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Information on the Striped Bass (*Morone saxatilis*) population of the southern Gulf of St. Lawrence relevant to the development of a 2nd COSEWIC status report for the species

Information sur la population de bar rayé (*Morone saxatilis*) du sud du golfe du Saint-Laurent servant à l'élaboration du deuxième rapport de situation pour cette espèce par le COSEPAC

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ABSTRACT

Canadian Striped Bass are being evaluated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) for the second time in 6 years. In 2004, COSEWIC identified the Striped Bass population of the southern Gulf of St. Lawrence as a single Designatable Unit and assessed the population as 'Threatened'. No decision to list the population on Schedule 1 of the *Species At Risk Act* has been made at this point. The Striped Bass population of the southern Gulf has generally increased from lows (3 to 5 thousand spawners) in the late 1990s to annual averages of 35 thousand spawners since 2001 and 50 thousand spawners since 2006. The rate of increase over the 18-year data set (1993-2010) has been 546%. Striped Bass 3 to 5 years old with corresponding lengths between 40 and 50 cm continue to make up the majority of the population while fish older than 6 years and longer than 60 cm are rarely sampled. Southern Gulf Striped Bass continue to spawn in the Northwest Miramichi estuary; the only confirmed spawning location for the stock, and thus maintains a small area of occupancy according to COSEWIC's criteria and previous evaluation. The extent of occurrence for Striped Bass in the southern Gulf encompasses the coastal waters of the entire southern Gulf and appears unchanged since the last COSEWIC status report. Mortality of southern Gulf Striped Bass continues to be related to fishing activities, either illegal or incidental catches in various commercial, recreational, and Aboriginal food, social, and ceremonial fisheries.

RÉSUMÉ

Le Comité sur la situation des espèces en péril au Canada (COSEPAC) entreprend une deuxième évaluation en six ans de la situation du bar rayé au Canada. Dans son évaluation de 2004, le COSEPAC a déterminé que la population de bar rayé du sud du golfe du Saint-Laurent était une unité désignable et que celle-ci était menacée. Jusqu'à présent, aucune décision n'a été prise par rapport à son inscription à la liste de l'annexe 1 de la *Loi sur les espèces en péril*. L'abondance de la population de bar rayé du sud du golfe est en augmentation; passant des faibles niveaux (3 à 5 milles géniteurs) à la fin des années 90, à des moyennes annuelles d'environ 35 milles géniteurs après 2001 et 50 milles géniteurs depuis 2006. Le taux d'augmentation des 18 dernières années, la série chronologique de données (1993 à 2010), se chiffre à 546%. Les poissons mesurant entre 40 et 50 cm et âgés entre 3 et 5 ans sont dominants dans la composante des géniteurs pour toutes les années évaluées. Des individus de bar rayé âgés de plus de six ans et de longueur supérieure à 60 cm sont présents mais en faible abondance. Le bar rayé frai annuellement dans l'estuaire de la rivière Miramichi nord-ouest et ce lieu demeure l'unique site de frai pour cette population dans le sud du golfe. Ainsi, la population occupe toujours une petite zone d'occupation selon les critères du COSEPAC. La zone d'occurrence du bar rayé comprend toutes les eaux côtières de l'ensemble du sud du golfe, une zone similaire à celle identifiée dans le dernier rapport de situation du COSEPAC. La mortalité du bar rayé du sud du golfe est causée par divers activités de pêches provenant d'activités illégales ou de mortalités incidentes dans les pêches commerciales, récréatives et des communautés autochtones pour des fins d'alimentation, sociale et cérémoniale.

BACKGROUND

The evaluation of Canadian Striped Bass as a potential species at risk began in 2002. Information possessed by the Department of Fisheries and Oceans (DFO) and the provincial government of Quebec on the Striped Bass populations of Atlantic Canada was provided to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) at a National Advisory Process meeting in Halifax Nova Scotia (Powles 2002; Douglas et al. 2003). The COSEWIC assessment identified three designatable units (DU) of Striped Bass in eastern Canada with the southern Gulf of St. Lawrence DU and the Bay of Fundy DU assessed as 'Threatened' and the St. Lawrence estuary DU as 'Extirpated' (COSEWIC 2004). Recovery potential assessments for the three DUs were conducted in 2005 (DFO 2006; Douglas et al. 2006). An Order Acknowledging Receipt of the Assessments Done Pursuant to Subsection 23(1) of the *Species at Risk Act* (SARA) for the population from the St. Lawrence Estuary assessed as extirpated in Canadian waters was published on October 13, 2010. Listing decisions for the other two populations have not yet been completed.

The COSEWIC opted for an earlier (6 year) than normal (10 year) review of Striped Bass in Canada. This document compiles and presents information possessed by the DFO that is of relevance to COSEWIC for the development of a second status report on Striped Bass in the southern Gulf of St. Lawrence. A companion document that addresses new information on population abundance, trends, and dynamics has also been prepared (Douglas and Chaput 2011).

INTRODUCTION

The Striped Bass (*Morone saxatilis*) is native to the southern Gulf of St. Lawrence and is at the northern limit of the species distribution in eastern North America. Southern Gulf Striped Bass spawn in the spring, undergo coastal movements in the summer, and return to many estuaries in autumn to overwinter. Striped Bass of various life stages are widely distributed throughout the southern Gulf for most of the year but continuous and detectable spawning is only known to occur from a single location in the Northwest (NW) Miramichi River (N47^{o}).

In its first status report, the COSEWIC (2004) identified the Striped Bass of the southern Gulf as a single DU and evaluated its status as 'Threatened'. The separation of the southern Gulf DU from the others was based on the genetic discreteness and the geographic isolation of Striped Bass in the southern Gulf of St. Lawrence. The rationale for COSEWIC's assessment of the status as 'Threatened' was largely based on the DU's single spawning location in the NW Miramichi estuary. It should be noted that the small area of occupancy for southern Gulf Striped Bass met COSEWIC's criteria for 'Endangered' but the risk designation was downgraded to 'Threatened' because of the 'high degree of resilience evident in recent spawner abundance estimates' (COSEWIC 2004).

The bulk of the information on Striped Bass in the southern Gulf stems from an annual assessment program that monitors adults returning to the NW Miramichi to spawn. The monitoring program began in 1993. In brief, mark and recapture experiments, catch per unit of effort analysis, and sampling for biological characteristics are conducted from Striped Bass bycatch in the commercial gaspereau (Alewife and Blueback Herring) fishery of the NW Miramichi River. The history of the program and its results can be found in previous stock assessments (Bradford et al. 1995a; Bradford and Chaput 1996; Bradford and Chaput 1997; Bradford and Chaput 1998; Douglas et al. 2001; Douglas et al. 2003; Douglas et al. 2006,

Douglas and Chaput 2011). The objective of this report is to provide COSEWIC with the most up to date information on southern Gulf Striped Bass that is relevant to the development of a second status report for the species in Canada.

LIFE HISTORY CHARACTERISTICS

AGE, SIZE, AND SEX

The maximum fork length of a Striped Bass intercepted and subsequently measured in the gaspereau fishery of the NW Miramichi was 115.5 cm on June 15, 1993. The oldest (15 years) Striped Bass aged from scales also happened to be the second largest on record at 97.0 cm captured on June 12, 2007 in the NW Miramichi.

Length and age information for Striped Bass sampled between 2006 and 2010 as part of the annual assessment program was summarized by Douglas and Chaput (2011). The small size and constricted age distributions for southern Gulf Striped Bass have been consistent over time and date back to the earliest sampling programs on record (1975-1984) (Hogans and Melvin 1984; Chaput and Robichaud 1995). The dominant ages and lengths of Miramichi Striped Bass continue to range between 3 and 5 years, and 40 to 50 centimeters, respectively. This size and age structure is similar to that of Striped Bass which spawn in the Shubenacadie-Stewiacke system of Nova Scotia but unlike the broader ranges of ages and lengths observed for spawning populations in the center (Chesapeake Bay) and south (North Carolina) of the species range (Douglas et al. 2003). While the lack of small (<30cm) Striped Bass in Miramichi samples can be attributed to their immature nature and negligible contribution to the spawning migration, explanations for the lack of older and larger Striped Bass in samples are wanting, particularly since they were sampled during earlier years of strong recruitment. While a small age and length distribution can be indicative of a fish population experiencing high mortality, it is unlikely that natural factors have been responsible for the regular losses of Miramichi Striped Bass aged 5 and older.

The skewed sex ratio towards a higher proportion of male Striped Bass in the spawning run of the NW Miramichi River was generally consistent with previous years (see previous assessments). This could largely be explained by the male's earlier maturation schedule at 3 years of age compared to that at 4 years of age for females.

MORTALITY

There are no legal retention fisheries that contribute to the mortality of Striped Bass in the southern Gulf of St. Lawrence, nor is there any evidence that natural causes contribute to their mortality once mature. Illegal fisheries for Striped Bass in the southern Gulf of St. Lawrence are believed to significantly contribute to the high estimate of total mortality (A = 0.47) for the population (Douglas and Chaput 2011).

FECUNDITY

Estimates of fecundity specific to southern Gulf Striped Bass are not available. Goodyear's (1985) general relationship for Striped Bass fecundity was borrowed for the development of a life history model specific to southern Gulf Striped Bass (Douglas et al. 2006). With the observed mean lengths at age and the weight to length relationship for Miramichi Striped Bass, the fecundity of an age 4 female bass averaged 83,000 eggs whereas the fecundity of age 10

and older females averaged 600,000 eggs (Douglas et al. 2006). These results were similar to fecundity values presented by Hogans and Melvin (1984) for 8 female Striped Bass sampled in the Kouchibouguac River (range 47.5 to 52.5 cm, 2.0 to 2.5 kg, and 78,000 to 121,000 eggs). The fecundity of female Striped Bass from the Shubenacadie-Stewiacke population in Nova Scotia was also similar and ranged between 41,000 and 2.1 million eggs for females with lengths between 44.9 and 91.0 cm (Paramore 1998).

GENERATION TIME

COSEWIC (2004) calculated the generation time (average age of parents in the population) as 12 years for southern Gulf Striped Bass. Considering the abundance at age for this population, 4 years is a more appropriate approximation of generation time for southern Gulf Striped Bass.

EARLY LIFE HISTORY PATTERNS

Studies of early life history patterns for southern Gulf Striped Bass began with the collections of eggs and larvae from the NW Miramichi estuary in 1992 (Robichaud-LeBlanc et al. 1996). Similar but unsuccessful attempts to collect Striped Bass eggs and larvae have occurred in a number of other southern Gulf estuaries (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)). Tagging studies and recent acoustic tracking work continue to show the high fidelity of southern Gulf Striped Bass to the NW Miramichi estuary; the only confirmed spawning location for the species in the region.

Annual bass spawning occurs in late May and early June in the upper portions of the NW Miramichi estuary when water temperatures increase to over 10^{o}C. Both male and female Striped Bass meet at the water's surface and gametes from both sexes are released simultaneously. Fertilized eggs remain in suspension until hatching occurs in 1 to 2 days depending on the temperature of the water. Larval Striped Bass feed on yolk reserves for approximately 1 week then switch to a diet of zooplankton and larger prey items as they grow. Larvae move to the near-shore habitats of the estuary where they grow rapidly and metamorphose into miniature versions of the adult by early July. Young-of-the-year (YOY) Striped Bass spawned in the Miramichi River can attain average lengths of >15 cm by the end of the first growing season (Bradford and Chaput 1996). Overwintering sites for YOY Striped Bass have not been well documented but are believed to overlap with sites in many Gulf estuaries known to harbor wintering adult bass.

Beach seine surveys have demonstrated that, after hatching in the Miramichi estuary, YOY Striped Bass progress downstream and into saltwater over the course of the summer months (Robichaud-LeBlanc et al. 1998). Robinson et al. (2004) demonstrated the same trend and collected YOY in coastal environments south of the Miramichi system by mid summer. Robinson et al. (2004) further demonstrated, with analysis of nuclear DNA, that yearling Striped Bass were of the same genetic make-up regardless of the capture locations which extended between the Miramichi and Richibucto rivers. Similarly, Douglas et al. (2001) demonstrated the summer coastal range extension of YOY bass that progressed from the Miramichi system to the coasts of Miscou Island in the north and the Little Buctouche River in the south by early August. It is also believed that Miramichi origin YOY extend their distribution further south where they are captured occasionally in summer beach seine surveys in Pugwash, Tatamagouche, and Pictou, NS (M.-H.Thériault, DFO, unpublished data) and the autumn commercial Rainbow Smelt fishery in Pugwash and Wallace, NS.

SPECIALISED NICHE OR HABITAT REQUIREMENTS

It is clear that the Miramichi River and specifically its Northwest branch are important to Striped Bass in the southern Gulf of St. Lawrence. The spawning grounds of the upper NW Miramichi estuary have been well established and all research to date indicates that this is likely the only spawning location for the species in the region. The reason why it may be the only spawning location in the southern Gulf is not well understood but is believed to be related to the estuary's specific hydrology and conditions that permit successful egg and larval development. For example, spawning Striped Bass have unhindered access to the neighbouring Southwest (SW) Miramichi in the spring but their use of that estuary is limited and not believed to be related to spawning (Douglas et al. 2009). It has been postulated that the larger size and higher discharge of the SW Miramichi may be harmful to Striped Bass eggs or flush them downstream and into areas not conducive for development. Given the large use of many estuaries in the southern Gulf by Striped Bass, the failed attempts to collect eggs in some of them, the multiple tag recaptures observed on the spawning grounds from bass tagged at various other locations throughout the region, and the high fidelity of bass implanted with sonic transmitters to the Miramichi, the NW Miramichi estuary possesses features that are unique and important for successful Striped Bass spawning in the southern Gulf of St. Lawrence.

REVIEW OF DESIGNATABLE UNITS

COSEWIC (2004) recognized three designatable units of Striped Bass in Canada. The southern Gulf DU comprised the Striped Bass population of the Miramichi, the Bay of Fundy DU comprised three spawning populations (Saint John, Annapolis, and Shubenacadie), and the St. Lawrence Estuary DU comprised the St. Lawrence Estuary population in Quebec. The southern Gulf DU was distinguished from the Bay of Fundy DU based on mitochondrial and nuclear DNA uniqueness and from the St. Lawrence Estuary DU based on tagging information that demonstrated the isolated nature of both populations (COSEWIC 2004).

There is no new evidence from genetic, tagging, or other studies, that would challenge the discreteness and isolated nature of the southern Gulf DU from the Bay of Fundy DU beyond what was considered by COSEWIC during the species' first evaluation (Douglas et al. 2003; COSEWIC 2004). Conversely, evidence to support a single Striped Bass population in the southern Gulf continues to emerge. For example, tags placed on Striped Bass in the Miramichi continue to be returned from locations exclusive to the southern Gulf; the most recent (summer 2010) from Cap d'Espoir, Percé, Quebec. Similarly, numerous Striped Bass tagged in the Kouchibouguac River during the autumns of 2007-2009 were observed in spawning condition the following spring in the bycatch of the gaspereau fishery of the NW Miramichi River.

Striped Bass are believed to have been extirpated from the St. Lawrence Estuary in the late 1960s and efforts to restore that population with Striped Bass of Miramichi origin began in 1998-99. Approximately 10-20 thousand young-of-the-year Striped Bass from the Miramichi River have been transported to Quebec for direct stocking to the St. Lawrence Estuary or the development of broodstock at a hatchery in Baldwin Mills. Since the program began, the Baldwin Mills hatchery has successfully reared hundreds of thousands of Striped Bass, most of which have been stocked into the St. Lawrence estuary at various sizes and life stages. Recent Quebec field collections of young Striped Bass from a cohort that was never stocked has provided some evidence that natural spawning has occurred from the introduced fish (G. Verreault, Quebec MRNF, unpublished data).

The question of which DU that a newly reestablished St. Lawrence estuary population should belong to is one that will require careful consideration as the ramifications in the COSEWIC evaluation, the SARA listing process, and ultimately the management of the species could be important. By all accounts, the St. Lawrence estuary population of Striped Bass and DU have been extirpated (Beaulieu 1985, COSEWIC 2004). It is not clear, but apparently possible, that the successful reestablishment of Striped Bass in Quebec from efforts of a stocking program with progeny from a neighbouring DU could reinstitute the St. Lawrence estuary DU (DFO 2011a). Alternatively, the argument can be made that successful spawning in Quebec would represent a 'Range expansion' (DFO 2011a) and second spawning location for the southern Gulf DU of Striped Bass. Regardless of DU assignment, a reestablished Striped Bass population in Quebec would have a net benefit for the species and increase the rescue potential of either group if ever needed.

REVIEW OF COSEWIC CRITERIA

POPULATION ABUNDANCE

COSEWIC (2004) calculated a 93% rate of decline for southern Gulf Striped Bass between 1995 and 1998 and an increase of 853% between 1998 and 2002. In this assessment, the trend in population size was calculated as the instantaneous annual rate of change (Z) over the 18 year data set (1993-2010). The rate of change was expressed as (exp^{Z*18}-1) and calculated to be an increase in spawner abundance of 546% over the 18 year time period (Figure 1). Adult Striped Bass returning to the NW Miramichi to spawn have averaged 35,000 fish annually in the last decade (2001-2010) and 50,000 fish in the last 5 years (2006-2010) (Douglas and Chaput 2011).

The RPA for southern Gulf Striped Bass proposed a recovery limit and compliance rule requirement of 21,600 spawners in 5 of 6 consecutive years. Douglas et al. (2006) further proposed that once the recovery limit was met, achieving an increased level of 31,200 spawners in 3 of 6 consecutive years would satisfy a recovery target, a level that access to the resource might be considered. Douglas et al. (2006) recommended that the population estimate's lower 95% confidence interval be used to gauge against recovery levels. If the lower confidence limit of spawners returning to the NW Miramichi River in 2011 number in excess of 31,200, the recovery limit and target will have both been met (Douglas and Chaput 2011).

DISTRIBUTION

Extent of occurrence

Douglas et al. (2003) summarized tagging studies and commercial landings that identified the coastal areas from Percé Quebec in the north, to Margaree Cape Breton in the south, to Prince Edward Island in the east, as the extent of occurrence for southern Gulf Striped Bass. The numerous reports of Striped Bass throughout the southern Gulf suggest that the extent of occurrence for the species remains unchanged and continues to be stable. COSEWIC's (2004) area estimate of 93,000 km^2 as the extent of occurrence for southern Gulf Striped Bass encompassed all of the area between the mainland coast and an arbitrary line drawn between Cap Gaspé, PQ and the northern tip of Cape Breton island, NS. Given the coastal nature of Striped Bass, their negligible use of freshwater, and the lack of any reported catches from the Magdalen Islands or any deep sea fisheries or surveys, the extent of occurrence for this Striped

Bass DU may be more appropriately delineated between the upper limit of salt intrusion in estuaries (head of tide) to some point offshore (maybe 10km), along the entire coast between Gaspé and Cape Breton, including Prince Edward Island.

Area of occupancy

COSEWIC (2004) considered the NW Miramichi estuary to be the only location where Striped Bass spawned in the southern Gulf, and as such, the population met the 'Endangered' criterion for small distribution. Without evidence of Striped Bass spawning elsewhere, the southern Gulf DU will always meet COSEWIC's small distribution criterion. The predictable annual use of the spawning grounds in the NW Miramichi suggests that the area of occupancy for the southern Gulf Striped Bass is stable.

HABITAT AND ASSOCIATED THREATS

Striped Bass of the southern Gulf are widespread and occupy a multitude of habitats over the course of a year. There has been no effort to characterize the specifics of each of these habitat types in the southern Gulf.

Generally, adult and juvenile Striped Bass occupy the estuarine and coastal environments during the summer months while undertaking feeding migrations throughout the region. Acoustic tracking studies suggest that implanted Striped Bass remain within one kilometer of shore and illegal fisheries from beaches and wharves demonstrate that they are closer than that. Similarly, yearling Striped Bass are close to shore during the summer and are easily captured by beach seine in estuaries and coastal waters. Young-of-the-year Striped Bass may avoid the beach seine or move into deeper waters by mid August. The presence of yearling Striped Bass in the bycatch of the open-water smelt fishery of the Miramichi River indicates a habitat shift to deeper sections of the estuary at some point before autumn.

Southern Gulf Striped Bass enter estuaries in the autumn to overwinter; most likely to avoid low and potentially lethal marine water temperatures (Bradford et al. 1995b). The locations of historical hoop-net fisheries and landings correspond with known Striped Bass wintering sites within many estuaries of the region and there is the potential that most estuaries in the southern Gulf contain wintering sites for Striped Bass (Chaput and Randall 1990). Bradford et al. (1997a) demonstrated that wintering Striped Bass in the Kouchibouguac and St. Louis rivers remained close together and occupied a relatively short (3-5 km) section of the estuary where average water temperatures were greater than -0.4^{o}C and salinities ranged between 0 and 15 ppt. Similar patterns for wintering Striped Bass have been observed in the Miramichi system where implanted fish remained together during the period of ice cover and moved progressively up the NW Miramichi estuary until ice-out in the spring or a winter freshet displaced them downstream prematurely (DFO unpublished; Bradford personal communication). Overwintering grounds for Striped Bass in the Miramichi system appear to be exclusive to the Northwest branch (DFO unpublished).

The area surrounding Beaubears Island (N46.973679 W65.572039) where the Northwest and Southwest branches of the Miramichi River meet has been identified as a staging area for pre-spawned Striped Bass in the spring (Douglas et al. 2009). Whether this choice of a staging area is related to habitat type or behaviour of the animal is not clear. Douglas et al. (2009) hypothesized that the close proximity of the upstream spawning location may play a role in the choice of this staging area.

Southern Gulf Striped Bass use the NW Miramichi estuary for spawning purposes. Robichaud-LeBlanc et al. (1996) collected Striped Bass eggs in the NW Miramichi River between the Highway 8 Anderson bridge (N46.965207 W65.598997) and a point 12 kilometers upstream near Whitneyville (N46.954293 W65.752872), with highest concentrations collected just upstream of the community of Eel Ground (N46.962183 W65.656038). Eggs were spawned over a two week period (May 24 to June 10) when daily average surface water temperatures ranged between 14 and 18 degrees Celsius. Striped Bass eggs were collected upstream of the salt wedge, almost exclusively in freshwater, and no eggs were found in locations where bottom salinities were ≥3 PSU. From visual observations, the spawning acts are generally further upstream than the egg distribution reported by Robichaud-LeBlanc et al. (1996). Surface spawning is often viewed in the area of Whitneyville (N46.954293 W65.752872) but extended to above Cassilis (N46.932363 W65.793789) in 2010. Striped Bass spawning this high in the estuary was likely related to a further upstream than normal position of the salt wedge in the estuary; the result of exceptionally low freshwater discharge and warm water temperatures in the spring of 2010 (Figures 2 and 3).

Specific threats having a negative impact on Striped Bass habitat in the southern Gulf have not been identified. Dredging activities, municipal waste water, effluent from power generating stations, pulp and paper mills, and fish processing plants have all been identified as having potential negative influences on Striped Bass habitat in the southern Gulf of St. Lawrence (Douglas et al. 2006). The UPM Kymmenne pulp and paper mills (n=2) on the banks of the NW Miramichi ceased operations in 2007 and effluent from this source no longer occurs.

RESIDENCE

While SARA [s.2(1)] defines a residence as “a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individual during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating”, formal criteria to evaluate whether a species has a residence have not been established. Environment Canada (2004) has produced ‘DRAFT Technical Guidelines for Describing Residence’ that elaborates on the three components (a dwelling place, occupied or habitually occupied, and important life-cycle functionality) of the SARA’s definition for residence. Until these guidelines become finalized, any comment on residence as it relates to Striped Bass in the southern Gulf of St. Lawrence is difficult.

In the above section, the importance and locations within the NW Miramichi estuary that are essential to Striped Bass for staging, spawning and overwintering were highlighted. These locations are ‘discrete spatial areas that perform functions similar to a den or nest’, they are ‘habitually occupied’, and are ‘essential to the successful performance of a specific, crucial function of the Striped Bass life-cycle’ in the southern Gulf of St. Lawrence. None of these locations possess an obvious physical structure similar to a den or a nest.

THREATS

Threats to Striped Bass in the southern Gulf were not explored in Douglas et al. (2003) but COSEWIC (2004) identified “bycatch in various fisheries such as gaspereau and Rainbow Smelt and illegal takes particularly during ice fishing” as limiting factors for the population. Potential threats and their associated mortality to southern Gulf Striped Bass were explored and

qualitatively ranked as low, medium, or high during the recovery potential assessment for the species (DFO 2006; Douglas et al. 2006). Levels of Striped Bass bycatch in many of the region's estuarial fisheries have been ranked qualitatively by DFO conservation and protection officers on two occasions (Chiasson et al. 2002; DFO 2011b). The threats discussed below have been limited to activities known to have a direct negative impact on Striped Bass in the southern Gulf of St. Lawrence. No further information has emerged on the 'Other potential sources of Striped Bass mortality/harm' that were reported in the RPA and will not be covered here (specifically Fisheries impacts on habitat, Direct mortality under permit, Habitat alterations under permit, Ecotourism and recreation, Shipping, transport and noise, Fisheries on food supplies, Aquaculture, Military activities, and Non-domestic) (Douglas et al. 2006).

ILLEGAL STRIPED BASS FISHERIES

Illegal angling activity was suggested as one of the most severe limiting factors for Striped Bass in the southern Gulf (Douglas et al. 2006) and anecdotal reports to support this claim appear to be directly correlated with their increased abundance in recent years. While Striped Bass mortality by illegal means is considered to be significant and most likely the largest limiting factor for southern Gulf Striped Bass, it is difficult to estimate. For example, charges laid by DFO conservation and protection officers for infractions dealing with Striped Bass have been relatively constant over the last decade (Table 1).

High angling effort continues to occur in May and June in the Miramichi River system; particularly at Strawberry Marsh, the known staging area for Striped Bass at the confluence of the Southwest and NW Miramichi rivers and in the upper NW Miramichi estuary directly on the spawning grounds (S. Douglas personal observation). Anglers continue to target post spawned Striped Bass during their summer and fall movements along the Gulf coasts, and in numerous estuaries and river mouths of the region. For example, 1 of 20 acoustic tags implanted in Striped Bass during their May 2008 spawning run to the NW Miramichi River was returned by an individual that angled and harvested the fish from the beaches of Miscou Island during August of the same year. In the nearby community of Pigeon Hill, one individual boasted to DFO conservation and protection officers of harvesting his 280th Striped Bass of the 2008 summer season (DFO C&P personal communication). Other areas of notable angling pressure continue to be the estuaries and coastal areas of Tracadie, Tabusintac, Kouchibouguac, and Richibucto in New Brunswick, and similarly in Nova Scotia's Pictou and Inverness counties.

Gillnetting is also a common form of illegal harvesting of Striped Bass throughout the southern Gulf. Striped Bass migrating during the spring and summer are extremely susceptible to sunken gillnets that are deployed easily from coastal shores with little more than chest waders. Gillnets deployed under the ice on Striped Bass overwintering grounds in the Richibucto River have also been a problem in recent years (DFO C&P personal communication).

STRIPED BASS BYCATCH IN COMMERCIAL FISHERIES

Due to the wide ranging and coastal nature of Striped Bass in the southern Gulf, interactions with a variety of commercial fishing gear is inevitable. It is well known but poorly documented that Striped Bass are intercepted in the gaspereau, Rainbow Smelt, American Eel, American Shad, and Atlantic Silverside fisheries of the southern Gulf of St. Lawrence. Quantitative Striped Bass bycatch surveys in the southern Gulf have been limited to the American Eel, gaspereau, and Rainbow Smelt fisheries of the Miramichi watershed (Hanson and Courtenay 1995; Bradford et al. 1995b; Bradford et al. 1997b; Douglas et al. 2006).

Gaspereau

Commercial fisheries for Gaspereau exist throughout the region and are executed with various gears such as trapnets, gillnets, dipnets, inland weirs, and coastal mackerel trapnets. Landings data prior to the commercial fishery closure in 1996 indicated that the Striped Bass bycatch in this fishery can be substantial (LeBlanc and Chaput 1991). The only quantitative information for Striped Bass bycatch in any commercial gaspereau fishery comes from the NW Miramichi River where it has been used as an index of Striped Bass abundance for nearly two decades (Bradford et al. 1995a; Douglas and Chaput 2011). The Striped Bass bycatch in the NW Miramichi River can be significant and is largely related to the adult spawning migration to that river in the spring. Handling and releasing practices by the fishermen of the NW Miramichi are good which results in the high survival of discarded Striped Bass.

The magnitude of the Striped Bass bycatch in other gaspereau fisheries using trapnets or other gears throughout the southern Gulf is poorly documented but known to occur (Chiasson et al. 2002; DFO 2011b). Whether bycatch handling practices used by other gaspereau fishers are as good as those in the NW Miramichi remains unconfirmed.

Rainbow Smelt

Commercial fisheries for Rainbow Smelt exist throughout the region and are executed with various gears such as box nets, bag nets, trapnets, gillnets, dipnets, angling, and spearing. Concerns about Striped Bass interception in smelt fisheries and specifically 'the destruction of young fry [striped bass] in smelt bag-nets, which, with a strange disregard of consequences, were permitted to be set in their winter habitat' date back to the 1800's (Cox 1893). Striped Bass bycatch in smelt fisheries is predominantly related to the interception of young-of-the-year, however there are also reports of captured adults and sub-adults (Bradford et al. 1995b). Bradford et al. (1997b) assessed the level of Striped Bass bycatch in the commercial smelt fishery of the Miramichi system during the open-water season (October 15 until ice up) of 1994 and 1995. They estimated that over the course of the 2-year study, 100-400 thousand YOY, and depending on the year, >1,000 each of age 1 and age ≥2 fish were captured in Miramichi box nets. Even though the catch in this fishery is loaded alive, the mortality of Striped Bass can be high and is partly attributable to inadequate handling techniques practiced by the fishers.

The abundance of Striped Bass captured in the winter component of the smelt fishery is unconfirmed but expected to be less than the open-water component. Similar to adult Striped Bass, YOY likely avoid the relatively cold and saline waters of the lower estuary and seek the fresh/brackish waters further upstream and away from the smelt fishery. YOY Striped Bass that are captured in the winter fishery, generally die once removed from the water and placed on the ice.

The magnitude of the Striped Bass bycatch in other smelt fisheries using box nets or other gears throughout the southern Gulf is not well documented but known to occur and can be substantial at times (Chiasson et al. 2002; DFO 2011b). The nature of this fishery makes efficient handling and releasing practices difficult.

American Eel

Commercial fisheries for American Eel exist throughout the region and are executed with various gears such as trapnets, fyke nets, hooks, weirs, box nets, spears, and pots. Very little is known about the bycatch in eel fisheries but all sizes of Striped Bass have the potential of being

intercepted (Bradford et al. 1995b). Chiasson et al. (2002) ranked the level of Striped Bass bycatch in the American Eel fishery from low to high at different locations throughout the region.

American Shad

Ten gillnets targeting American Shad are permitted during a 4-week period between mid May and mid June in the coastal waters between Kouchibouguac and Pointe Sapin, New Brunswick. This fishery occurs at a time and a location where Striped Bass migrating to the NW Miramichi River to spawn would be expected. By the shad fishers own accounts, the Striped Bass bycatch in this fishery can be significant (hundreds of fish).

Atlantic Herring

Evidence, albeit minimal, exists that Striped Bass have been intercepted in the Atlantic Herring fishery that is prosecuted with gillnets near the coasts of Escuminac NB in the spring (Bradford and Chaput 1998). It is likely but unconfirmed that gillnets fished close to shore for herring in the spring intercept Striped Bass migrating to the NW Miramichi River to spawn.

Atlantic Silverside

All but 2 of the 83 commercial licenses for Atlantic Silverside are located on Prince Edward Island and the Striped Bass bycatch in this fishery is unknown. There is mounting pressure for additional silverside licenses in Gulf Nova Scotia (DFO 2010). Similar to the Rainbow Smelt fishery in Gulf NS, the small mesh size of silverside traps and leaders is expected to intercept all sizes of Striped Bass.

STRIPED BASS BYCATCH IN ABORIGINAL FOOD, SOCIAL, AND CEREMONIAL (FSC) FISHERIES

Similar to the commercial fisheries described above, Aboriginal FSC fisheries occur on gaspereau, Rainbow Smelt, American Eel, Atlantic Silverside, American Shad, and Atlantic Herring. In most cases, the season and gear used to exploit these species commercially is identical to that used for FSC purposes. All else being equal, the Striped Bass mortality in these FSC fisheries is expected to be similar to the level experienced in the commercial fisheries for the same species.

Several FSC fisheries for Atlantic Salmon exist throughout the region and are executed with a variety of gear including gillnets and trapnets. While it is well known that both gillnets and trapnets intercept Striped Bass, reliable harvest statistics have never been provided by any First Nation. FSC fisheries that target the fall run of Atlantic salmon also intercept Striped Bass returning to overwinter in the Tabusintac, Richibucto, and East (Pictou Co.) rivers. Similarly, FSC salmon fisheries overlap with the spawning run of Striped Bass to the NW Miramichi each spring. Striped Bass catches from three individual gillnets deployed in the NW Miramichi for a soak time of 24 hours or less yielded 80, 72, and 22 adult bass in June 2003, May 28, 2008, and June 5, 2009, respectively.

STRIPED BASS BYCATCH IN RECREATIONAL FISHERIES

The bycatch of Striped Bass in legal recreational angling fisheries prosecuted with the targeted species in mind is considered to be minimal. However, the Striped Bass bycatch is considered to be significant when they are targeted illegally, usually under the guise of angling for Brook

Trout in estuaries, Mackerel around wharves, or any other species with an open season along the coasts. Unless a species with a specific season and bag limit is retained, fishing permits are not required to angle in the tidal waters of DFO's Gulf Region. Mortality rates of Striped Bass hooked and then released range between 8% and 16% (Diodati and Richards 1996; Millard et al. 2005) and depend on a multitude of different factors (Wilde et al. 2000).

The magnitude of the Striped Bass bycatch in recreational fisheries for Rainbow Smelt using gillnets (100 permitted in PEI, and 55 permitted in Gulf NS) and for American Eel using pots (6 permitted in Gulf NS) is unknown but probably similar to levels experienced in the commercial fishery for these species using the same gear in the same area.

SCIENTIFIC SAMPLING OF STRIPED BASS

Scientific sampling is not considered to be a threat to Striped Bass but does cause harm to the individual. Generally, scientific activities dealing with adult Striped Bass use trapnets for their capture which permits their live release. Any capture or handling technique, the application of dorsal or acoustic tags, and the removal of scales for ageing purposes disrupts the fishes' mucous membrane and increases the chance of infection. The 100% survival rate of over 80 Striped Bass implanted with sonic transmitters between 2003 and 2009 suggests that the mortality from all science activities described above is negligible.

DFO's Community Aquatic Monitoring Program (CAMP), and until 2010, a weekly beach seine survey of the Miramichi, captured hundreds to thousands of YOY Striped Bass annually. Every effort for the wellbeing of all captured species was made but some mortality was inevitable due the fragility of the small fish.

A program to reintroduce Striped Bass into the St. Lawrence Estuary saw the removal of approximately 12,000 YOY from the Miramichi system; 2,000 in each of 1999, 2002, 2003, 2005, 2006, 2007. The majority of the YOY Striped Bass were stocked directly into the St. Lawrence estuary, while others were reared in a hatchery for the development of broodstock. There are no current plans for additional Striped Bass collections from the Miramichi or southern Gulf of St. Lawrence.

REFERENCES

AVC Inc. 2003. Do striped bass spawn in the Hillsborough River? Phase II of a feasibility study for a bass enhancement project. Report prepared for Hillsborough River and Area Development Corporation 42 p.

Beaulieu, H. 1985. Rapport sur la situation du bar rayé (*Morone saxatilis*). Association des Biologistes du Quebec et Ministère du Loisir, de la Chasse et de la Pêche. 53 p.

Bradford, R.G., Chaput, G., and Tremblay, E. 1995a. Status of striped bass (*Morone saxatilis*) in the Gulf of St. Lawrence. DFO Atl. Fish. Res. Doc. 95/119: 43 p.

Bradford, R.G., Robichaud, K.A., and Courtnay, S.C. 1995b. By-catch in commercial fisheries as an indicator and regulator of striped bass (*Morone saxatilis*) abundance in the Miramichi River estuary. P. 249-259. *In* E.M.P. Chadwick (ed.). Water, science, and the public: the Miramichi ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Bradford, R.G. and Chaput, G. 1996. The status of striped bass (*Morone saxatilis*) in the southern Gulf of St. Lawrence. DFO Atl. Fish. Res. Doc. 96/62: 36 p.

Bradford, R.G. and Chaput, G. 1997. Status of striped bass (*Morone saxatilis*) in the Gulf of St. Lawrence in 1996 and revised estimates of spawner abundance for 1994 and 1995. DFO Can. Sci. Advis. Sec. Res. Doc. 97/16: 31 p.

Bradford, R.G. and Chaput, G. 1998. Status of striped bass (*Morone saxatilis*) in the Gulf of St. Lawrence in 1997. DFO Can. Sci. Advis. Sec. Res. Doc. 98/35: 25 p.

Bradford, R.G., Tremblay, E., and Chaput, G. 1997a. Winter distribution of striped bass (*Morone saxatilis*) and associated environmental conditions in Kouchibouguac National Park during 1996-1997. Parks Canada – Eco. Monit. Data Rep. 003: iv + 59 p.

Bradford, R.G., Chaput, G., Hurlbut, T., and Morin, R. 1997b. Bycatch of striped bass, white hake, winter flounder, and Atlantic tomcod in the autumn “open water” smelt fishery of the Miramichi River estuary. Can. Tech. Rep. Fish. Aquat. Sci. 2195: vi + 37 p.

Chaput, G.J. and Randall, R.G. 1990. Striped bass (*Morone saxatilis*) from the Gulf of St. Lawrence. DFO CAFSAC Res. Doc. 90/71: 28 p.

Chaput, G.J. and Robichaud, K.A. 1995. Size and growth of striped bass, (*Morone saxatilis*), from the Miramichi River, Gulf of St. Lawrence, Canada. P. 161-176. *In* E.M.P. Chadwick (ed.). Water, science, and the public: the Miramichi ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Chaput, G., and Douglas, S. 2011. Hierarchical Bayesian Model to Estimate the Spawning Stock of Striped Bass (*Morone saxatilis*) in the Northwest Miramichi River, 1994 to 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/081: iv + 51 p.

Chiasson, G., Gallant, P.A., and Mallet, P. 2002. Traditional and local knowledge: estuarine fisheries by-catch in the southern Gulf of St. Lawrence; ecosystem based fisheries management considerations. Can. Man. Rep. Fish. Aqua. Sci. No. 2613: vi + 45 p.

COSEWIC. 2004. COSEWIC assessment and status report on the striped bass *Morone saxatilis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 43 p.

Cox, P. 1893. Observations on the distribution and habits of some New Brunswick fishes. Bull. Nat. Hist. Soc. Of New Brunswick 11: 33-42.

DFO. 2006. Recovery assessment report for the St. Lawrence estuary, southern gulf of St. Lawrence and Bay of Fundy striped bass (*Morone saxatilis*) populations. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/053: 21 p.

DFO. 2010. Opportunity for Atlantic silverside and Atlantic saury fisheries in the Nova Scotia portion of the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/081. 14 p.

DFO. 2011a. A complement to the 2005 framework for developing science advice on recovery targets in the context of the *Species At Risk Act*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/061: 9 p.

DFO 2011b. Allowable harm assessment of striped bass (*Morone saxatilis*) in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/014:17 p.

Diodati, P.J. and Richards, R.A. 1996. Mortality of striped bass hooked and released in salt water. Trans. Amer. Fish. Soc. 125: 300-307.

Douglas, S.G., Chaput, G.C., and Bradford, R.G. 2001. Status of striped bass (*Morone saxatilis*) in the southern Gulf of St. Lawrence in 1999 and 2000. DFO Can. Sci. Advis. Sec. Res. Doc. 2001/058: 34 p.

Douglas, S.G., Bradford, R.G., and Chaput, G. 2003. Assessment of striped bass (*Morone saxatilis*) in the Maritime Provinces in the context of species at risk. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/008: iii + 49 p.

Douglas, S.G., Chaput, G., and Caissie, D. 2006. Assessment of status and recovery potential for striped bass (*Morone saxatilis*) in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/041: viii + 95 p.

Douglas, S.G., Chaput, G., Hayward, J., and Sheasgreen, J. 2009. Prespawning, spawning, and postspawning behavior of striped bass in the Miramichi River. Trans. Am. Fish. Soc. 138: 121-134.

Douglas, S.G., and G. Chaput. 2011. Assessment and status of Striped Bass (*Morone saxatilis*) in the Southern Gulf of St. Lawrence, 2006 to 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/097: iv + 22 p.

Environment Canada. 2004. Species at risk act policy DRAFT Technical guidelines for describing residence – As drafted by Environment Canada – August 12, 2004:12 p.

Goodyear, C.P. 1985. Toxic materials, fishing, and environmental variation: simulated effects on striped bass population trends. Trans. Am. Fish. Soc. 114: 107-113.

Hanson, J. M., and Courtenay, S.C. 1995. Seasonal abundance and distribution of fishes in the Miramichi estuary. P. 141-160. *In* E.M.P. Chadwick (ed.). Water, science, and the public: the Miramichi ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Hogans, W. and Melvin, G. 1984. Kouchibouguac National Park striped bass (*Morone saxatilis* Walbaum) fishery survey. Aquatic Industries Limited. St. Andrews, N.B. 91 p.

LeBlanc, C.H. and Chaput, G.J. 1991. Landings of estuarine fishes in the Gulf of St. Lawrence 1917 – 1988. Can. Data Rep. Fish. Aquat. Sci. 842: viii + 101 p.

Millard, M.J., Mohler, J.W., Kahnle, A., and Cosman, A. 2005. Mortality associated with catch and release angling of striped bass in the Hudson River. North Amer. J. Fish. Manag. 25: 1533-1541.

Paramore, L.M. 1998. Age, growth, and life history characteristics of striped bass, *Morone saxatilis*, from the Shubenacadie-Stewiacke River, Nova Scotia. M.Sc. thesis, East Carolina University, Greeneville, NC. 91 p.

Powles, H. 2002. Proceedings of the national science review meeting on species at risk issues, December 9-13, 2002, Halifax, Nova Scotia. DFO Can. Sci. Advis. Sec. Proc. Ser. 2002/035: 62 p.

Robichaud-LeBlanc, K.A., Courtenay, S.C., and Locke, A. 1996. Spawning and early life history of a northern population of striped bass (*Morone saxatilis*) in the Miramichi River estuary, Gulf of St. Lawrence. Can. J. Zool. 74: 1645-1655.

Robichaud-LeBlanc, K.A., Courtenay, S.C., and Benfey, T.J. 1998. Distribution and growth of young-of-the-year striped bass in the Miramichi River estuary, Gulf of St. Lawrence. Trans. Am. Fish. Soc. 127: 56-69.

Robinson, M., Courtenay, S., Benfey, T., Maceda, L., and Wirgin, I. 2004. Origin and movements of young-of-the-year striped bass in the southern Gulf of St. Lawrence, New Brunswick. Trans. Amer. Fish. Soc. 133: 412-426.

Wilde, G.R., Muoneke, M., Bettoli, P., Nelson, K., and Hysmith, B. 2000. Bait and temperature effects on striped bass hooking mortality in freshwater. North Amer. J. of Fish. Manag. 20: 810-815.

ZIP Zone d'intervention prioritaire Baie des Chaleurs. 2010. Projet d'acquisition de connaissances sur l'habitat du bar rayé (*Morone saxatilis*) dans le secteur de la baie des Chaleurs dans le but de supporter la conservation et la protection de l'espèce. Rapport d'activités No. permis SG-NBT-10-069: 13 p.

Table 1. Infractions for Striped Bass in the DFO's Gulf Region 1995 to 2010.

	Year														
Action	**1995**	**1996**	**1997**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Charges laid	9	5	1		1	5	4	7	10	2	6	2	5	17	10
Charges not approved			1			4		11	9	2		1		1	2
Charges pending / under review												1		5	2
Native protocol															3
Seizure(s) - persons unknown					2	6	13	9		3	1	3	3	1	3
Ticket issued														1	
Warning issued			4		3	1	1		2	1		2	3	12	
Total	9	5	6		6	16	18	27	21	8	7	9	11	37	20

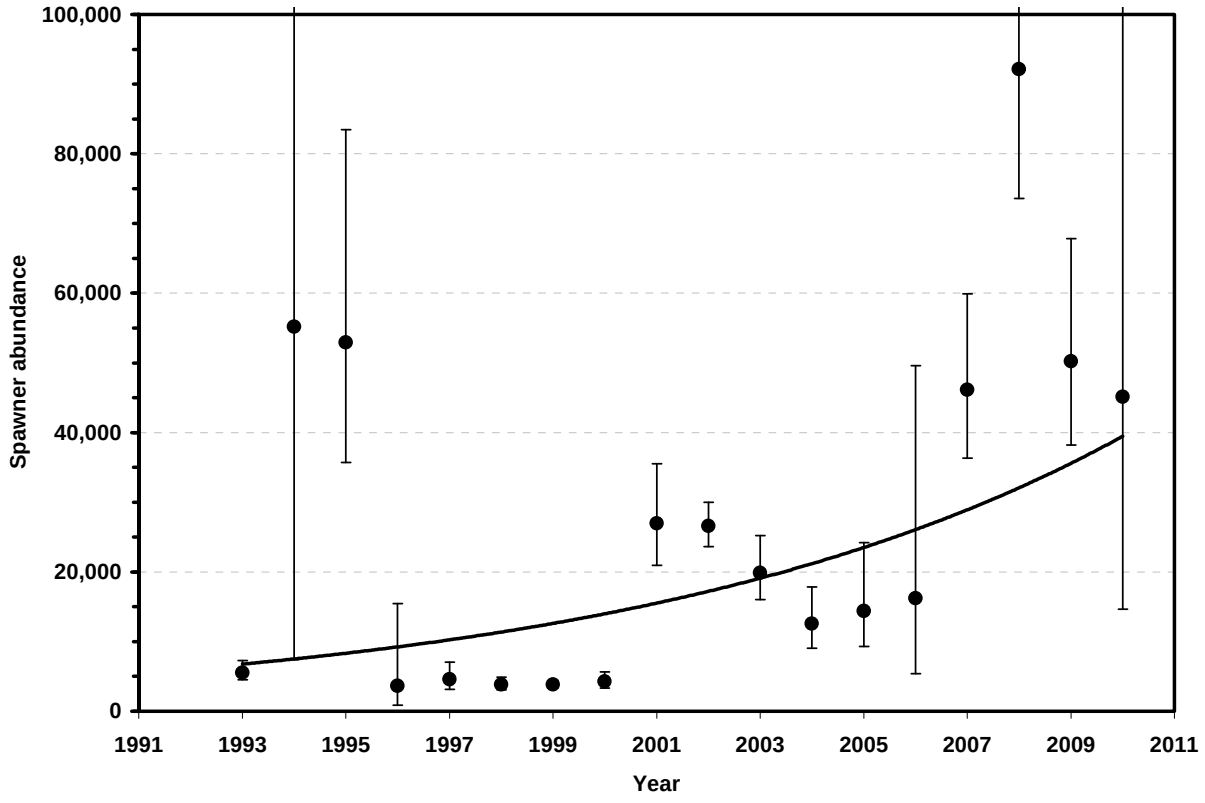

Figure 1. Annual variation and trend of Striped Bass spawner abundance in the NW Miramichi River, 1993 to 2010. Values for 1994 to 2010 are derived from the Bayesian hierarchal model in Chaput and Douglas (2011).

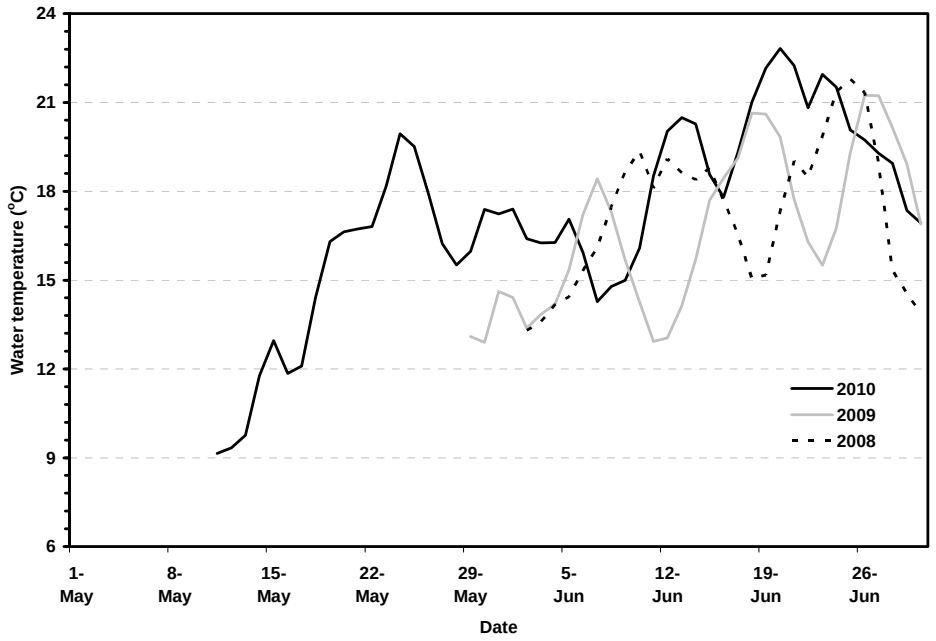

Figure 2. Daily mean water temperatures in the upper portion of the NW Miramichi estuary in 2008-2010.

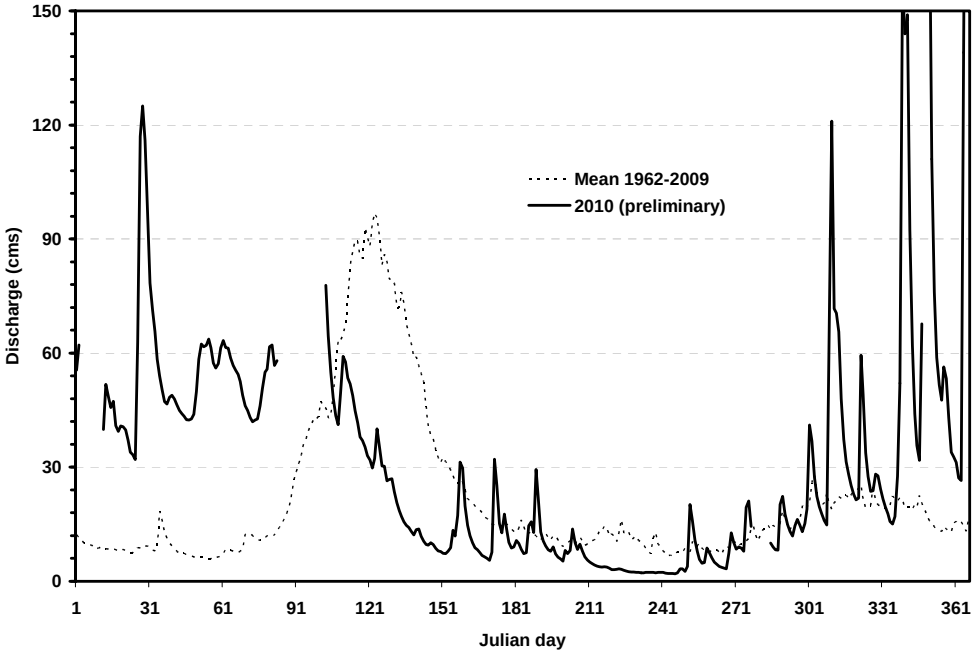

Figure 3. Daily discharge of freshwater on the NW Miramichi in spring 2010 relative to the previous 48 year (1962-2009) average. Julian day 121 corresponds to May 1 and Julian day 151 to May 31.