



Striped Bass Monitoring in the Annapolis River, Bear River and Allains Creek, Nova Scotia

Final Report



Produced for the Clean Annapolis River Project

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Clean Annapolis River Project

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Executive Summary

The Striped Bass Monitoring Project was initiated by Dr. Trevor Avery of Acadia University in collaboration with the Clean Annapolis River Project (CARP). Striped bass (*Marone saxatilis*) populations are thought to occupy three regions in Canada; the Bay of Fundy, the Southern Gulf of St. Lawrence and the St. Lawrence River. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Southern Gulf of St. Lawrence population as a species of special concern and The Bay of Fundy and St. Lawrence River populations as endangered. Juvenile and adult surveys were completed by CARP in 2010 and 2011 in the Annapolis River. This year surveys were completed in the Annapolis River as well as the Bear River and Allains Creek.

A series of duplicate beach seine surveys were completed above and below the causeway on the Annapolis River at Annapolis Royal. Eight sites were surveyed above the causeway and four were surveyed below, resulting in 5,637 fish caught across 13 families. Four duplicate beach seine surveys were completed on the Bear River resulting in 233 fish caught across 3 families. Finally, one duplicate beach seine survey was completed on Allains Creek resulting in 194 fish caught across 3 families. No juvenile striped bass were caught during any of these surveys.

Fyke net surveys were completed on Allains Creek and on the Annapolis River looking for adult striped bass. Fyke nets were set at low tide at both sites and left for two full tide cycles checking the catch each morning at low tide. At both sites a total of 8 species across 3 families were caught. No adult striped bass were caught during these surveys.

Outreach activities were an important component of this project to try and learn more about striped bass in these three systems from local anglers and through the creation of partnerships. Outreach activities included:

- Participating as a striped bass stewardship centre (CARP office)
- Developing a partnership with Bear River First Nations
- Participating in the 7th Annual Bear River Striped Bass Tournament
- Participating in the CARP Fly Tying Workshop
- Creating awareness through the use of social media

Although no juvenile or adult striped bass were located as a result of these surveys continued efforts will remain important. Trying different survey techniques might help to locate striped bass on these systems. Outreach initiatives in communities surrounding these systems will remain important to tap into local angler knowledge. Recommendations for the upcoming monitoring season include:

- Seine surveys on Annapolis River sites 1, 3, 4 and 5 at lower tide levels as they have steep slopes and/or no beach at high tide.
- Seine surveys on Annapolis River sites 9-12, Bear River sites BR1-BR4 and Allains Creek site AC1 at least 2 hours before high tide so as to catch fish as they are coming in with the tide. Surveys that occurred at high tide and as the tide was going out resulted in little to no catches.
- Eggs tows should be completed on the Annapolis River, Bear River and Allains Creek in the spring (2014).
- Different survey methods should be considered on the Bear River and the Annapolis River to increase catch success. Plankton net surveys for juveniles and use of a weir might be methods worth investigating.

Outreach activities should be continued in the communities surrounding these three systems to learn more about striped bass in these areas. Recording of catches in log books and scale sample collection should be promoted further to anglers.

1.0 Introduction

Striped bass, *Morone saxatilis*, are a member of the Moronidae family more commonly known as the temperate bass family. The striped bass has a dark olive green back while the sides fade to a silvery colour and the belly is white (COSEWIC 2012, Scott and Scott 1988). An adult striped bass is easily identifiable by the 7 or 8 dark stripes that run along its sides (COSEWIC 2012, Scott and Scott 1988). Striped bass have been reported to weigh over 45.4 kg with the largest fish caught weighing in at 56.7 kg in North Carolina in 1891; however, today these weights would be extremely rare (Scott and Scott 1988).

Striped bass are anadromous and can be found distributed along the Atlantic Coast of North America from the St. Lawrence River to the St. John's River in northeast Florida (COSEWIC 2012). In the late 1800's, striped bass were introduced to the Pacific coast and have been known to enter Canadian Pacific waters (COSEWIC 2012). In Canada, historically it is reported that striped bass spawned in 5 river systems: the Saint John and Miramichi rivers in New Brunswick, the Annapolis and Shubenacadie rivers in Nova Scotia and the St. Lawrence River in Quebec (COSEWIC 2012). The three regions that striped bass are still known to occupy in Canada are the Bay of Fundy, the Southern Gulf of St. Lawrence and the St. Lawrence River (COSEWIC 2012).

Striped bass make use of a variety of habitats. Often spawning, incubation and early larval stages occur in fresh or brackish water while juvenile and adult fish make use of coastal, estuarine and saltwater habitats (COSEWIC 2012). Winter is spent in estuaries or freshwater habitats and spawning sites are returned to in the spring (COSEWIC 2012). Threats to striped bass include: overfishing, habitat loss and degradation, contaminants and migration barriers (COSEWIC 2012).

The COSEWIC assessment and status report was re-examined for striped bass in 2012. The Southern Gulf of St. Lawrence population was designated as a species of special concern. The Bay of Fundy and St. Lawrence River population were designated as endangered. Juvenile and adult surveys were completed by CARP in 2010 and 2011 under the direction of Dr. Trevor Avery of Acadia University. This year (2013) juvenile and adult surveys have continued under the direction of Dr. Trevor Avery in the Annapolis River and have expanded to the Bear River and Allains Creek. Dr. Trevor Avery's research focuses on finding evidence of spawning populations of striped bass in the Annapolis River and surrounding area and CARP's role is to collect data using a variety of survey methods in these areas for his use.

2.0 Objectives

The overall research goals for this project were to learn more about striped bass in several river systems in the Annapolis River watershed. Surveys included juvenile and adult surveys using tools such as beach seines, fyke nets, and a boat equipped with an outboard motor. The project aimed to:

1. Conduct 8-12 striped bass surveys in the Annapolis River including sites above and below the tidal power plant.
2. Conduct 4-6 striped bass surveys along the upper portion of the Bear River.
3. Conduct a variety of outreach activities to engage people within communities of the watershed to create awareness and promote education about striped bass. Through these initiatives gather volunteers to assist with surveys, use social media to provide updates and activities going on with the project and act as a striped bass drop-in centre for anglers.

3.0 Methods

A series of surveys were conducted on the Annapolis River, Bear River and Allains Creek between August and November 2013 and are described in the following sections.

3.1 Beach Seine Surveys

A beach seine was used at sample sites targeting juvenile striped bass while recoding all other by-catch (Labenski 2011). Duplicate samples were completed at each sampling site using a seine measuring 24.3 m in length, 2.10 m in height with a purse mesh diameter of approximately 0.3 cm. Water quality measurements were taken at each site using a YSI Professional Plus (Model: Pro 10102030). All information collected was recorded on a data sheet (Appendix A).

Beach seining consisted of person A walking the net out perpendicular to the shoreline while person B fed the seine out. Person A would walk upstream and then back into shore while person B held the net at the shoreline. If a site had a steep shoreline, person A would wade slightly downstream with the net and continue parallel to the bank and upstream before returning to person B at the shoreline. Once person A returned to the shoreline, person A and B would slowly draw in the net simultaneously ensuring the bottom and top of the net were pulled together, effectively trapping small fish in the purse, a pocket in the center of the seine where small fish collect when being hauled to shore (Nielsen and Johnson 1983).

Fish were carefully sorted into buckets containing fresh river water and aerators. Fish collected from the first tow of the seine were identified to family counted and released once the second tow was completed and fish were sorted. Fish from the second tow of the seine were identified to species, counted and at least 20 from each species were caught and measured (fork length and total length). All species of herring were kept from the second tows and preserved in 70% ethanol and brought back to the lab for identification to species. All other fish were released at the site once data was collected. *Atlantic Fishes of Canada* (Scott and Scott 1988) was used to identify fish caught to family and species.

3.1.1 Annapolis River

Beach seine surveys were conducted at 8 predetermined sites above the Annapolis River causeway and 4 predetermined sites below the causeway (Figure 1-2, Table 1). The sites were previously surveyed by Department of Fisheries and Oceans (DFO) in the summers of 2001 and 2002 (Labenski 2011), by Labenski (2011) in 2010 and Postma (2011) in 2011. Sites were accessed by boat or vehicle. Each site was visited as close to high tide

as possible. However, due to the installation of the Annapolis causeway and harvesting of tidal energy, the tide schedule above the causeway has been altered. Tide times for above the causeway were determined using the Digby, Annapolis Basin, Nova Scotia tide table and adding 3 hours for low tide and 1 hour for high tide.

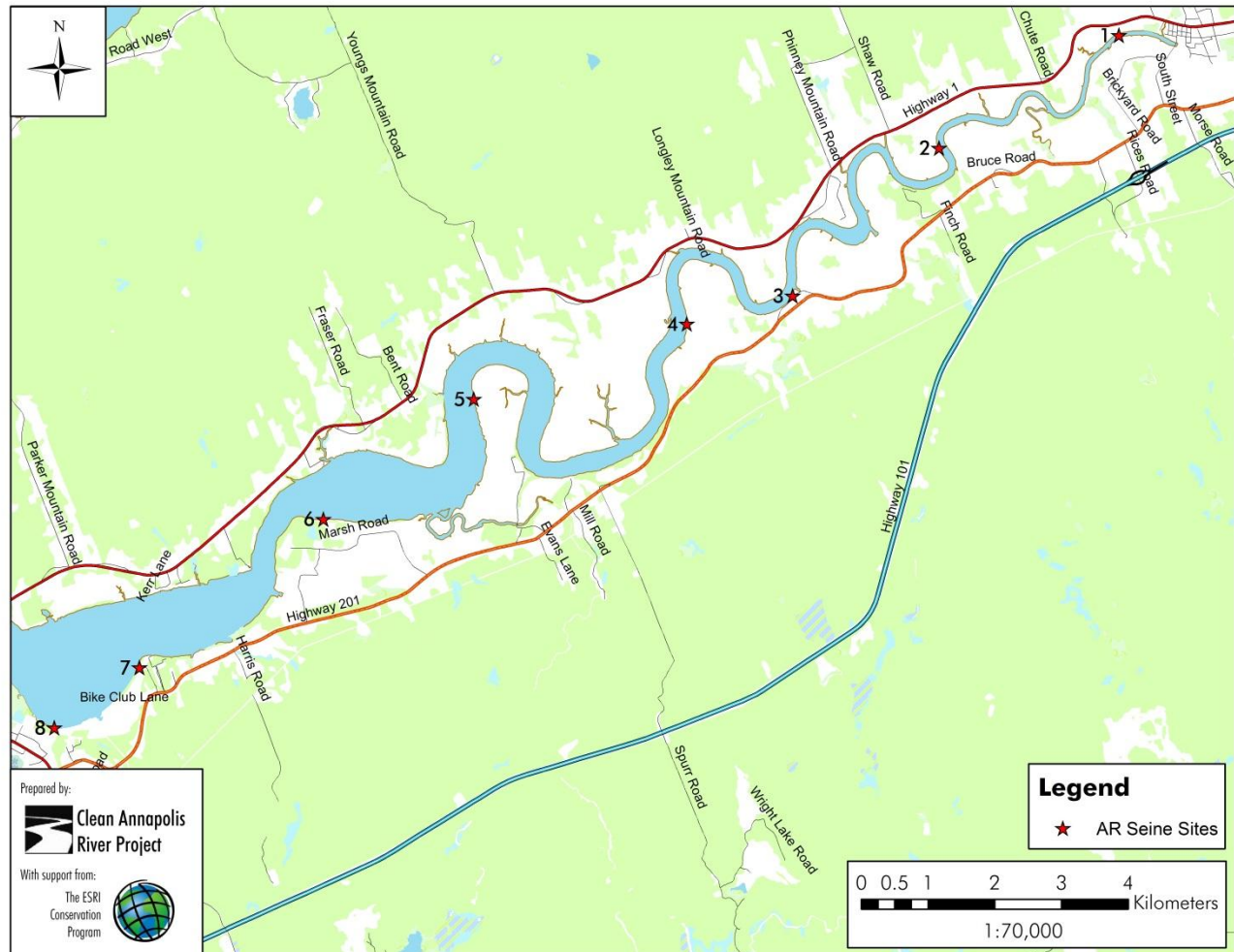


Figure 1. Beach seine sample sites (1-8) in the Annapolis River above the causeway.

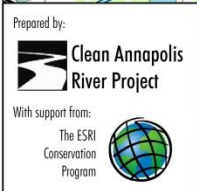


Figure 2. Beach seine sample sites (9-12) in the Annapolis River below the causeway.

Table 1. Site, location and UTM coordinates for Annapolis River beach seine sample sites 1-12.

Site	location	GPS Coordinates (UTM, 20T, accuracy ± 3 m)	
		Easting	Northing
1	Jubilee Park	318045	4967745
2	Upper Granville	315348	4966055
3	Tupperville	313151	4963837
4	Belleisle	311562	4963417
5	Roundhill Road	308369	4962286
6	Marsh Road	306113	4960484
7	Head Pond	303355	4958257
8	Annapolis Royal	302081	4957354
9	Upper Clements	294183	4952401
10	Cornwallis	290913	4947705
11	Bear River	287235	4944429
12	Smith's Cove	284282	4943399

3.1.2 Bear River

Beach seine surveys were conducted at 4 sites in the Bear River (Figure 3, Table 2). Sites were chosen based on collaboration with Bear Rivers First Nations and were accessed by car or boat. Tide times were determined using the Digby, Annapolis Basin, Nova Scotia tide table.

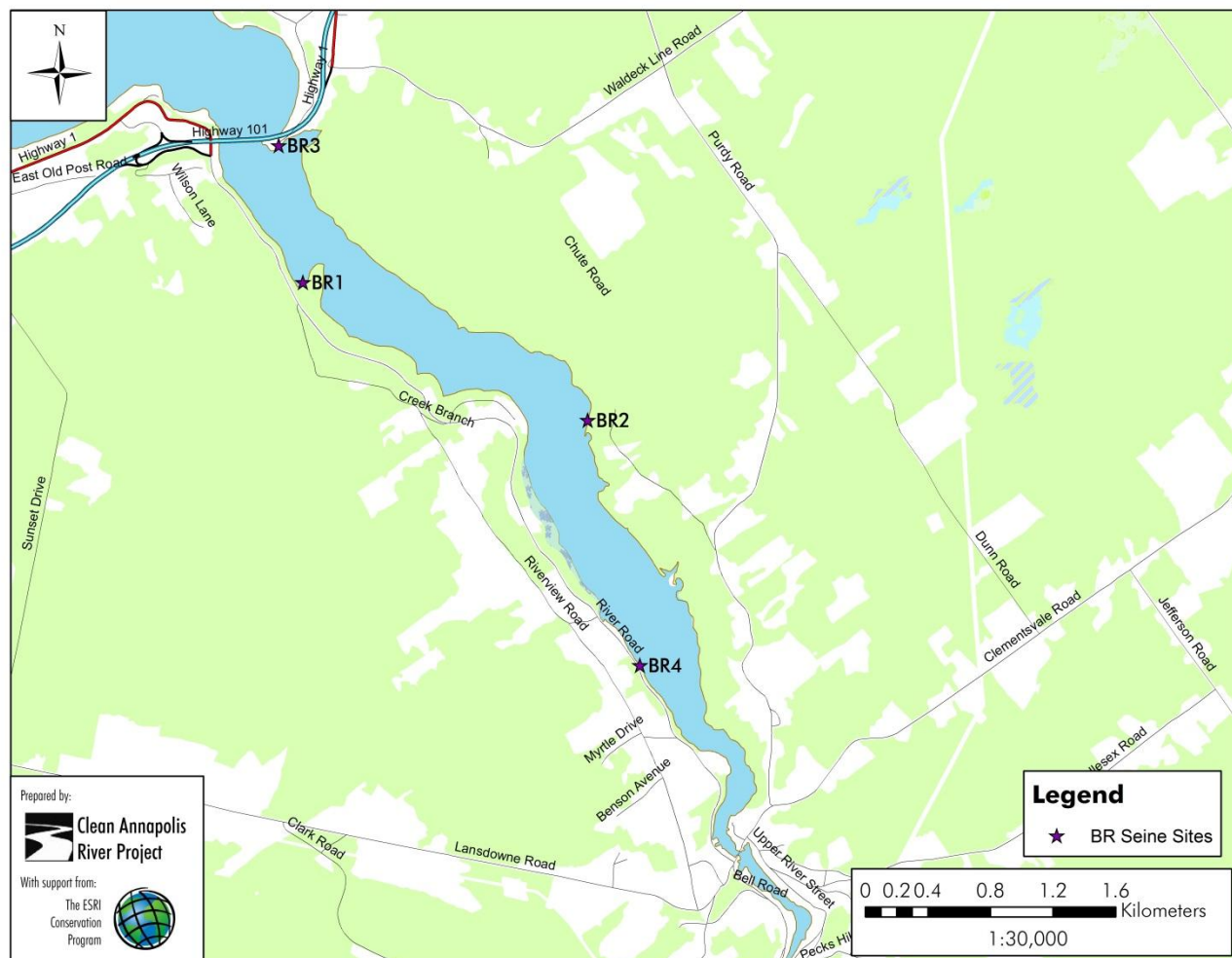


Figure 3. Beach seine sample sites (BR1-BR4) in the Bear River.

Table 2. Site, location and UTM coordinates for Bear River beach seine sample sites BR1-BR4.

Site	Location	GPS Coordinates (UTM, Zone 20T, accuracy ± 3 m)	
		Easting	Northing
BR1	Raymond's Point	287625	4942840
BR2	Kniffen's Hollow	289447	4941958
BR3	Bear River Bridge	287470	4943717
BR4	River Rd	289780	4940387

3.1.3 Allains Creek

One beach seine survey was conducted at Allains Creek (Figure 4, Table 3). The site was chosen based on angler knowledge and the site was accessed by car. Tide times were determined using the Digby, Annapolis Basin, Nova Scotia tide table.

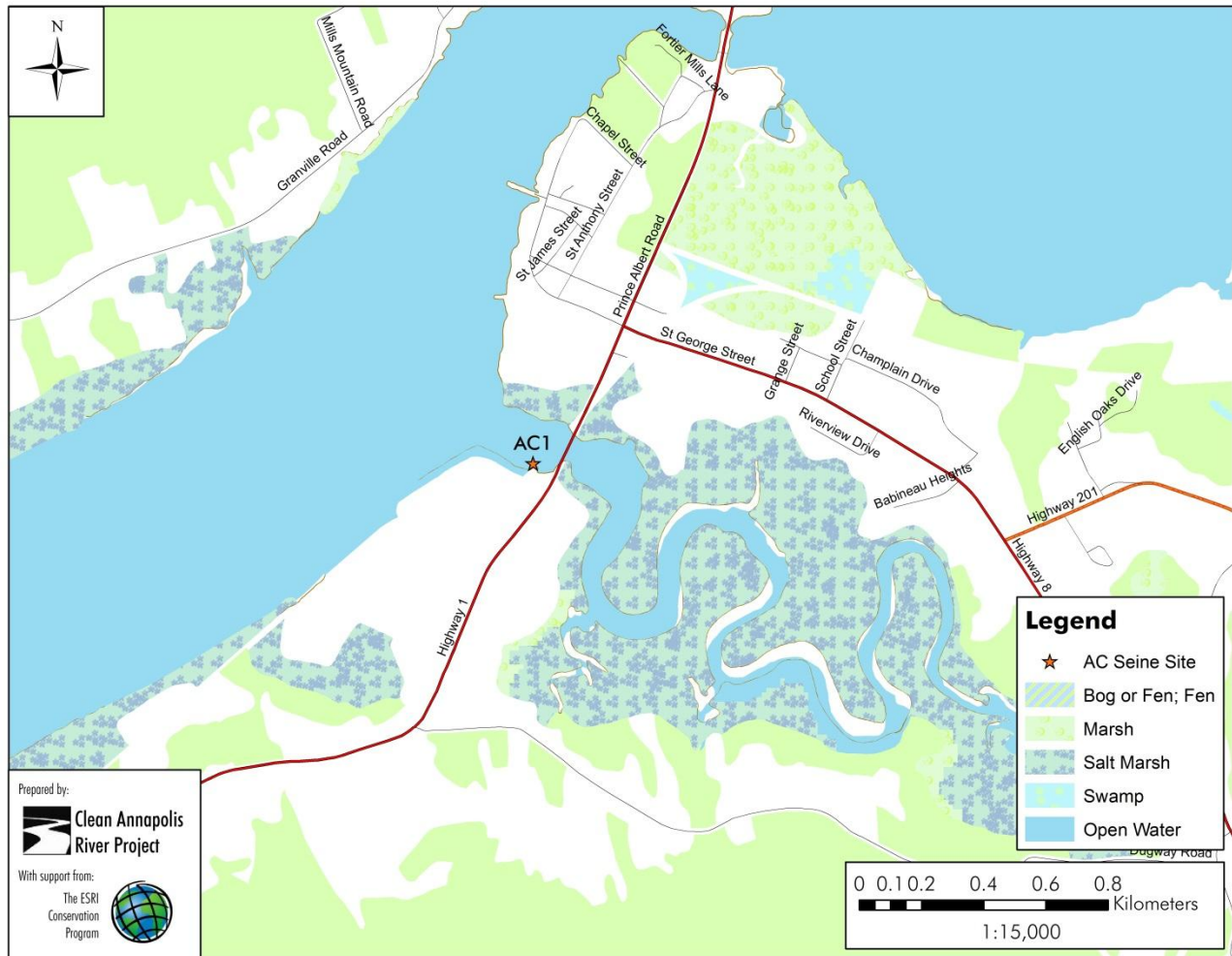


Figure 4. Beach seine sample site (AC1) at Allains Creek.

Table 3. Site, location and UTM coordinates for Allains Creek beach seine sample site AC1.

Site	Location	GPS Coordinates (UTM, Zone 20T, accuracy ± 3 m)	
		Easting	Northing
AC1	Old rail bridge	300541	4956931

3.2 Fyke Net Surveys

A fyke net was used to target adult striped bass and record all other by-catch. The fyke net was installed on the first day and checked twice over a series of 2 full tide cycles before being removed. The fyke net used was a modified hoop net with one leader attached to the mouth, which acted to

guide fish into the enclosure (Nielson and Johnson 1983). The fyke net measured 19.06 m in length with a box height and width of 1.24 m. The opening width measured 14.0 cm. The leader line had a length of 15.13 m and a height of 1.15 m. The mesh size measured 1.8 cm. Water quality measurements were taken at each site using a YSI Professional Plus (Model: Pro 10102030). All information collected was recorded on a data sheet (Appendix B).

To set the fyke net, at minimum 2 people were required. The fyke net was set at low tide to ensure that it would remain submerged under water. A piece of rebar was used to secure the leader line of the fyke net to the shore. Person A and B walked the leader line, box and hoop perpendicular to the shore so that the leader line was fully extended. Once the leader line was fully extended person A held the box in place while person B extended and secured the hoop with the anchor. Person B then used rebar to secure the box in place. Buoys were attached to the anchor and all rebar to ensure visibility to potential boaters.

The fyke net was checked at low tide the following day to process the sample. The anchor was retrieved and the net was brought to shore so all fish could be removed from the net and sorted into buckets containing fresh river water and aerators. Fish were identified to species, counted and measured (fork length and total length) before being released. *Atlantic Fishes of Canada* (Scott and Scott 1988) was used to identify fish caught to family and species. Once the sample was processed the fyke net was reset for one more tide cycle and checked again the following day at low tide before it was removed.

3.2.1 Allains Creek and Annapolis River

One fyke net was set up in Allains Creek, and another above the causeway in the Annapolis River (Figure 5, Table 4). The Allains Creek site was chosen based on angler knowledge while the Annapolis River site was chosen based on historical striped bass information. The Allains Creek site was accessed by car while the Annapolis River site was accessed by boat and car. Tide times were determined using the Digby, Annapolis Basin, Nova Scotia tide table. Three hours were added to the low tide time for the Annapolis River site to correct for the causeway.

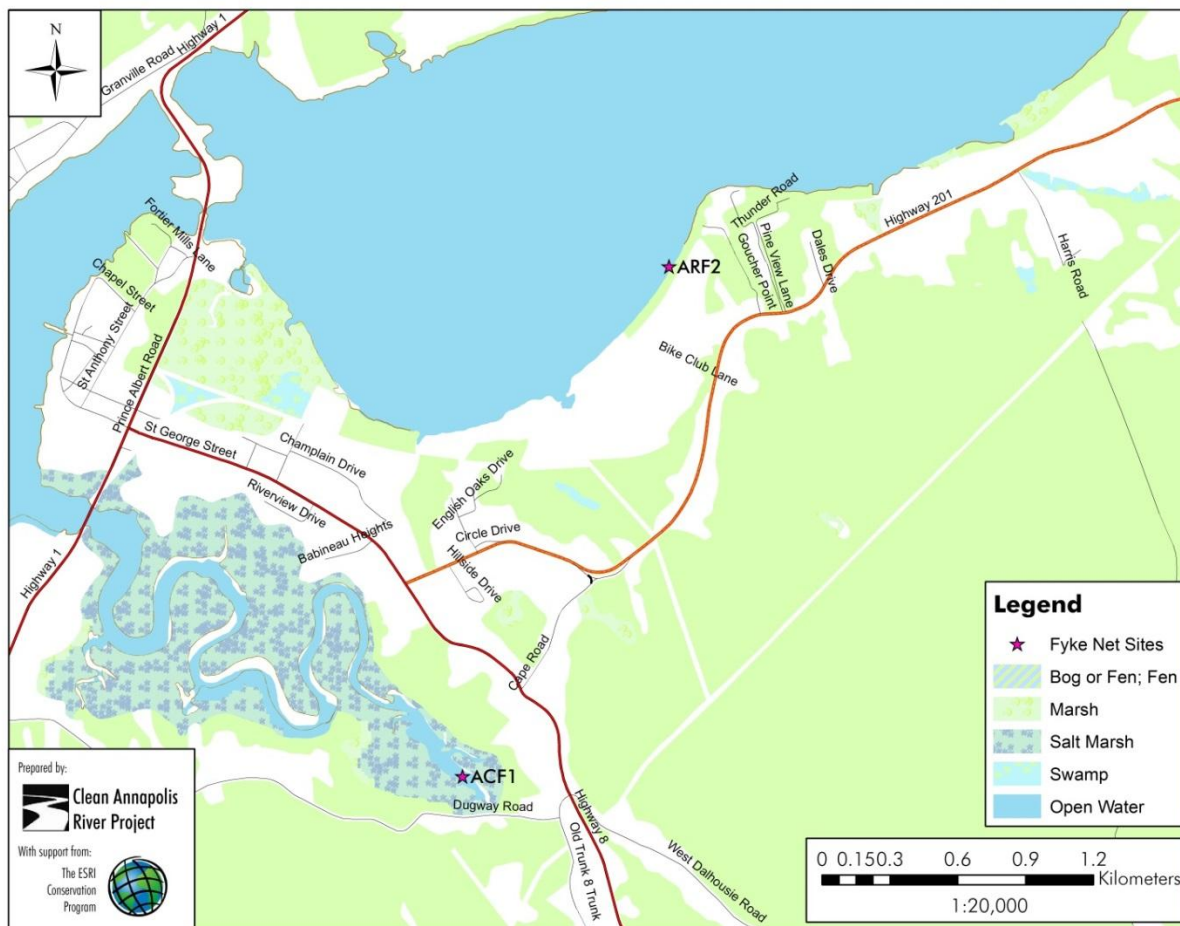


Figure 5. Fyke net sample sites at Allains Creek (ACF1) and at the Annapolis River (ARF2).

Table 4. Site, location and UTM coordinates of fyke net sampling sites ACF1 (Allains Creek) and ARF2 (Annapolis River).

Site	Location	GPS Coordinates (UTM, Zone 20T, accuracy ± 3 m)	
		Easting	Northing
ACF1	Dugway Road	302309	4955830
ARF2	Goucher Point	303222	4958086

3.3 Outreach

Outreach activities were an important component of the striped bass project. Outreach was used as a tool to educate and engage local citizens within communities to become involved and help provide more information about the species in key areas. Outreach activities in 2013 included:

- Participating as a striped bass stewardship centre (CARP office)
- Developing a partnership with Bear River First Nations
- Participating in the 7th Annual Bear River Striped Bass Tournament
- Participating in the CARP Fly Tying Workshop
- Creating awareness through the use of social media

4.0 Results

Beach seine surveys produced a total of 6,064 fish across 13 families on the Annapolis River, Bear River and Allains Creek. Fyke net surveys produced a total of 16 fish across 4 families on Allains Creek and the Annapolis River. No juvenile or adult striped bass were found during beach seine or fyke net surveys.

4.1 Beach Seine Surveys

4.1.1 Annapolis River

A total of 8 duplicate beach seine surveys were completed on the Annapolis River above the causeway and 4 duplicate beach seine surveys were completed below the causeway. Beach seine surveys completed (Tables 5-16) yielded 5,637 fish across 13 families. No juvenile striped bass were caught. The most prevalent families caught included Atherinopsidae (silverside) and Fundulidae (killifish). Sites 2, 3 and 6 had the highest number of fish caught while sites 1 through 5 had the highest diversity of families caught. Water quality data (Table 17) shows a more or less increasing salinity and specific conductance (SpC, $\mu\text{S}/\text{cm}$) from sites 1 to 12. While dissolved oxygen (DO) ranged from 6.5 mg/L to 10.6 mg/L and pH ranged from 7.36 to 8.03.

Table 5. Beach seine sample site 1 catch, Annapolis River.

Site	Location	UTM easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
1	Jubilee Park	318045	4967745	29-Aug	1	Pleuronectidae	-	-	1
						Fundulidae	-	-	7
						Gasterosteidae	-	-	4
						Moronidae	-	-	7
					2	Fundulidae	<i>F. diaphanus</i>	Banded killifish	1
						Gasterosteidae	<i>G. aculeatus</i>	Threespine stickleback	3
						Moronidae	<i>M. americana</i>	White perch	4
						Catostomidae	<i>C. commersonii</i>	White sucker	1
				16-Oct	1	Fundulidae	-	-	3
						Gasterosteidae	-	-	7
					2	Gasterosteidae	<i>A. quadracus</i>	Fourspine stickleback	9

Table 6. Beach seine sample site 2 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
2	Upper Granville	315348	4966055	29-Aug	1	Clupeidae	-	-	5
						Fundulidae	-	-	876
						Atherinopsidae	-	-	107
						Gasterosteidae	-	-	7
						Moronidae	-	-	10
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	346
						Fundulidae	<i>F. diaphanus</i>	Banded killifish	1260
						Fundulidae	<i>F. heteroclitus</i>	Mummichog	35
						Cyprinidae	<i>C. eos</i>	Northern red belly dace	1
				16-Oct	1	Fundulidae	-	-	9
						Gasterosteidae	-	-	173
					2	Gasterosteidae	<i>G. aculeatus</i>	Threespine stickleback	11
						Gasterosteidae	<i>A. quadacus</i>	Fourspine stickleback	162

Table 7. Beach seine sample site 3 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
3	Tupperville	313151	4963877	21-Aug	1	Clupeidae	-	-	13
						Fundulidae	-	-	1
						Gadidae	-	-	1
						Atherinopsidae	-	-	261
						Gasterosteidae	-	-	7
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic Silverside	284
						Fundulidae	<i>F. diaphanus</i>	Banded killifish	1
						Clupeidae	?	Herring	2
						Gasterosteidae	<i>G. aculeatus</i>	Threespine stickleback	4
						Pleuronectidae	<i>P. americanus</i>	Winter flounder	7
				10-Oct	1	-	-	-	0
					2	Anguillidae	<i>A. rostrata</i>	American Eel	1

Table 8. Beach seine sample site 4 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
4	Belleisle	311562	4963417	21-Aug 10-Oct	1	Pleuronectidae	-	-	1
						Fundulidae	-	-	1
						Syngnathidae	-	-	1
						Atherinopsidae	-	-	1
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silversides	126
						Clupeidae	?	Herring	3
						Fundulidae	<i>F. heteroclitus</i>	Mummichog	1
						Syngnathidae	<i>S. fuscus</i>	Northern pipefish	2
						Gasterosteidae	<i>G. aculeatus</i>	Threespine stickleback	3
						Pleuronectidae	<i>P. americanus</i>	Winter flounder	2
					1	Anguillidae	-	-	1
						Atherinopsidae	-	-	4
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silversides	6

Table 9. Beach seine sample site 5 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
5	Roundhill Road	308369	4962286	19-Aug	1	Anguillidae	-	-	1
						Pleuronectidae	-	-	7
						Clupeidae	-	-	2
						Atherinopsidae	-	-	98
					2	Anguillidae	<i>A. rostrata</i>	American eel	1
						Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	16
						Pleuronectidae	<i>P. americanus</i>	Winter flounder	5
				15-Oct	1	Pleuronectidae	-	-	1
						Atherinopsidae	-	-	5
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	6
						Fundulidae	<i>F. heteroclitus</i>	Mummichog	1
						Gasterosteidae	<i>G. aculeatus</i>	Threespine stickleback	2

Table 10. Beach seine sample site 6 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
6	Marsh Road	306113	4960484	19-Aug	1	Atherinopsidae	-	-	474
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	266
				15-Oct	1	Atherinopsidae	-	-	3
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	9



Table 11. Beach seine sample site 7 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
7	Head Pond	303355	4958257	16-Aug	1	Pleuronectidae	-	-	1
						Atherinopsidae	-	-	27
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	52
						Pleuronectidae	<i>P. americanus</i>	Winter flounder	3
				9-Oct	1	Atherinopsidae	-	-	45
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	106

Table 12. Beach seine sample site 8 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
8	Annapolis Royal	302081	4957354	16-Aug	1	Pleuronectidae	-	-	22
						Gasterosteidae	-	-	2
					2	Gasterosteidae	<i>P. pungitius</i>	Ninespine stickleback	2
						Syngnathidae	<i>S. fuscus</i>	Northern pipefish	1
						Pleuronectidae	<i>P. americanus</i>	Winter flounder	27
					1	Pleuronectidae	-	-	1
						Atherinopsidae	-	-	136
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	81

Table 13. Beach seine sample site 9 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
9	Upper Clements	294183	4952401	23-Aug	1	Fundulidae	-	-	12
					2	Fundulidae	<i>F. hetericlitus</i>	Mummichog	10
				2-Oct	1	Atherinopsidae	-	-	32
					2	Fundulidae	<i>F. hetericlitus</i>	Mummichog	1
						Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	10

Table 14. Beach seine sample site 10 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
10	Cornwallis	290913	4947705	29-Aug	1	-	-	-	0
					2	-	-	-	0
				23-Oct	1	Atherinopsidae	-	-	4
					2	Ammodytidae	<i>A. americanus</i>	American sand lance	221
						Pleuronectidae	<i>P. americanus</i>	Winter flounder	1

Table 15. Beach seine sample site 11 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
11	Bear River	287235	4944429	30-Aug	1	Atherinopsidae	-	-	5
						Osmeridae	-	-	1
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	11
				7-Oct	1	Pleuronectidae	-	-	1
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	15

Table 16. Beach seine sample site 12 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
12	Smith's Cove	284282	4943399	30-Aug	1	Pleuronectidae	-	-	1
						Fundulidae	-	-	7
						Atherinopsidae	-	-	43
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	4
						Fundulidae	<i>F. heteroclitus</i>	Mummichog	27
				7-Oct	1	Atherinopsidae	-	-	22
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	23

Table 17. Beach seine sample sites (1-12) water quality data for the Annapolis River.

Site	Date (2013)	Temp (°C)	SpC (µS/cm)	Cond (µS/cm)	TDS (mg/L)	Sal (g/L)	DO%	DO (mg/L)	pH	pHmV
1	29-Aug	21.1	6032	5619	4010	3.33	7.1	6.70	7.41	-39.7
	16-Oct	11.9	4290	3203	2775.5	2.28	89.6	9.32	7.40	-38.6
2	29-Aug	21.1	13881	12818	8970	7.97	81.7	6.96	7.93	-32.1
	16-Oct	11.7	7169	5340	4654	3.96	86.0	9.11	7.36	-36.7
3	21-Aug	23.7	18302	17847	11895	10.83	117.0	9.44	7.91	-67.2
	10-Oct	14.2	6776	5386	4420	3.75	94.0	9.40	7.44	-67.4
4	21-Aug	23.4	18545	17941	12012	11.1	103.4	8.32	7.70	-55.3
	10-Oct	14.6	6779	5591	4537.6	3.86	99.0	9.80	7.69	-77.6
5	19-Aug	22.5	26867	25615	17498	16.51	89.5	6.99	7.96	-64.9
	15-Oct	12.8	20835	15981	13552.5	12.53	89.7	8.75	7.55	-47.1
6	19-Aug	21.2	36725	33910	23946	23.34	85.0	6.50	7.99	-66.5
	15-Oct	13.5	32998	25706	21638.5	20.80	88.6	8.08	7.73	-56.0
7	16-Aug	20.3	32969	3085	21541.5	20.87	93.3	7.52	7.96	-64.8
	9-Oct	14.3	35801	29450	22647.5	22.32	102.0	8.90	7.86	-91.0
8	16-Aug	19.4	41805	37327	27196	26.94	128.5	10.05	8.03	-68.7
	9-Oct	14.7	36067	28021	23315	22.04	100.0	8.80	7.81	-88.6
9	23-Aug	17.7	47709	41134	31011.5	31.13	97.5	7.53	7.88	-65.1
	2-Oct	13.9	46791	36835	30413.5	30.43	100.0	8.60	7.69	-83.3
10	23-Aug	17.0	48927	41768	31187	31.39	103.0	8.07	7.92	-66.7
	23-Oct	12.0	44748	33718	29289	29.09	90.3	8.03	7.75	-61.5
11	30-Aug	14.4	49333	39323	32012.5	32.21	92.3	7.73	7.93	-66.7
	7-Oct	12.1	46921	35332	30485	30.44	130	10.6	7.92	-94.5
12	30-Aug	14.7	48355	38796	31330	31.43	89.1	7.41	7.86	-63.2
	7-Oct	12.5	48636	36992	31635.5	31.71	106.0	9.10	7.98	-97.6

4.1.2 Bear River

A total of 4 duplicate beach seine survey were completed at the Bear River. Beach seine surveys completed (Tables 18-21) yielded 233 fish across 5 families. No juvenile striped bass were caught. The most prevalent family caught was Atherinopsidae (silverside). Site BR3 had the highest number of fish caught while BR4 had the highest diversity of families caught. Water quality data (Table 22) shows a more or less decreasing salinity and SpC (µS/cm) from the BR3 (Bear River bridge) towards BR4 (River Road). DO (mg/L) ranged from 6.8 to 10.7 while pH ranged from 7.46 to 7.95.

Table 18. Beach seine sample site BR1 catch, Bear River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
BR1	Raymond's Point	287625	4942840	28-Aug	1	-	-	-	0
					2	Fundulidae	<i>F. heteroclitus</i>	Mummichog	2
				7-Oct	1	-	-	-	0
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	66

Table 19. Beach seine sample site BR2 catch, Bear River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
BR2	Kniffen's Hollow	289447	4941958	28-Aug	1	-	-	-	0
					2	-	-	-	0
					1	Fundulidae	-	-	5
						Atherinopsidae	-	-	8
				2-Oct	2	Fundulidae	<i>F. heteroclitus</i>	Mummichog	1

Table 20. Beach seine sample site BR3 catch, Bear River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
BR3	Bear River Bridge	287470	4943717	11-Oct	1	Fundulidae	-	-	1
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	14
						Fundulidae	<i>F. heteroclitus</i>	Mummichog	1
				17-Oct	1	Fundulidae	-	-	1
						Atherinopsidae	-	-	127
					2	Fundulidae	<i>F. heteroclitus</i>	Mummichog	1

Table 21. Beach seine sample site BR4 catch, Bear River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
BR4	River Road	289780	4940387	31-Oct	1	-	-	-	0
					2	Cyprinidae	<i>N. crysoleucus</i>	Golden shiner	1
				5-Nov	1	Pleuronectidae	-	-	2
						Atherinopsidae	-	-	1
						Osmeridae	-	-	1
					2	Osmeridae	<i>O. mordax</i>	Rainbow Smelt	1

Table 22. Beach seine sample sites (BR1-BR4) water quality data for the Bear River.

Site	Date (2013)	Temp (°C)	SpC (µS/cm)	Cond (µS/cm)	TDS (mg/L)	Sal (g/L)	DO%	DO (mg/L)	pH	pHmV
BR1	28-Aug	15.5	48887	39965	31785	31.95	108.8	9.23	7.88	-64.4
	7-Oct	11.9	47377	35610	30868.5	30.87	101.0	8.90	7.76	-85.9
BR2	28-Aug	21.2	31259	29154	20702.5	19.97	86.7	6.80	7.88	-65.0
	2-Oct	14.3	9809	7950	6383.5	5.59	110.0	10.7	7.66	-78.8
BR3	11-Oct	12.6	45515	34611	29629	29.39	104.0	9.10	7.95	-96.1
	17-Oct	12.1	44667	33599	28983.5	28.75	88.3	7.83	7.83	-61.1
BR4	31-Oct	8.9	42662	29603	27742.5	27.2	79.9	7.63	7.87	-83.9
	5-Nov	8.5	34351	23196	20667.5	20.19	96.0	9.70	7.46	-69.1

4.1.3 Allains Creek

One duplicate beach seine survey was completed at Allains Creek. The beach seine survey completed (Table 23) yielded 194 fish across 3 families. No juvenile striped bass were found. The most prevalent family caught was Atherinopsidae (silverside). Water quality data (Table 23) shows that salinity and SpC ($\mu\text{S}/\text{cm}$), DO (mg/L) and pH were similar for the duplicate surveys.

Table 23. Beach seine sample site AC1 catch, Allains Creek.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set	Family	Species	Common Name	Count
AC1	Old Rail Bridge	300541	4956931	24-Oct	1	Pleuronectidae	-	-	3
						Fundulidae	-	-	1
						Atherinopsidae	-	-	4
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	51
						Fundulidae	<i>F. heteroclitus</i>	Mummichog	5
						Pleuronectidae	-	-	6
				25-Oct	1	Fundulidae	-	-	1
						Atherinopsidae	-	-	92
						Pleuronectidae	-	-	1
					2	Atherinopsidae	<i>M. menidia</i>	Atlantic silverside	26
						Pleuronectidae	<i>P. americanus</i>	Winter Flounder	1
						Pleuronectidae	<i>L. ferruginea</i>	Yellowtail flounder	4

Table 24. Beach seine sample sites (AC1) water quality data for Allains Creek.

Site	Date (2013)	Temp (°C)	SpC ($\mu\text{S}/\text{cm}$)	Cond ($\mu\text{S}/\text{cm}$)	TDS (mg/L)	Sal (g/L)	DO%	DO (mg/L)	pH	pHmV
AC1	24-Oct	12.0	38932	29270	26317	24.77	96.9	9.10	7.73	-60.4
	25-Oct	11.4	38771	28721	25200.5	24.62	99.3	9.27	7.77	-62.4

4.2 Fyke Net Surveys

4.2.1 Allains Creek

A fyke net was installed at 1 location on Allains Creek. The fyke net was set at low tide and checked the following morning at low tide. The fyke net was set and checked at this location for two full tide cycles. The fyke net survey on Allains Creek (Table 25) yielded total of 8 fish across 3 families. No adult striped bass were caught. The most prevalent family caught was Gadidae (codfishes). One American eel and 1 Atlantic tomcod were found dead. The eel was in the leader line while the tomcod was found in the hoop part of the net. The eel and tomcod were dead before going into the net. The death of the eel may have been caused by the turbine upstream while the tomcod appeared to have been attacked by a predator. Water quality data (Table 26) shows a low salinity. SpC ($\mu\text{S}/\text{cm}$) ranged from 55.0 to 217.0, DO (mg/L) ranged from 8.41 to 8.66 while pH ranged from 5.73 to 6.16. This site was quite far from the confluence of Allains Creek and the Annapolis Basin.

Table 25. Fyke net sample site ACF1 catch, Allains Creek.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set Time of day	Set Length	Family	Species	Common Name	Count
ACF1	Dugway Road	302309	4955830	21-Oct	Morning	24 h	Gadidae	<i>M. tomcod</i>	Atlantic tomcod	5
							Anguillidae	<i>A. rostrata</i>	American eel*	1
							Moronidae	<i>M. americanus</i>	White perch	1
				22-Oct	Morning	24 h	Gadidae	<i>M. tomcod</i>	Atlantic tomcod*	1

*Dead prior to going into net

Table 26. Fyke net sample site (ACF1) water quality data for Allains Creek.

Site	Date (2013)	Temp (°C)	SpC (μS/cm)	Cond (μS/cm)	TDS (mg/L)	Sal (g/L)	DO%	DO (mg/L)	pH	pHmV
ACF1	21-Oct	12.7	55.0	43.2	37.05	0.03	80.7	8.75	5.73	44.3
	22-Oct	12.3	127.8	94.3	78.0	0.06	78.2	8.41	6.06	26.5
	23-Oct	12.3	217.7	164.2	139.1	0.09	80.7	8.66	6.16	19.9

4.2.2 Annapolis River

A fyke net was installed at 1 location on the Annapolis River. The fyke net was set at low tide and checked the following morning at low tide. The fyke net was set and checked at this location for two full tide cycles. The fyke net survey on the Annapolis River (Table 27) yielded total of 8 fish across 3 families. No adult striped bass were caught. The most prevalent family caught was Gadidae (codfishes). When the fyke net was checked on 25-Oct-2013 the opening had fallen into the water. Extreme weather including high winds and waves most likely played a factor in knocking the fyke net out of place which most likely impacted the catch. Water quality data (Table 28) collected showed a salinity ranging from 7.70 to 18.87, an SpC (μS/cm) ranging from 13334 to 30596, a DO (mg/L) ranging from 9.28 to 9.89 and a pH ranging from 6.66 to 7.81. This site is close to the tidal power plant and is exposed to marine water.

Table 27. Fyke net sample site ARF1 catch, Annapolis River.

Site	Location	UTM Easting	UTM Northing	Date (2013)	Set Time of day	Set Length	Family	Species	Common Name	Count
ARF2	Goucher Point	303222	4958086	23-Oct	Morning	24 h	Gadidae	<i>M. tomcod</i>	Atlantic tomcod	4
							Osmeridae	<i>O. mordax</i>	Rainbow smelt	1
				24-Oct	Morning	24 h	Anguillidae	<i>A. rostrata</i>	American eel	2
							Gadidae	<i>M. tomcod</i>	Atlantic tomcod	1

Table 28. Fyke net sample sites (ACF1, ARF1) water quality data for Allains Creek and the Annapolis River.

Site	Date (2013)	Temp (°C)	SpC (μS/cm)	Cond (μS/cm)	TDS (mg/L)	Sal (g/L)	DO%	DO (mg/L)	pH	pHmV
ARF2	23-Oct	10.8	13334	9731	8645	7.70	87.4	9.28	6.66	-7.4
	24-Oct	10.4	13996	10091	9100	8.11	89.2	9.45	7.63	-54.7
	25-Oct	10.3	30596	21900	19805.5	18.87	99.2	9.89	7.81	-64.0



4.3 Outreach

A variety of outreach activities were completed this season. CARP acted (and continues to act) as a Striped Bass Stewardship Centre where anglers can pick up and drop off recording booklets and scale envelopes to record striped bass catch information. A partnership was created with Bear River First Nations to learn more about Striped Bass on the Bear River as well as to learn where seine and fyke net survey locations could be completed. Participation in 2 events, the 7th Annual Bear River Striped Bass Tournament and a Fly Tying Workshop, in conjunction with Acadia University allowed for engagement opportunities with local anglers. Booths were set up at both locations providing information on striped bass and a survey created by Dr. Trevor Avery was passed out to local anglers to learn more about striped bass in the area. Social media was used to provide CARP followers with information about the project; updates, pictures and events were uploaded on the CARP Facebook and Twitter accounts.

5.0 Discussion

5.1 Beach Seine Surveys

Similar to beach seine surveys conducted by Labenski (2011) in 2010 and Postma (2011) in 2011, no juvenile or adult striped bass were caught in 2013. A higher number and diversity of species was caught in the Annapolis River this year than in 2010 and in 2011. Beach seine surveys on the Bear River and on Allains Creek yielded lower numbers and diversity of fish as compared to surveys on the Annapolis River. However, *Atherinopsidae* (silverside) was the most prevalent in all 3 systems. Further surveys on the Bear River and Allains Creek will allow for more in depth comparison of sites and between sites. Completing beach seine surveys at least 2 hours before high tide on sites 9-12 on the Annapolis River, BR1-BR4 on the Bear River and AC1 on Allains Creek might yield larger catches. Sampling that occurred at high tide or just as tide was going out may have resulted in fewer catches as fish were being drawn out of areas that the beach seine could reach.

The construction of the causeway and tidal power plant as well as changes in the quality of the water has had a significant impact on the striped bass population in the Annapolis River (COSEWIC 2012). Availability of fish species that have commonly been found in the stomach contents of striped bass are readily available in the Annapolis River, Bear River and Allains Creek as seen through beach seine surveys. Survey results received from striped bass anglers in the Annapolis River suggest a decline in striped bass from 1975-2000 with low recruitment (COSEWIC 2012). There is little evidence that large striped bass are still being caught in the Annapolis River, however some small adults have been caught in recent years (COSEWIC 2012). These smaller fish are thought to be migrants from US populations or from the Upper Bay of Fundy (COSEWIC 2012). Local angler knowledge suggests that striped bass are still being caught in Allains Creek and Bear River however there were no striped bass caught during beach seine surveys or the 7th Annual Bear River Striped Bass Tournament in 2013. Reaching out to local anglers that fish in these two systems could provide a better idea of striped bass in these systems.

Data collected from beach seine surveys were provided to Dr. Trevor Avery for further analysis and surveys will continue in these areas next spring (2014).

5.2 Fyke Net Surveys

Fyke net surveys yielded no adult striped bass catches in 2013. This was also the case in 2011. The most prevalent family caught in both 2011 and 2013 was *Gadidae* (codfishes). Fewer species were caught in the fyke net in 2013 on the Annapolis River but this might be explained by the net falling over in extreme weather. The fyke net was also installed further downstream in 2013. Setting fyke nets at different locations along the Annapolis may be worthwhile above and below the causeway to cover a wider range of the river.

On Allains Creek, the most prevalent family caught was also *Gadidae* (codfishes). At the Allains Creek site two species were deceased when found in the net but appeared to have been this way before entering the net which could be explained by a turbine located just upstream of the fyke net and possibly a predator. There are not many suitable sites to set the fyke net on Allains Creek however continued efforts on the system are worthwhile as local anglers have caught striped bass in this system recently.

No fyke nets were set in the Bear River in 2013. The tide is very strong in this area and the bottom is very soft resulting in areas that were without water or that would pull the fyke net out of place. Local angler knowledge suggests that striped bass exist in this system so it would be ideal to try different survey methods to assess juvenile and adult populations in the river. Plankton net surveys might be a good way to assess juvenile populations as this was successfully done in the Annapolis River in 1976, 1977 and 1980 in conjunction with beach seine surveys (COSEWIC 2012).



The use of a weir might also be helpful in the successful catch of adult striped bass allowing to gather further information on the species (Nielson and Johnson 1983).

Data collected from fyke net surveys were provided to Dr. Trevor Avery for further analysis and surveys will continue in these areas next spring.

5.3 Outreach

Continued outreach in communities around the Annapolis River, Bear River and Allains Creek will be critical to learning more from striped bass anglers in these areas. Promoting CARP as a Striped Bass Stewardship Centre and handing out more log books and scale sample envelopes may also help with the collection of striped bass data from these areas. Creating events that are geared towards anglers (ex. Fly Tying Workshop) may help to focus the knowledge that can be obtained from these sorts of events.

Continued collaboration with Bear Rivers First Nations will provide local knowledge of striped bass on the Bear River. Maintaining this collaboration in the future will ensure assistance with surveys in the area and valuable knowledge about sites that can be surveyed, especially if different survey methods are explored.

6.0 Recommendations

1. Seine surveys on Annapolis River sites 1, 3, 4 and 5 should be sampled at lower tide levels as they have steep slopes and/or no beach at high tide.
2. Seine surveys on Annapolis River sites 9-12, Bear River sites BR1-BR4 and Allains Creek site AC1 should be sampled at least 2 hours before high tide so as to catch fish as they are coming in with the tide. Sampling that occurred at high tide and as the tide was going out resulted in little to no catches.
3. Eggs tows should be completed on the Annapolis River, Bear River and Allains Creek in the spring (2014).
4. Different survey methods should be considered on the Bear River and the Annapolis River to increase catch success of juvenile and adult striped bass. Plankton net surveys for juveniles and use of a weir might be methods worth investigating.
5. Outreach activities should continue in communities surrounding these 3 systems to learn more about striped bass in these areas. Recording of catches in log books and scale sample collection should be promoted further to anglers.



7.0 Conclusion

Beach seine and fyke net surveys completed on multiple sites in the Annapolis River, Bear River and Allains Creek this year resulted in no juvenile or adult striped bass caught. These results were similar to those collected on the Annapolis River in 2010 and 2011. Completing spring time surveys and using a variety of survey techniques such egg tows, plankton net surveys and weirs in conjunction with beach seine and fyke net surveys may yield more positive results across these 3 systems. Although striped bass have not been caught in the Annapolis River for quite some time, local angler knowledge suggests that striped bass are still being caught in Allains Creek and in the Bear River. Continued outreach in the communities around these systems will be an important step towards understanding the striped bass populations in these areas.

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Appendices

Appendix A: Striped Bass – Beach Seine Sampling Datasheet

STRIPED BASS – Beach Seine Sampling

Site # and Location _____ N: _____ E: _____									
Researchers: _____									
Date: _____ Time: _____ Weather: _____ Air Temp: _____									
WATER QUALITY -									
SONDE	Temp (°C)	SpC (μS/cm°)	Cond (μS/cm)	TDS (g/L)	Sal (g/L)	DO%	DO (mg/)	pH	pHmV
Site Map					Fish Abundance				
					Species		Count		
Number of Passes: _____									
Second Pass Sample Collected <input type="checkbox"/>									

Site # and Location _____ N: _____ E: _____									
Researchers: _____									
Date: _____ Time: _____ Weather: _____ Air Temp: _____									
WATER QUALITY -									
SONDE	Temp (°C)	SpC (μS/cm°)	Cond (μS/cm)	TDS (g/L)	Sal (g/L)	DO%	DO (mg/)	pH	pHmV
Site Map					Fish Abundance				
					Species		Count		
Number of Passes: _____									
Second Pass Sample Collected <input type="checkbox"/>									

Appendix B: Striped Bass — Fyke Net Datasheet

STRIPED BASS – Fyke Net

[illegible]