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RECREATIONAL FISHERY CATCHES, SPAWNER ABUNDANCE, AND BIOLOGICAL CHARACTERISTICS OF STRIPED BASS (*MORONE SAXATILIS*) IN THE SOUTHERN GULF OF ST. LAWRENCE IN 2014

Context

The recreational fishery for Striped Bass in the southern Gulf of St. Lawrence re-opened in 2013 and was permitted again in 2014. In 2014, anglers were granted an additional 21 days during the spring and summer retention periods (combined) and a new seven-day retention period in the autumn. Fisheries and Oceans Canada (DFO) Gulf Ecosystems and Fisheries Management branch requested a compilation of the recreational fishery information and an update on the size of the spawning stock and information on biological characteristics for southern Gulf Striped Bass for 2014.

This report provides an examination of the recreational fishery information collected by Conservation and Protection staff during the three Striped Bass retention periods (May 1 to 25, August 1 to 21, and September 24 to 30) in 2014 in DFO Gulf Region and in the Chaleur Bay portion of the province of Quebec. It also provides an update of the current biological characteristics and spawner abundance estimates in the Northwest Miramichi estuary in 2014.

The estimated minimum number of harvested Striped Bass in the Miramichi River during the May retention season was approximately 450 fish, while between 9,600 and 12,000 bass were estimated to have been caught and released. Insufficient recreational fishery survey data precluded estimation of the numbers of bass released or kept during the 2014 August and September retention periods. The catches of Striped Bass during all retention periods are incomplete. The limitations of the creel survey and angler reported catch and effort data are discussed.

The estimated spawner abundance in the Northwest Miramichi in 2014 was 138,300 fish (median value, 5th to 95th percentile range of 81,800 to 251,900) and sufficient to meet the population's recovery objective for the fourth consecutive time since 1993. The fork length distribution of Striped Bass sampled at DFO index trapnets in May was dominated by fish measuring between 40 and 50 cm, a size which was proportionally less abundant in sampled catches at DFO index trapnets in the autumn of 2014. The fork length distribution in autumn 2014 was dominated by Striped Bass measuring between 30 and 40 cm fork length.

This Science Response Report results from the Science Response Process of December 10, 2014 to Update, striped bass spawner abundance and fisheries catches for 2014.

Background

Striped Bass from the southern Gulf have a distribution that extends from the eastern tip of the Gaspe peninsula in Quebec to the western tip of Cape Breton Island. Fisheries for Striped Bass in the Chaleur Bay portion bordering the province of Quebec are managed by the province of Quebec.

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 allocations to aboriginal groups in 2000. Beginning in 2012, access to Striped Bass incidentally captured in food, social, and ceremonial fisheries was reinstituted for some aboriginal groups that previously had allocations prior to the closure. A recreational fishery for Striped Bass in the southern Gulf of St. Lawrence was re-opened in 2013 and permitted again in 2014. Details regarding seasons, retention periods, size limits, and gear restrictions are provided in several variation orders in 2013 (Variation orders GVO-2013-026, GVO-2013-29, GVO-2013-055, GVO-2013-057) and 2014 (Variation orders GVO-2014-042, GVO-2014-043) (Table 1).

Table 1. Summary of Striped Bass recreational fishery management measures in 2013 and 2014.

Management measure	2013 Southern Gulf	2013 Quebec portion of Chaleur Bay	2014 Southern Gulf	2014 Quebec portion of Chaleur Bay
Directed fishery season open	May 1 – Sept. 30	June 15 – Sept. 30	May 1 – Sept. 30	June 15 – Sept. 30
Retention period(s)	May 1 – May 15 Aug. 2 – Aug. 11	None	May 1 – May 21* Aug. 1 – Aug. 21 Sept. 24 – Sept. 30	July 26 – Aug. 24
Daily retention limit	1	0	1*	1
Possession limit	1	0	1*	1
Retention size limits	55 – 65 cm Total Length		50 - 65 cm Total Length	< 65 cm Total Length

**The retention period in May 2014 was extended for four days to May 25. During this extension, anglers were permitted to retain two Striped Bass per day and possess no more than two at any given time.*

In 2013, anglers fishing in southern Gaspé, Quebec (zone 21 includes waters between the downstream side of the Campbellton Bridge, including the Baie des Chaleurs, and the waters of the Gulf of St. Lawrence to the western tip of Cap-Gaspé) were permitted to catch and release (no retention) Striped Bass between June 15 and September 30. In 2014, the catch and release season for Striped Bass was the same as in 2013 with a retention period between July 26 and August 24, 2014. During the retention period, anglers were permitted to retain one bass per day with a maximum of one bass in their possession at any time. Retained Striped Bass had to be less than 65 cm total length. Only single hooks with no more than three per line could be used, and only artificial lures were permitted (no natural bait).The estuary of the Rivière Malbaie is within zone 1 although all waters external to the estuary are in zone 21. The estuary was open to catch and release only during June 15 to September 1, 2014 and no retention was allowed.

The monitoring of the Striped Bass bycatch in the commercial gaspereau trapnets of the Miramichi River has provided the platform for assessing the Striped Bass spawning population of the southern Gulf 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 monitored 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 2011). An analysis of catch per unit of effort (CPUE) from this fishery has also been used as an index of abundance for Striped Bass since 1993 (Douglas and Chaput 2011).

DFO Science and the province of Quebec are conducting a three-year (2013-2015) study of predator-prey interactions of Striped Bass and other species in the southern Gulf of St. Lawrence. One component of the study is a diet analysis of adult Striped Bass in the Miramichi

estuary during the May and June spawning period. The field collections for 2013 and 2014 are complete but the dissections and diet analysis of the 2014 samples were incomplete at the time of this publication. A similar sampling program for diet composition of Striped Bass is being conducted the province of Quebec in Chaleur Bay. Samples were collected in 2014 and being processed.

Analysis and Response

Striped Bass Recreational Fishery

The collection of the Striped Bass recreational fishery information by DFO Conservation and Protection officers was concentrated in the Miramichi River during the May retention period in 2014. The fishery data collection was designed with the objective of estimating the total number of Striped Bass caught and kept or released during the retention season. Details of the creel survey design are provided in Appendix 1.

The province of Quebec conducted a creel survey targeting ten primary locations along the Quebec portion of Chaleur Bay known to be highly frequented by anglers. The survey coverage extended from 15 June to 31 August with full daily coverage during the weekends, civic holidays and the retention season.

Other Striped Bass recreational fishery information compiled included C&P interviews outside the May creel survey design period, mail-in survey cards, and angler volunteer reports from a DFO website. This information is summarized but is not sufficient for estimating catch and effort.

May retention period in Miramichi

The collection of fishery data in the Miramichi River only occurred on 17 days (May 4-21) of the 25-day retention season and estimates of catch and effort are restricted to this time period.

Conservation and Protection officers counted almost 3,600 anglers and interviewed 818 within the Miramichi River system during the May retention period in 2014, representing 65% and 45% of the 2013 values, respectively. Individual anglers reported catches of Striped Bass in single trips ranging from 0 to as high as 111 fish per trip, and there was large variation among angler catches and success rates.

For the sectors (1 to 4; Appendix 1 Figure 1) of the Miramichi River most frequently used by anglers, the total number of Striped Bass reported released from the angler interviews was over 2,500 fish, while 94 were reported harvested (Appendix 1 Table 1). The average number of bass released per angler/day ranged from 0.33 to 4.66 within the four Miramichi sectors with the highest CPUE estimates found in Sector 2 (SW/NW confluence) and Sector 3 (Northwest Miramichi). The average number of bass retained per angler/day ranged between 0.05 and 0.16 with the highest values estimated in Sectors 2 and 3. When these average catch rates were applied to the estimated number of anglers for the retention period, about 12,000 Striped Bass were estimated to have been caught and released and 450 Striped Bass harvested (Appendix 1 Table 1). The highest proportions of the catches were found in Sectors 2 and 3.

Interviewed anglers in the Miramichi reported having fished for about 2,100 hours, the equivalent of over 2,800 hours once adjustments were made for incomplete fishing trips (Appendix 1 Table 1). The majority of the effort (hours) was concentrated in Sector 2 (SW/NW Confluence) (44%) and Sector 4 (SW Miramichi) (34%). Average catch rates for Striped Bass caught and released ranged from 0.19 to 1.13 bass per hour of effort, with the high value estimated for Sector 2. The average catch rate for retained Striped Bass ranged between 0.01 bass per hour (main Miramichi and Southwest Miramichi) and 0.04 bass per hour in Sector 2.

When these average catch rates were applied to the estimated hours of effort for the 17-day period, over 9,600 Striped Bass were estimated to have been caught and released while 400 were retained (Appendix 1 Table 1).

Assuming a catch-and-release mortality rate of 10% (DFO 2014), the minimum caught and release mortality during the May retention period would be in the range of 1,200 to 1,360 fish which is higher than the estimate of retained fish (Table 2).

The angler survey information in May 2014 indicates that there was lower participation in the Striped Bass recreational fishery in 2014 compared to 2013. Catches of Striped Bass were underestimated given that interviews only covered a portion of the 25-day season. Similar to 2013, angling effort and catches of Striped Bass were highest in Sector 2 (SW/NW confluence), and Sector 3 (NW Miramichi).

Table 2. Summary of recreational fishery survey estimates of effort, catch and release, retained, and total losses during the May retention period from the Miramichi River sectors for Striped Bass in 2013 and 2014. Details are in Appendix tables 1, 2 and 3.

Descriptor	May 1-15, 2013	May 5-21, 2014
Effort (angler days)	6,263	3,879
Estimated catch and release	20,162	12,147
Estimated retained	931	448
Estimated loss (retained plus catch and release mortality)	2,947	1,663
Adjusted effort (hours)	23,281	13,536
Estimated catch and release	29,224	9,637
Estimated retained	2,400	400
Estimated loss (retained plus catch and release mortality)	5,322	1,364

August and September retention periods

During the 2014 August and September retention periods, Conservation and Protection officers interviewed 192 (August) and 242 (September) anglers throughout the southern Gulf. Interviewed anglers in August reported harvesting 38 Striped Bass and releasing 239 (Appendix 1 Table 2). The majority of released Striped Bass appeared to have come from Gulf Nova Scotia, while the majority of those retained came from Chaleur Bay. From September interviews, anglers reported keeping 20 Striped Bass and releasing 216 (majority Gulf Nova Scotia) (Appendix 1 Table 2). Insufficient coverage precluded the extrapolation of interviewed catches to a total for these retention periods.

Mail in cards and DFO website self-reports

Only 72% of the 172 cards returned to DFO were completed properly. Cards were returned from areas throughout the southern Gulf but most (80%) originated from Chaleur Bay. Cards covered fishing events from May 9 to October 3 but the majority (85%) were from August and September. From the returned cards, anglers reported releasing and retaining 760 and 53 Striped Bass, respectively (Appendix 1 Table 3). The majority of the released bass were reported from eastern New Brunswick, Gulf Nova Scotia, and Chaleur Bay.

The number of valid web entries was 91. Anglers reported releasing 1,560 Striped Bass and retaining 40. The majority of released bass (n = 949) and kept bass (n = 17) originated from reports in the Miramichi area (Appendix 1 Table 3).

Results for the Quebec portion of Chaleur Bay

A total of 766 interviews were completed in 2014. The average duration of a fishing trip was three hours (± 9 %; 2h45 - 3h15). The total estimated fishing effort was 15,195 hours (95% C.I. range 12,074 to 18,315) equivalent to a total of 5,043 rod days of effort (4,008 to 6,079). The estimated total catch (released and retained fish) was 9,010 (5,370 to 12,650) and the estimated number of bass retained was 554 (299 to 809). Assuming a 10% catch and release mortality, the total fisheries related losses were estimated at 1,400 bass (1,146 to 2,013) in 2014. Of the Striped Bass retained by anglers, 27% were less than 50 cm total length and 73% were between 50 and 65 cm total length. There was no evidence of size selection of bass in the retention fishery; the proportion of Striped Bass under 50 cm total length retained was very similar to the proportion of that size group which was reported released (33%). Of the released fish, 13% were reported to be greater than 65 cm total length.

Spawner abundance

The commercial gaspereau season for individuals fishing in the Northwest Miramichi River in 2014 was from 6 pm on June 1 to 6 pm on June 29, 2014. Some traps were first set on June 2 with the first catches to monitor on June 4. A total of 59 fishery hauls out of a possible 147 (40%) were sampled for Striped Bass bycatch during the commercial gaspereau season. Catches were monitored regularly throughout the season.

The sampling periods considered appropriate for estimating abundance of Striped Bass spawners extended for six days between June 4 and June 13. Similar to previous years, the bycatch of Striped Bass was highest early in the season and decreased to low levels by mid-June (Appendix 2 Figure 1). Catches of Striped Bass were higher than the average of the time series beginning in 1994 but lower than the values in 2011 and 2013. DFO Science personnel first observed spawning Striped Bass in the Cassilis area (Northwest Miramichi) on May 31 which coincided with increasing water temperatures to around 15ºC (Appendix 2 Figure 1).

The Bayesian hierarchical model used in previous Striped Bass assessments was applied again to the 2014 CPUE information from the gaspereau fishery monitoring program. An adjustment to the model was made for 2014 to account for the observed behaviour of Striped Bass carrying internal acoustic tags (Chaput and Douglas 2011; DFO 2014). The movements of 67 Striped Bass carrying acoustic transmitters were monitored with receiver arrays anchored throughout the Miramichi system and along the coast lines of the southern Gulf during May and June 2014. The tracking of acoustically tagged Striped Bass provided information on the daily distribution of spawners on the spawning grounds and therefore available to be captured in the gaspereau trapnets of the Northwest Miramichi.

To estimate spawner abundance in 2014, the catch rates on individual sampling dates were assumed to be proportional to the total spawners on the spawning grounds in the Northwest Miramichi. The abundance on the spawning grounds for those dates was estimated as the product of the total spawner abundance at the beginning of the spawning period and the proportion of the acoustically tagged bass on the spawning grounds. Based on acoustically tagged bass, the proportions declined from 73% for June 4 to 16% for June 13. The estimated spawner abundance of Striped Bass in the Northwest Miramichi in 2014 was 138,300 (median, 5th to 95th percentile range 81,800 to 251,900).

Catches of Striped Bass at DFO index trapnets at Millerton on the Southwest Miramichi River and at Cassilis on the Northwest Miramichi River provide fishery independent indices of the southern Gulf Striped Bass population. The trapnet at Cassilis operated between May 27 and

October 21, 2014 while the one at Millerton operated between June 5 and October 21, 2014. Periods when these facilities were not operating in the spring (May and June) and autumn (September and October) were negligible. Striped Bass catches at these facilities remained high in the spring (n=1,575) and autumn (n = 3,374) and similar to levels experienced since 2010 (Appendix 2 Figure 2).

The Recovery Potential Assessment proposed a recovery limit and target for the southern Gulf Striped Bass population based on the abundance of spawners estimated for the Northwest Miramichi estuary (DFO 2006; Douglas et al. 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 (5th percentile) of the spawner abundance estimate be used to assess status relative to these recovery objectives (Douglas et al. 2006). The abundance of Striped Bass spawners in the Northwest Miramichi in 2014 was sufficient to meet the recovery limit and target for the fourth consecutive year (2011-2014) (Fig. 1).

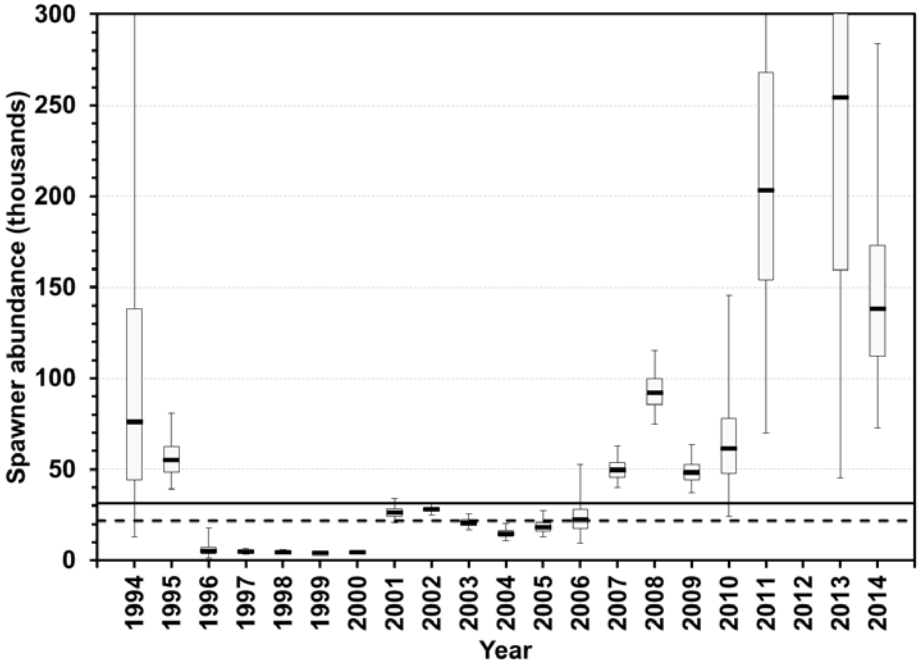

Figure 1. Estimated abundances of adult Striped Bass in the Northwest Miramichi estuary between 1994 and 2014. The estimate for 2010 is considered to be an underestimate due to the earlier timing of the spawning events (Douglas and Chaput 2011). Box plots are interpreted as follows: dash is the median, boxes are the interquartile range, and the vertical dashes are the 5th to 95th percentile ranges. The solid and dashed horizontal lines show the recovery objectives defined in the Recovery Potential Assessment (DFO 2006).

Biological characteristics

Striped Bass catches at DFO index trapnets from late May to mid-October in 2014 were sampled for abundance and length. On infrequent occasions when there were too many fish to measure, a subsample (usually 100) was measured and the length distribution is derived by weighting to the complete catch.

The mean fork length of adult Striped Bass (assumed to be > 30 cm) measured in May and June 2014 was 49.6 cm (range 31.0 to 87.3 cm; n=1,460). The majority (85.7%) of Striped Bass measured between 30 and 60 cm, while 14.3% of samples measured > 60 cm. During the spring, nearly 46% of Striped Bass measured between 46 and 61 cm FL, the equivalent of the 50 to 65 cm Total Length (TL) slot regulation. The 2014 spring length distribution was very similar to the pre-winter lengths measured during the autumn of 2013 (Fig. 2).

The mean fork length of adult fish measured during the months of September and October 2014 was 44.0 cm (range 30.0 to 89.0; n=984). Over 90% of the Striped Bass sampled during autumn 2014 measured between 30 and 60 cm FL, while those greater than 60 cm FL made up the remainder (9.7%). Over 31% of Striped bass measured in the autumn satisfied the 2014 regulation slot size of 50 to 65 cm total length. A large peak in abundance of Striped Bass that measured between 40 and 50 cm during the spring 2014 was not well represented in the autumn fork length distribution (expected sizes of 50 to 60 cm), however, bass measuring between 30 and 40 cm, likely immature fish in the spring of 2014, were proportionally abundant (Fig. 2).

Striped Bass Movements

The DFO in partnership with the Quebec Department of Forests, Wildlife, and Parks (DFWP), the Atlantic Salmon Federation, and the Miramichi Salmon Association have been applying acoustic tags to Striped Bass and Atlantic Salmon smolts to monitor behaviour and various migration parameters. Telemetry studies also provide the unique opportunity to assess survival of implanted fish.

During the summer of 2013, the DFWP implanted 40 Striped Bass from Gaspé waters with an acoustic transmitter. By early October 2013, 38 of the bass had been detected in the Miramichi. All 38 Striped Bass overwintered, survived, exhibited spawning behaviour in the upper Northwest Miramichi estuary during the spring, and migrated north along the NB coast after spawning. At the time of the last receiver retrieval in mid-October 2014, 15 of the original 38 implanted bass had returned to the Miramichi. Of an additional 60 Striped Bass implanted with an acoustic tag from Gaspé waters during the summer of 2014, 24 were detected in the Miramichi by mid-October 2014. The number of overwintering striped Bass in the Miramichi that were originally tagged in Gaspé is expected to increase once winter receivers are downloaded in the spring of 2015.

Forty Striped Bass from the Southwest Miramichi River were implanted with an acoustic transmitter during the fall of 2013. Five of these Striped Bass died or ejected their tags during the winter, six left the Miramichi system shortly after ice-out and did not spawn in the Miramichi, and the remaining 29 exhibited spawning behaviour in the upper Northwest Miramichi estuary. Two Striped Bass died or ejected their tags after spawning and were not detected leaving the Miramichi. All post-spawned Striped Bass (n = 27) and those that left shortly after ice-out (n = 6) were subsequently detected migrating north along the NB coast and 21 were detected along the Chaleur Bay coast of Quebec. Of the 33 bass from this group that left the Miramichi in spring 2014, 21 fish, not necessarily the same ones detected in Chaleur Bay, had returned to the Miramichi River to overwinter by mid-October.

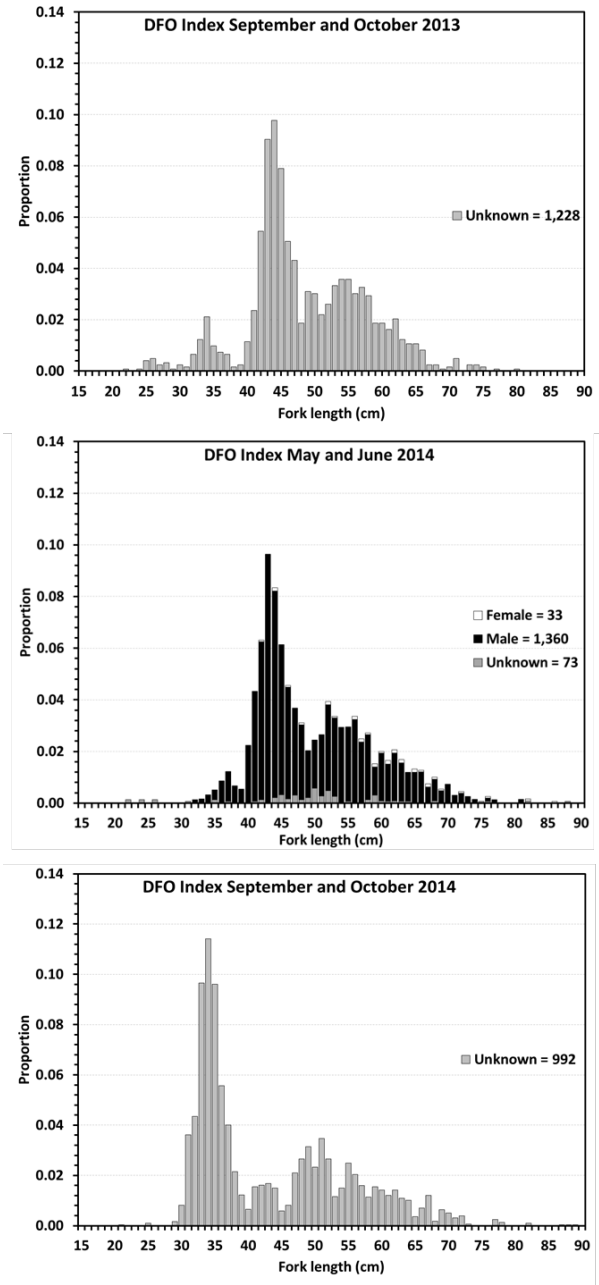

Figure 2. Fork length distributions of Striped Bass by sex and season at DFO index trapnets in the Southwest and Northwest Miramichi rivers. The size distributions of Striped Bass sampled in the autumn 2013 (upper panel), spring 2014 (middle panel), and autumn 2014 (lower panel) are shown.

Striped Bass Diet

The DFO and the province of Quebec are conducting a 3-year study (2013-2015) to describe and quantify the prey and assess the interactions of Striped Bass and their prey in the southern Gulf of St. Lawrence. One component of the study is to conduct a diet analysis of adult Striped Bass in the Miramichi estuary during the spring time. The field collections for 2013 and 2014 are complete but the dissections and diet analysis of the 2014 samples were incomplete at the time of this review.

In 2013, a total of 580 Striped Bass were captured and sampled between May 1 and June 26 in the Miramichi estuary. The majority of samples (60%) were collected from trapnets while the remainder was collected by angling. Females made up the largest component of the angled samples (54%) while males were more abundant in trapnet samples (71%) (Appendix 3 Table 1).

In 2014, 615 Striped Bass were sacrificed from the Miramichi estuary during the spring (May 9 to June 25). Forty-seven percent of samples were angled while 53% were captured in trapnets. Male Striped Bass contributed to the majority of samples collected by angling (64%) and from trapnets (82%) (Appendix 3 Table 1).

Overall, 66% of Striped Bass stomachs collected in 2013 were empty (Table 3). Of the stomachs with contents, 21% contained Rainbow smelt, 6% gaspereau, 5% other fish and parts, 3% insects, 2% Atlantic Salmon, and 2% crustaceans (Table 3).

Table 3. Summary of percentages of stomachs sampled which were empty and the percentages of stomachs which contained prey type categories for Striped Bass sampled in 2013. Percentages have been rounded to the nearest percent.

Source	Empty	Smelt	Gaspereau	Other fish & parts	Insects	Salmon	Crustaceans
Angled	60	33	0	5	3	3	1
Trapnet	69	14	9	4	3	1	2
Total	66	21	6	5	3	2	2

A total of 20 Atlantic Salmon smolts and one salmon parr were identified from ten Striped Bass stomachs sampled in 2013. Six of the Striped Bass that had smolts were angled; the other four were sampled from trapnets (Table 4). Atlantic salmon smolts were found in Striped Bass sampled on six different days between May 10 and May 29, 2013. Of the 20 smolts identified, 13 (65%) came from four bass and from a single angling event on May 28, 2013 near the mouth of the Northwest Millstream (Table 4). These four bass had consumed one to six salmon smolts each. The number of smolts in the individual stomachs of Striped Bass sampled from trapnets ranged between 1 and 3 fish.

Table 4. The number of Atlantic Salmon identified from stomach samples in May and June 2013, by sampling method, date and location. The date, method, and location of capture for the individual Striped Bass containing Atlantic salmon is identified. "Comm gasp NW" refers to samples from a commercial gaspereau trapnet in the Northwest Miramichi River. Sampling details are provided in Appendix 3 Table 1.

Capture method	Collection date	Location	Total bass sampled	Bass with salmon	Total number of salmon
angling	14-May-13	Beaubear's Island	25	1	1
	16-May-13	Beaubear's Island	20	1	1
	28-May-13	Northwest Millstream	30	4	13
	all other dates	all other locations	155	0	0
trapnet	10-May-13	DFO Cassilis	15	1	1
	27-May-13	Comm gasp NW	32	1	3
	29-May-13	Comm gasp NW	30	1	1
	26-Jun-13	DFO Millerton	22	1	1
	all other dates	all other locations	251	0	0
Total	all dates	all locations	580	10	21

Knowledge gaps and uncertainties

The estimates of Striped Bass released and retained in the Miramichi River during the May retention period should be considered as minimum values. The collection of fishery data only occurred on 17 days of the 25-day retention period, and no data were collected during the 4 day extension in May when daily retention limits were increased to two fish from one fish per day.

Until a method of obtaining a representative sample of angler information and the total effort in the Striped Bass recreational fishery is implemented, an estimation of the total catch of Striped Bass kept and released will be difficult to resolve. The large spatial distribution of Striped Bass during the summer months makes this task especially challenging. The information provided by the public on the mail-in survey cards and the DFO website were insufficient to derive estimates of Striped Bass catch or effort.

The total fishery related mortality of Striped Bass in the southern Gulf in 2014 is unknown but considered to be substantial and not reflected in the results of the recreational fishery surveys. Losses of Striped Bass in recent years from illegal fisheries, catch and release fisheries, and incidental bycatch have been estimated to be in the tens of thousands per year (DFO 2011). With the continued number of anecdotes about the bycatch and illegal retention of Striped Bass, there is no reason to think that the level of illegal fisheries has changed.

Conclusions

Approximately 400 Striped Bass were estimated to have been harvested and between 9,600 and 12,000 caught and released over 17 days (May 4-21) of the 25 day (May 1-25) spring retention period in the Miramichi River. These values did not encompass the entire May retention period and excluded catches from the rest of the southern Gulf. Similar to 2013, catches of Striped Bass in May were the highest in the staging and spawning areas of the Miramichi estuary. Estimates of catch and effort for the August and September retention periods, as well as, the May to September catch and release season, could not be resolved with the information collected in 2014. The numbers of anglers that returned survey cards or completed the online DFO survey were insufficient to calculate meaningful catch or effort indices for the 2014 Striped Bass recreational fishery.

The estimated total catch (released and retained fish) of Striped Bass in the Quebec portion of Chaleur Bay in 2014 was 9,010 fish (5,370 to 12,650) and the estimated number of bass retained was 554 (299 to 809) fish. The proportion of the catch released was 77.5%. Assuming a 10% catch and release mortality, the total fisheries related losses were estimated at 1,400 bass (1,146 to 2,013) in 2014.

Assuming a 10% hook and release mortality in the recreational fishery, there were more losses attributed to catch and release mortality then retentions although the catch and release losses occurred over the entire size range of bass angled whereas the retention losses are from a restricted size group of fish. Striped bass are available for capture from late April in the Miramichi River and to September in the southern Gulf of St. Lawrence, including Chaleur Bay. If effort during the catch and release season is as important as during the retention seasons, the potential cumulative loss from catch and release fishing can be more important than the losses associated with the shorter season retention fisheries.

The ability to monitor the movements of Striped Bass using acoustic telemetry provided a method of estimating the proportion of bass spawners that were available to capture in the bycatch monitoring program of the gaspereau fishery. Spawner abundance in 2014 was

estimated at approximately 140,000 fish; a decrease from the highest value of the time series (255,000) estimated in 2013.

The recovery objective for southern Gulf Striped Bass was met for the fourth consecutive time in 2014. The recovery objectives for the southern Gulf Striped Bass are not synonymous to Precautionary Approach reference points for managing fisheries. An assessment of harvestable surplus would require consideration of the assessment program to gain more reliable estimates of abundance (due to annual variations in the spawning period and the reliance on gaspereau trapnets as the sampling platform), reliable fisheries catch statistics, and appropriate reference points.

The most abundant size group of Striped Bass spawners in the spring of 2014 measured between 40 and 50 cm fork length. This size group would have grown to between 50 and 60 cm by the autumn of 2014 and it was proportionally less important in the autumn samples. Striped Bass measuring between 30 and 40 cm were proportionally the most abundant size group.

The acoustic tracking and diet studies of Striped Bass in the southern Gulf and in the Quebec portion of Chaleur Bay are ongoing.

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Appendices

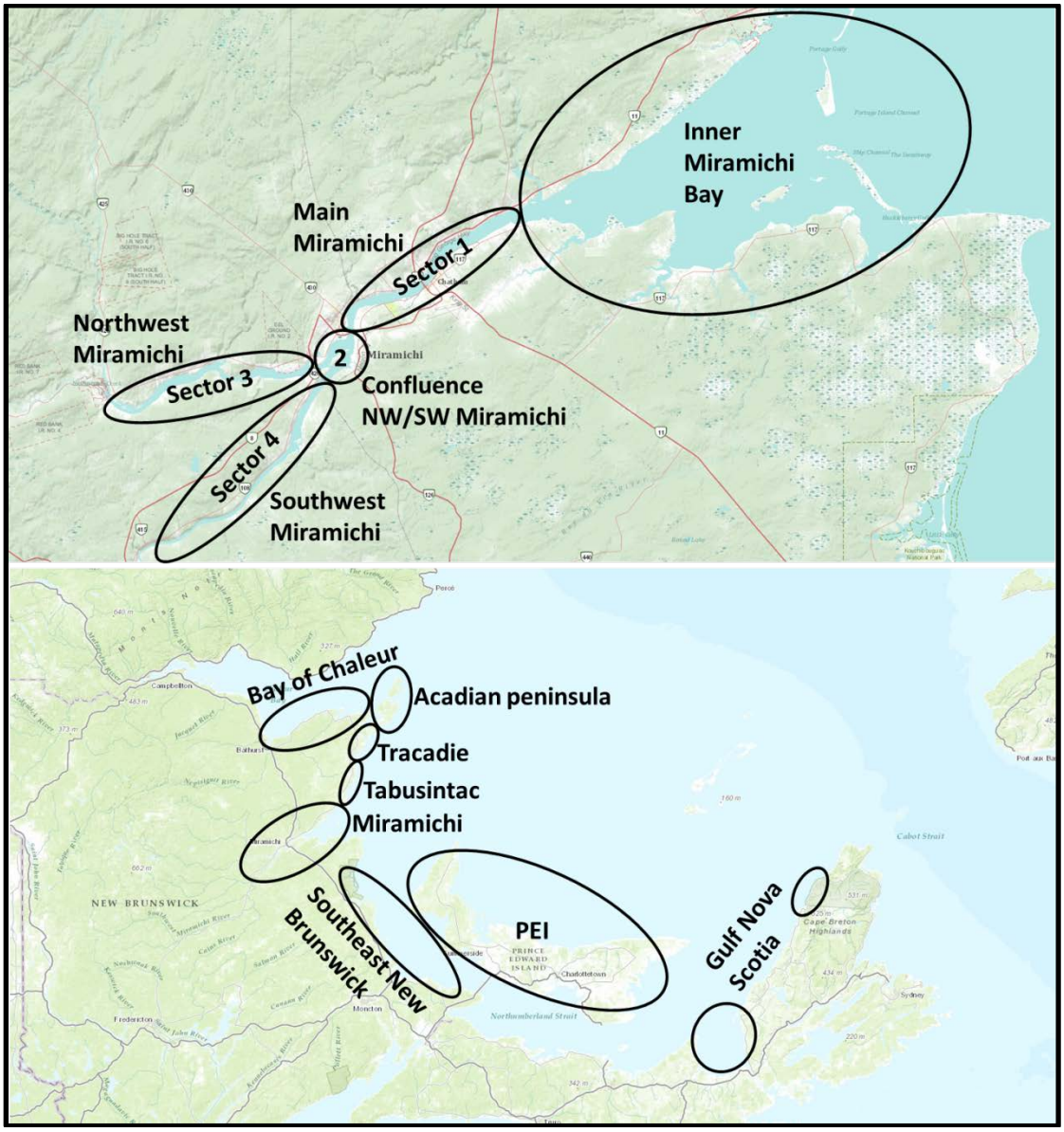
Appendix 1. Recreational fishery survey methods and results for the 2014 directed Striped Bass fishery.

Days within the May retention season were divided into three potential periods to collect fishery data (morning 7:00-12:00, afternoon 12:00-17:00, and evening 17:00-22:00). The Miramichi River was divided into four sectors (Sector 1-Sector 4) (Appendix 1 Figure 1). Both the sector and period of the day to be sampled were chosen randomly with each combination having the same probability of being selected. Sampling events were intentionally higher for sectors 2 to 4 compared to sector 1 (about 25 sampling events in each of sectors 2 to 4 compared to 10 in Sector 1). During a sampling event, fishery officers were asked to conduct two boat patrols and angler effort counts within the chosen sector and period. The first count was to be at the beginning of the period and the second mid-way through the sampling period. During the times between angler counts, officers were asked to interview anglers and collect information on their effort (time fishing) and number of Striped Bass caught and kept or released.

Conservation and Protection officers also conducted “spot checks” of the Striped Bass recreational fishery throughout the southern Gulf in 2014 with a particular focus on the August and September retention periods. Similar to 2013, the areas surveyed in the southern Gulf of St. Lawrence were grouped into eight locations (Appendix 1 Figure 1) (DFO 2014). To assess total effort in the fishery, officers were asked to count the number of individuals angling within stretches of river, coastline or at access points, and to interview individual anglers and collect information on their Striped Bass catches (retained and released) and effort (hours fished). To assess the difference in catches and effort between a complete and incomplete fishing trip, anglers that had not finished fishing at the time of the interview were given an individually numbered questionnaire to return at the end of their fishing trip. The returned card with the complete information was compared with the incomplete information that the fishery officer collected at the time of the interview. Other mail-in questionnaires were distributed by various means throughout the southern Gulf and DFO Gulf region hosted a website asking anglers to upload their 2014 Striped Bass fishing information.

Analysis of the recreational fishery information has been limited to the fishery retention periods (May 1-25, August 1-21 and September 24-30). For the May retention period in the Miramichi, the total angling effort (angler days) was determined by calculating the average daily maximum number of anglers for each location raised by the number of days sampled (n = 17). The number of Striped Bass released or retained was then estimated using the average catch per angler day for each location raised by the number of days sampled. This method ignored the fact that the catch and effort information was often incomplete because most anglers were interviewed before the end of their fishing trip.

A second method for estimating effort was considered. An adjustment to the number of hours fished by interviewed anglers was made to account for incomplete fishing events. It was assumed that a complete trip should be three hours of effort (DFO 2014). For individuals that reported having fished for less than three hours, the total hours fished was adjusted upwards to three hours. For anglers that reported having fished for three or more hours, the fishing event was considered complete and no adjustments were made. The mean CPUE (released or retained bass per hour) was calculated based on interviews and raised by the estimate of total effort in hours for the days sampled.



Appendix 1 Figure 1. Locations surveyed during the May (upper panel), and August and September (lower panel) Striped Bass retention fisheries periods in the southern Gulf of St. Lawrence in 2014.

Appendix 1 Table 1. Summary of the recreational fishery survey information for the period May 5 to 21 collected during the first retention period (May 5 - 21) of the 2014 Striped Bass recreational fishery in the southern Gulf of St. Lawrence. SW/NW confluence refers to the confluence of the Southwest and Northwest Miramichi rivers. Areas are shown in Appendix Figure 1. The cell entry "nd" means not determined. The dashed horizontal line in the table separates the analyses using angler effort in days (upper section) from angler effort in hours (lower section). Areas are shown in Appendix 1 Figure 1.

Characteristics	Sector 1 Main Miramichi	Sector 2 SW/NW Confluence	Sector 3 Northwest Miramichi	Sector 4 Southwest Miramichi	Total	Inner Bay*
Days surveyed of 17-day period	10	16	17	15	nd	6
Number of angler interviews	30	324	219	245	818	107
Bass released (interviews)	28	1,510	971	82	2591	523
Bass retained (interviews)	2	52	28	12	94	28
Average max. anglers counted / day	7.2	102.4	46.6	72.1	nd	17.8
Estimated total effort (days)	122	1,740	792	1,225	3879	nd
Mean CPUE (released bass/angler)	0.93	4.66	4.43	0.33	nd	4.89
Mean CPUE (retained bass/angler)	0.07	0.16	0.13	0.05	nd	0.26
Estimate of bass released May 5-21	114	8,111	3,512	410	12147	nd
Proportion of all areas	0.01	0.67	0.29	0.03	1.00	nd
Estimate of bass retained May 5-21	8	279	101	60	448	nd
Proportion of all areas	0.02	0.62	0.23	0.13	1.00	nd
Total hours fished (interviews)	67	789	513	730	2,099	253
Average hours fished	2.23	2.46	2.41	2.98	nd	2.36
Hours adjusted for incomplete trips	99	1,110	728	923	2,860	nd
Mean CPUE (released bass/hour)	0.19	1.13	0.51	0.33	nd	2.41
Mean CPUE (retained bass/hour)	0.01	0.04	0.03	0.01	nd	0.12
Average adjusted hours fished per day	2.91	3.43	3.31	3.75	nd	nd
Estimated total effort (hours)	356	5,942	2,621	4,597	13,536	nd
Proportion of all areas	0.03	0.44	0.19	0.34	1.00	nd
Estimate of bass released May 5-21	67	6,736	1,333	1,502	9,637	nd
Proportion of all areas	0.01	0.70	0.14	0.16	1.00	nd
Estimate of bass retained May 5-21	5	250	77	68	400	nd
Proportion of all areas	0.01	0.63	0.19	0.17	1.00	nd

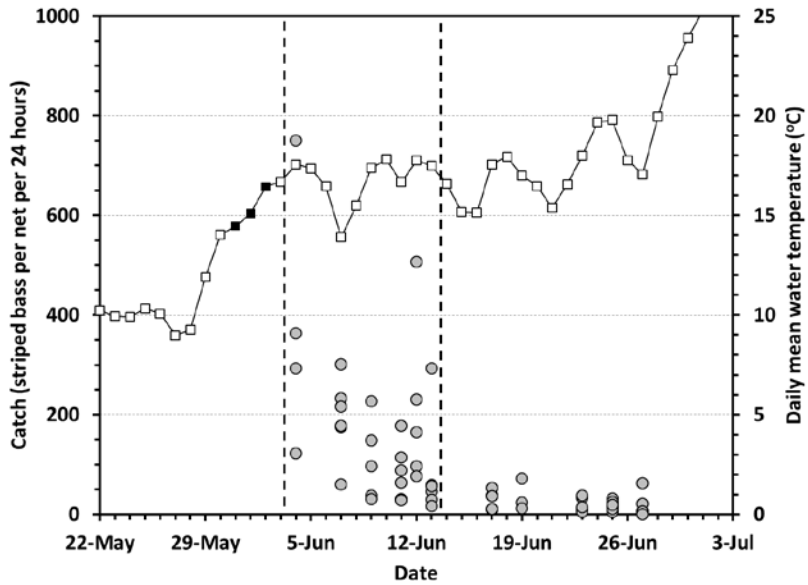
Appendix 1 Table 2. Summary of the recreational fishery survey information collected during the second retention period (August 1 - 21) and the third retention period (September 24 - 30) of the 2014 Striped Bass recreational fishery in the southern Gulf of St. Lawrence. Areas are shown in Appendix 1 Figure 1.

Characteristics	Chaleur Bay	Acadian Peninsula	Tabusintac	Miramichi	Eastern New Brunswick	Prince Edward Island	Gulf Nova Scotia
August 1 – 21, 2014							
Days surveyed of 21-day season	7	3	-	-	3	4	2
Number of angler interviews	131	26	-	-	19	4	12
Bass released (interviews)	54	22	-	-	11	0	152
Bass retained (interviews)	21	14	-	-	3	0	0
Average maximum anglers counted per day	21.1	11.0	-	-	6.3	1.0	6.0
Mean CPUE (released bass/angler)	0.41	0.85	-	-	0.58	0.00	12.67
Mean CPUE (retained bass/angler)	0.16	0.54	-	-	0.16	0.00	0.00
Total hours fished (interviews)	153	56	-	-	31	19	19
Average hours fished per day (interviews)	1.17	2.17	-	-	1.63	4.75	1.54
Mean CPUE (released bass/hour)	0.23	0.72	-	-	0.53	0.00	9.01
Mean CPUE (retained bass/hour)	0.13	0.52	-	-	0.14	0.00	0.00
September 24-30, 2014							
Days surveyed of 7-day season	4	5	2	5	3	2	6
Number of angler interviews	70	57	13	23	15	2	62
Bass released (interviews)	46	29	6	19	9	0	107
Bass retained (interviews)	4	5	2	3	2	0	4
Average maximum anglers counted per day	18.3	12.6	6.5	4.6	5.0	1.0	11.2
Mean CPUE (released bass/angler)	0.66	0.51	0.46	0.83	0.60	0.00	1.73
Mean CPUE (retained bass/angler)	0.06	0.09	0.15	0.13	0.13	0.00	0.06
Total hours fished (interviews)	65	41	14	31	34	5	94
Average hours fished per day (interviews)	1.1	0.7	1.1	1.3	2.3	2.5	1.6
Mean CPUE (released bass/hour)	0.28	0.23	0.21	0.31	0.17	0.00	1.01
Mean CPUE (retained bass/hour)	0.27	0.33	0.09	0.21	0.03	0.00	0.06

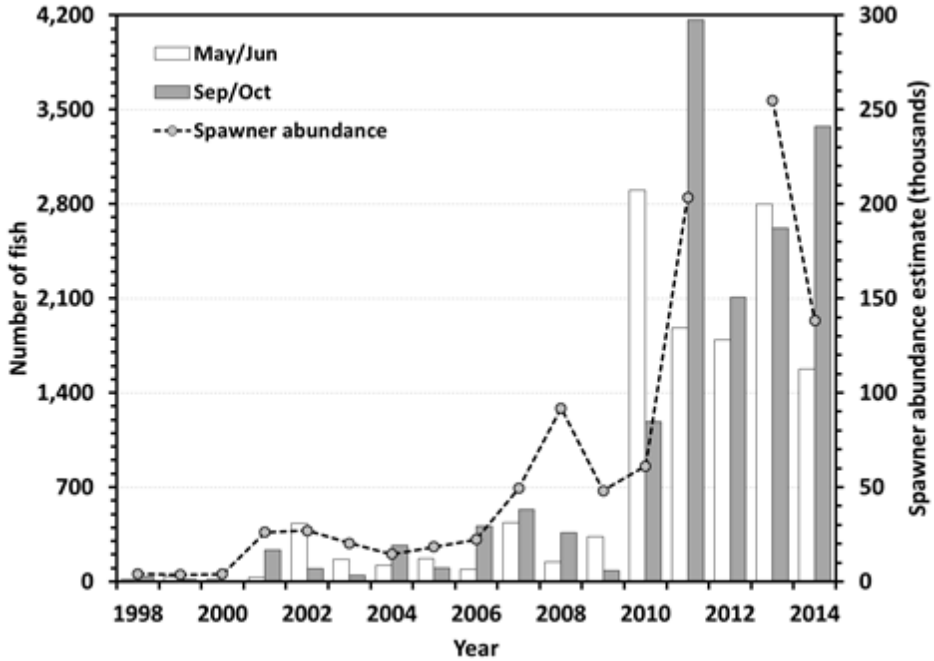
*Appendix 1 Table 3. Summary of the Striped Bass Fishery Questionnaire information collected during the 2014 Striped Bass recreational fishery in the southern Gulf of St. Lawrence. * represents value based on one card.*

Characteristics	Chaleur Bay	Acadian Peninsula	Tracadie	Tabusintac	Miramichi	Eastern New Brunswick	Prince Edward Island	Gulf Nova Scotia	Total
Number of valid cards received	42	5	14	7	1	30	0	24	123
Average hours fished per day (cards)	2.25	2.65	2.32	4.43	1.50*	2.60	-	3.79	2.78
Bass released (cards)	171	42	29	44	0	257	-	217	760
Bass retained (cards)	22	2	6	4	0	7	-	12	53
Number of valid web entries received	25	4	3	-	16	14	13	16	91
Average hours fished per day (web)	2.26	4.50	4.00	-	5.34	3.18	2.00	2.16	3.04
Bass released (web)	143	20	16	-	949	183	93	156	1,560
Bass retained (web)	8	3	1	-	17	4	4	3	40

Appendix 2



Appendix 2 Figure 1. The number of Striped Bass captured per net per day in the commercial gaspereau fishery of the Northwest Miramichi estuary in 2014 (grey circles). Vertical hatch lines encompass the data and the period which were used in the CPUE analyses. Squares show the mean daily water temperature and the black squares represent the temperatures on the dates of the initial observations of Striped Bass spawning in the upper Northwest Miramichi estuary in 2014.



Appendix 2 Figure 2. The combined number of Striped Bass captured in the DFO index trapnets at Cassilis on the Northwest Miramichi River and at Millerton on the Southwest Miramichi River during the spring (May/June) and autumn (Sept./Oct.) from 1998 to 2014. The median estimates of spawner abundance are also shown for comparison.

Appendix 3

Appendix 3 Table 1. The date, location, sex and sampling method (angling or trapnet) for Striped Bass sacrificed for stomach content analysis in 2013.

Date in 2013	Angling	Female	Male	Trapnet	Female	Male
1-May	Nelson	1	-	-	-	
5-May	Whitney	-	1	-	-	
7-May	Anderson Bridge	2	1	-	-	
8-May	Anderson Bridge	1	-	-	-	
10-May	NW Millstream	14	7	DFO Cassilis	5	10
13-May	South Esk	1	4	Comm gasp NW	7	25
14-May	Beaubear's Island	19	6	-	-	
14-May	Beaubear's Tickle	5	1	-	-	
15-May	-	-		Comm gasp NW	16	15
16-May	Beaubear's Island	14	6	-	-	
17-May	Beaubear's Island	20	5	-	-	
21-May	NW Millstream	7	2	-	-	
21-May	Whitney	17	23	Comm gasp NW	20	12
23-May	Cassilis	7	13	Comm gasp NW	21	10
27-May	-	-		Comm gasp NW	10	22
28-May	NW Millstream	15	15	-	-	
29-May		-		Comm gasp NW	9	21
30-May	Cassilis	-	17	-	-	
6-Jun	Whitney	1	4	-	-	
9-Jun	-	-		Comm gasp NW	3	28
10-Jun	Whitney	-	1	-	-	
13-Jun	-	-		DFO Cassilis	1	29
13-Jun	-	-		Comm gasp NW	2	15
19-Jun	-	-		DFO Cassilis	1	29
25-Jun	-	-		DFO Cassilis	-	1
25-Jun	-	-		DFO Millerton	-	8
26-Jun	-	-		DFO Cassilis	2	6
26-Jun	-	-		DFO Millerton	6	16
All dates	All angling	124	106	All trapnets	103	247

Appendix 3 Table 2. The date, location, sex and sampling method (angling or trapnet) for Striped Bass sacrificed for stomach content analysis in 2014.

Date in 2014	Angling	Female	Male	Trapnet	Female	Male
9-May	NW Millstream	6	7	-	-	
14-May	NW Millstream	1	2	-	-	
15-May	Acadia wharf	6	5	-	-	
16-May	Acadia wharf	10	8	-	-	
20-May	Acadia wharf	1	4	-	-	
22-May	Beaubear's Island	11	5	-	-	
23-May	Beaubear's Island	13	8	-	-	
26-May	Hackett's Beach	3	10	-	-	
28-May	Beaubear's Island	13	17	-	-	
29-May	Beaubear's Island	7	4	-	-	
1-Jun	-	-		DFO Cassilis	4	26
2-Jun	Cassilis	14	50	-	-	
3-Jun	Cassilis	6	28	DFO Cassilis	1	26
4-Jun	-	-		DFO Cassilis	4	10
5-Jun	Cassilis	13	18	DFO Cassilis	7	23
9-Jun	-	-		Comm gasp NW	4	28
10-Jun	Cassilis	1	19	-	-	
11-Jun	-	-		Comm gasp NW	4	11
13-Jun	-	-		Comm gasp NW	6	23
18-Jun	-	-		DFO Cassilis	-	31
20-Jun	-	-		DFO Millerton	2	28
23-Jun	-	-		Comm gasp NW	15	48
25-Jun	-	-		Comm gasp NW	11	13
All dates	All angling	105	185	All trapnets	58	267

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