	851	15,480	5,042	1,154	17,460	37%
1997	4,588	3,144	7,053	4,537	3,298	6,425	-1%
1998	3,845	3,061	4,924	4,442	3,561	5,638	16%
1999	3,844	3,344	4,434	4,123	3,588	4,781	7%
2000	4,290	3,305	5,671	4,166	3,286	5,389	-3%
2001	26,990	20,960	35,520	26,510	20,880	34,690	-2%
2002	26,600	23,650	29,960	28,120	24,910	31,740	6%
2003	19,890	16,010	25,180	20,610	16,890	25,620	4%
2004	12,550	9,054	17,840	14,510	10,610	20,300	16%
2005	14,400	9,328	24,180	18,370	12,580	27,880	28%
2006	16,200	5,385	49,590	22,330	9,423	52,080	38%
2007	46,110	36,320	59,880	49,520	39,800	63,280	7%
2008	92,160	73,600	117,900	91,900	74,580	115,200	0%
2009	50,230	38,200	67,800	48,040	37,300	63,080	-4%
2010	45,120	14,670	134,300	60,990	24,160	141,900	35%
2011				203,100	69,270	532,100	
2012							

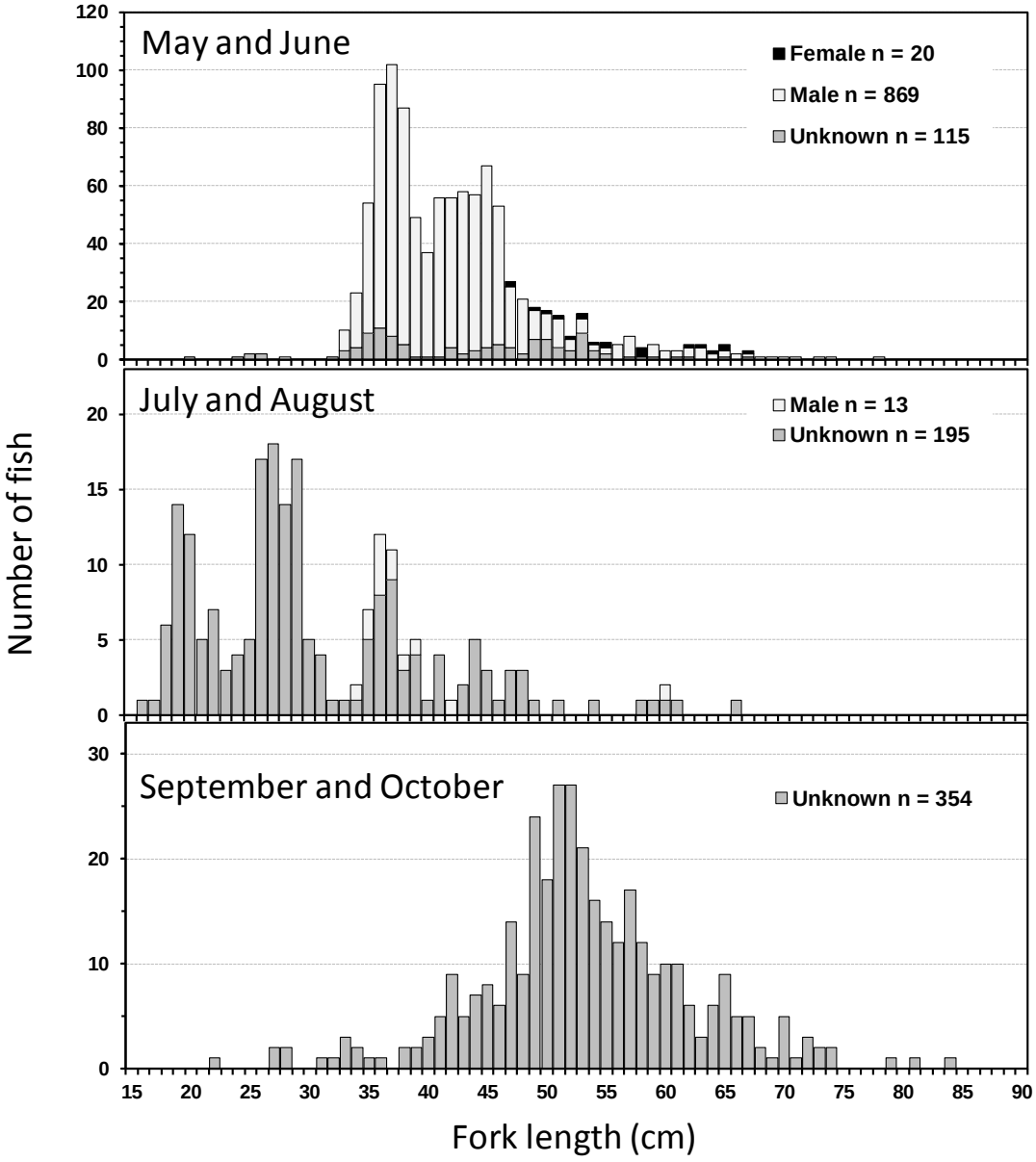
Appendix Table 2. Summary of estimated losses of medium and large sized Striped Bass in fisheries of the southern Gulf of St. Lawrence. All values have been rounded to the nearest 100. From Table 1 of the Allowable Harm Assessment for Striped Bass in the southern Gulf of St. Lawrence (DFO 2011).

	Total			Percentage	Percentage of total
Fishery	Released	Dead	Handled	killed	killed
Atlantic Silverside	400	0	400	0	0
American Eel	15,500	1,300	16,800	7.7	2.1
FSC Salmon	1,200	1,900	3,100	61.3	3.1
American Shad	500	2,500	3,000	83.3	4.1
Rainbow Smelt	12,900	3,900	16,800	23.2	6.3
Atlantic Herring	2,300	4,500	6,800	66.2	73
Gaspereau	37,900	4,800	42,700	11.2	7.8
Recreational	19,600	8,900	28,500	31.2	14.4
Illegal	0	33,900	33,900	100	54.9
Total	90,300	61,700	152,000	40.6	

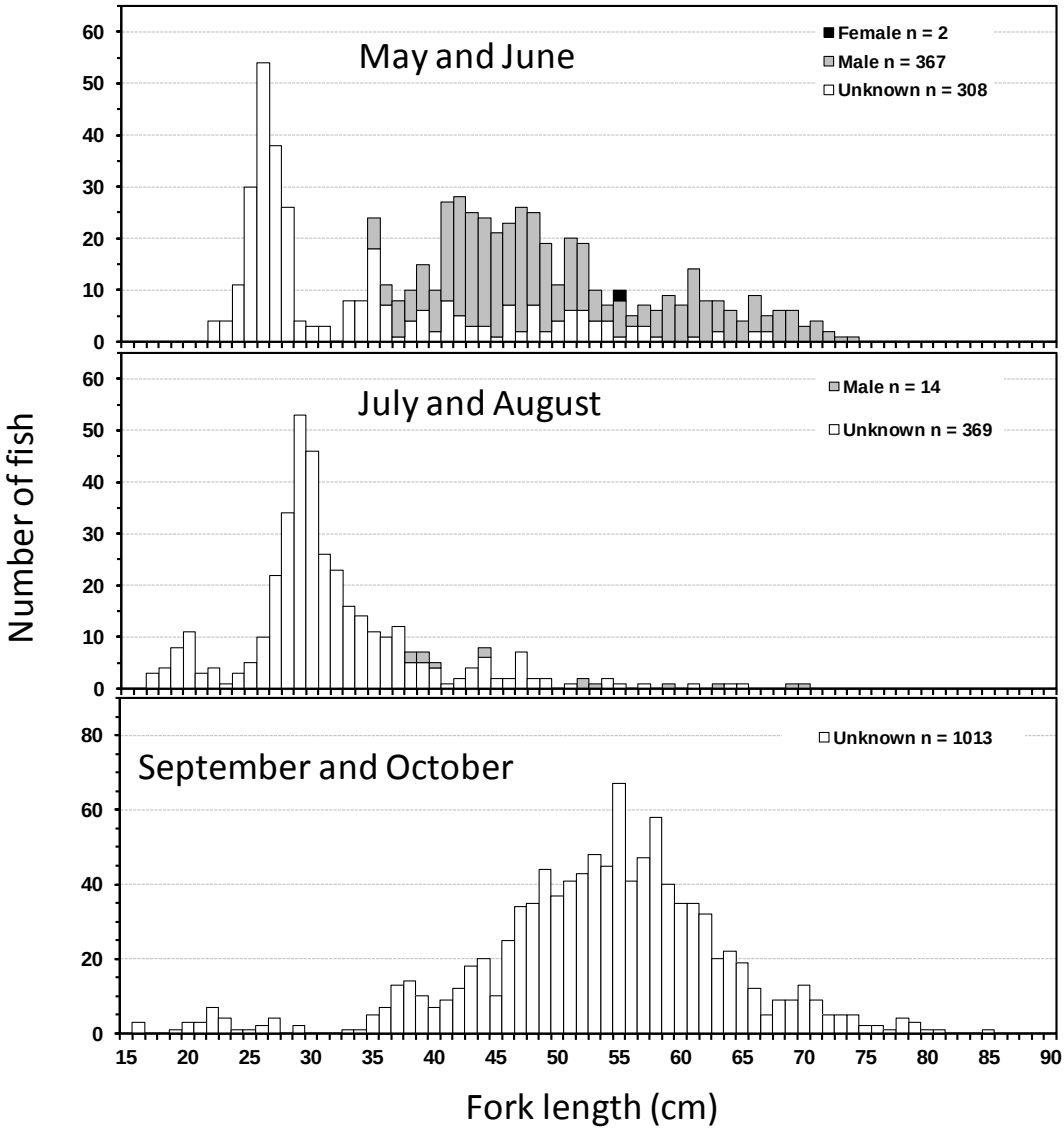
Appendix Figure 1. The number of Striped Bass captured per net per day in the commercial gaspereau fishery of the NW Miramichi estuary in 2011 (upper) and 2012 (lower). Note differences in abundance scales for 2011 and 2012. Hatch lines encompass the data and the period which were used in the CPUE analyses (shaded circles). Solid squares (water temperature) in the 2012 panel represent days when striped bass were observed spawning in the upper Northwest Miramichi estuary.



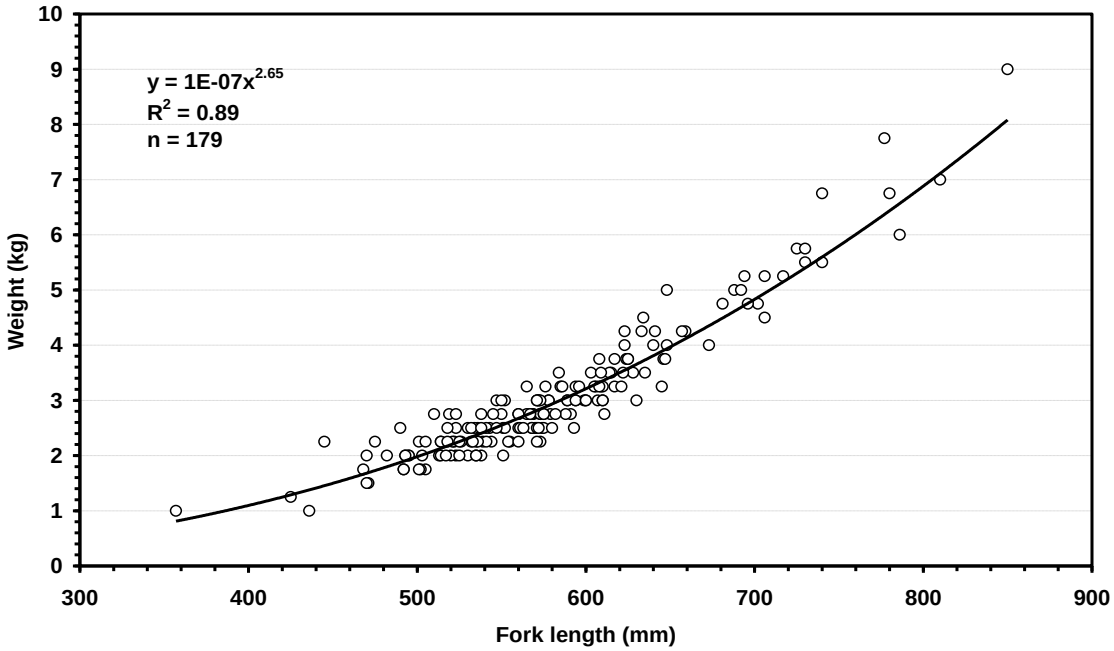
Appendix Figure 2a. Fork length distributions of Striped Bass by sex and by month (upper panel: May and June, middle panel: July and August, lower panel: September and October) sampled at the DFO index trapnets in the Southwest Miramichi and the Northwest Miramichi estuaries in 2011.



Appendix Figure 2b. Fork length distributions of striped bass by sex and by month (upper panel: May and June, middle panel: July and August, lower panel: September and October) sampled at the DFO index trapnets in the Southwest Miramichi and the Northwest Miramichi estuaries in 2012.



Appendix Figure 3. Relationship between fork length (mm) and whole weight (kg) for Striped Bass sampled at the DFO index trapnet in the Southwest Miramichi estuary at Millerton during October 2012.



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