Canadian Technical Report of
Fisheries and Aquatic Sciences 3061

2015

SUMMARY OF REPORTED ATLANTIC SALMON (*Salmo salar*) CATCHES AND SIGHTINGS IN BRITISH COLUMBIA AND RESULTS OF FIELD WORK CONDUCTED IN 2011 AND 2012

by

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Cat. No. Fs 97-4/3061-PDF ISBN 978-1-100-25788-4 ISSN 1488-5387

Correct citation for this publication:

Andres, B. 2015. Summary of reported Atlantic salmon (*Salmon salar*) catches and sightings in British Columbia and results of field work conducted in 2011 and 2012. Can. Tech. Rep. Fish. Aquat. Sci. 3061: 19 p.

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ABSTRACT

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The Atlantic Salmon Watch Program (ASWP) operated 1991-2003 by Fisheries and Oceans Canada (DFO) and the Province of British Columbia. The program monitored the abundance and distribution of Atlantic salmon (*Salmo salar*) in BC.

Field surveys recommenced in 2011-12 only on systems deemed at highest risk of having established feral populations. These focused field efforts included; surveying Georgie Lake, Songhees River and nine other stream systems all considered to be the most likely to harbour established feral Atlantic salmon populations.

No Atlantic salmon adults or juveniles were identified in any of these surveys.

RÉSUMÉ

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Le Programme de surveillance du saumon atlantique (PSSA), voué au suivi de l'abondance et de la répartition du saumon de l'Atlantique (*Salmo salar*) en Colombie-Britannique, a été exploité par Pêches et Océans Canada (MPO) et la province de la Colombie-Britannique de 1991 à 2003.

Les enquêtes de terrain repris en 2011-12 uniquement sur les systèmes jugés plus à risque d'avoir établi des populations sauvages. Les efforts ont été principalement déployés dans le lac Georgie, la rivière Songhees et neuf autres réseaux de cours d'eau, tous considérés comme les plus susceptibles d'abriter des populations ensauvagées de saumon de l’Atlantique.

Aucun saumon de l'Atlantique adulte ou juvénile n'a été repéré au cours de ces relevés.

1.0. INTRODUCTION

In the early 1990's, the Atlantic salmon Watch Program (ASWP) was established by Fisheries and Oceans Canada (DFO) and the BC Ministry of Agriculture, Food and Fisheries to monitor the presence of Atlantic salmon (*Salmo salar*) in BC streams and marine waters. The general objectives of the Program were to: increase the awareness of the presence of Atlantic salmon in British Columbia (BC) waters; expand the reporting of Atlantic salmon; establish and maintain a database of the number of Atlantic salmon reported and/or observed in BC; and prepare and publish annual reports of catches or sightings of Atlantic salmon.

As the program developed, the core elements of work undertaken through the ASWP were: (1) contacting a large number of individuals working in fisheries related activities to alert them to the monitoring program, (2) collecting and analyzing as many of the captured Atlantic salmon as possible, (3) retrieving catch data from several sources to provide information about the number of Atlantic salmon observed on an annual basis, and maintaining a public access information line for the reporting of Atlantic salmon. Additionally, an Atlantic salmon biological database was maintained through the ASWP.

Between 1992 and 1995, the number of reported Atlantic salmon catches and/or sighted ranged over an order of magnitude (1993 - 408; 1994 - >4500). A series of annual reports were published summarizing the reported Atlantic salmon catches and sightings (Thomson and McKinnell, 1993; 1994; 1995 & 1996) and the program remained active until 2003. The ASWP did not identify any evidence of established feral Atlantic salmon in any waters of BC, despite numerous systems where adults were reported, including some in spawning condition and one report of juveniles that were presumed to be a product of wild spawning (Volpe, Taylor, Rimmer and Glickman, 2000).

In December 2010, the federal government assumed primary responsibility for the regulation and management of aquaculture in British Columbia. As the lead federal agency, DFO became responsible for regulating, monitoring and licensing all marine finfish aquaculture operations in the province. As part of the establishment of the British Columbia Aquaculture Regulatory Program, the ASWP was re-established including a 24 hour reporting hotline and dedicated email address, to receive reports of Atlantic salmon catches and sightings.

The ASWP was re-established with three overall objectives: (1) to revive contacts with the various groups in the department whom, through regular programs, were likely to encounter Atlantic salmon in freshwater if present such as stock assessment and enhancement, (2) To re-invigorate the public reporting hotline and email inbox through promotion and responding to calls and emails in a timely manner and, (3) To undertake a focused field program to look at what may have occurred during the 8 year monitoring gap from 2003 to 2011.

The field program was developed to look specifically at waterbodies in which adult Atlantic salmon, and in one instance, juveniles had been previously identified. These included both Georgie Lake, which had previously been home to a freshwater aquaculture net cage system for the rearing of Atlantic salmon smolts and Songhees Creek, which drains Georgie Lake and in which, juvenile Atlantic salmon had been identified as outmigrant smolts in a previous study.

This report summarizes the results of surveys conducted in 2011 and 2012 and discusses potential areas of focus for the ASWP in the future.

2.0. METHODS

2.1. ASSESSING HIGH PRIORITY AREAS

Over the life of the ASW Program, Atlantic salmon have been identified in a relatively high number of coastal streams on Vancouver Island and it was identified that not all streams could be surveyed in one season. Therefore, a prioritization exercise – based on historic data was undertaken.

In 2011, DFO conducted an analysis of readily available data from 2003 to 2010 from stock assessment, enhancement, and other interest groups to identify high priority areas for survey. In order to further inform this process, DFO commissioned a review in early 2012, which would identify those areas most likely to have experienced colonization by Atlantic salmon based on the frequency of occurrences in the historic data and on the life stage of identified fish in those systems. Systems hosting juvenile Atlantic salmon would be considered higher risk for colonization based on the assumption that these fish, if they survived, would be hardier, imprinted on their “natal” stream, and more likely to return as spawning adults than would be adult salmon that entered into rivers having recently escaped from culture. To further identify systems as high risk, DFO contracted an analysis of available data, including provincial and private survey data to identify lakes and streams of high risk on Vancouver Island (Williams and McCorquodale, 2012. Pacificus Biological Service Ltd., Box 2760 Port Hardy, BC V0N 2P0, unpublished data).

High priority waters were surveyed preferentially during the 2011 and 2012 summer seasons in an attempt to identify the existence of feral Atlantic salmon in the event that the fish had managed to become established during the dormancy of the program.

2.2. RISK ASSESSMENT OF FERAL POPULATION ESTABLISHMENT

Due to the dormant period of the program between 2003 and summer 2011, there was an appreciable gap in survey effort and applicable data to direct future survey effort so criteria to focus the initial program efforts was required. It was determined that systems on Vancouver Island could be assessed for their risk of having established feral Atlantic salmon populations based on a number of factors. The risk analysis for Atlantic salmon establishment was conducted at two initial coarse levels. The first relied on information reported to the ASWP hotline and/or email inbox by the public and commercial sector over its existence. The second considered available information from other programs within the department such as stock assessment and escapement data as well as enhancement which conduct river surveys of various types and surveys A third metric considered Atlantic salmon adults and juveniles identified in freshwater systems within the historical ASWP records (1991-2010).

Based on these analyses, an initial series of snorkel survey swims in 2011 were conducted with the dual goal of re-initiating the program and increasing staff skills in conducting surveys and in the identification of Atlantic salmon in freshwater. During the spring of 2012, a private consultant was contracted to undertake a comprehensive literature review, including unpublished survey data to further focus program resources on a thorough investigation of freshwater systems considered "highest risk" for the establishment of feral Atlantic salmon populations based on the observed occurrence of adult Atlantic salmon and in particular, juveniles.

2.3. RIVER SWIMS

Snorkel surveys were conducted on 6 rivers in 2011 and eight rivers in 2012 (Table 1). Wherever possible, time frames, as well as put in and take out points from previous surveys (where Atlantic salmon had been observed) were used. Surveys were conducted with a minimum of two survey members. Water clarity and stream conditions were recorded, as well as the numbers of fish observed of each species. The number of surveyors used was dependent on the size of the system being surveyed. For smaller systems, two surveyors were used and three or four surveyors were used for larger systems such as the Nimpkish and Salmon Rivers. Wherever possible, surveyors entered the system at the same points as those used during previous surveys and floated downstream with the current. Surveys were not conducted unless visibility was considered adequate and periods of heavy rainfall were avoided.

Table 1: List of waterbodies surveyed by ASWP staff snorkel swims in 2011 and 2012.

2011	2012
Marble River	Marble River
Nimpkish River	Amor de Cosmos River
Adam/Eve River	Nimpkish River
Salmon River	Adam/Eve River
Colonial River	Salmon River
Cayeghle River	Tsitika River
	Campbell River
	Quinsam River

Surveyors recorded the estimated numbers of all species of fish observed. Large pools were drifted multiple times as necessary to increase the accuracy of the assessment. Surveyors also put additional focus on areas of each system that supported juvenile salmonids. Juvenile salmon encountered during swims were carefully observed to ensure that all life stages of Atlantic salmon were surveyed for. A tactic commonly used was holding station in a pool, undercut bank, or root wad and waiting for fish to return after initially being spooked by the surveyor. This method works well because the fish tend to return in small numbers and can be individually assessed.

2.4. LAKE SURVEY

As a result of an Atlantic salmon smolt production facility on Georgie Lake, historical occurrences of juvenile Atlantic salmon were frequently reported during the period leading up to 2003. These fish were presumed to have escaped from the net cage smolt rearing facility located on Georgie Lake. During the previous decade from 2002 to 2012, the facility contained fish on several occasions from Sep-03 – Aug-04, May-05 – May-07, Jul-07 – Nov-07, Jan-09 – May-09, Jul-09 – Dec-10. The facility operator expressed their intention to begin reusing the facility in July 2012, after a period of latency since December 2010. Georgie Lake was chosen for intensive survey effort in 2012 to ensure that if any Atlantic salmon were identified in the system, particularly juveniles, they would have to have come from previously established feral populations and not from the new fish to be entered.

The lake survey consisted of setting a winged lake box trap (Figures 1 & 2) along a prominent point of shoreline on Georgie Lake. A box trap is commonly used in lake systems to capture fish moving along a shoreline or at other pinch points. Trap location was based on proximity to the aquaculture facility and at a location deemed most likely to intercept outmigrant smolts near the outlet stream, using prominent current direction (Figure 3). The lake trap was operated for a period of 5 days from May 15 to 17, 2012. The trap was checked daily and all fish caught were enumerated and released to local waters outside the trap.

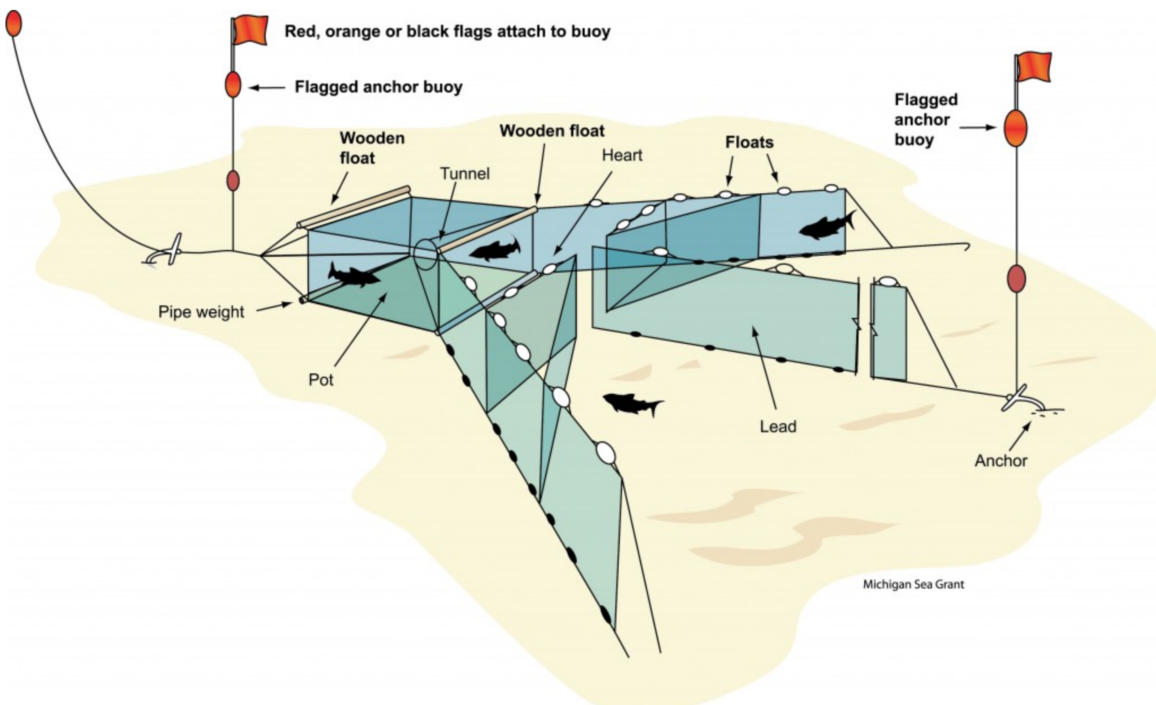

Figure 1: Diagram of lake net box trap, similar to that used in Georgie Lake (Kinnunen, R. 2012. Michigan State University, USA. Retrieved November 2014 from www.msue.anr.msu.edu/news).

Figure 2: Lake net trap set along the shore of Georgie Lake, north of net pen facility, near outlet. (Photo: Byron Andres, May, 2012).

Figure 3: Songhees Creek drainage showing connection to Georgie Lake, trap location, rotary screw trap location, and Songhees Creek outlet (Retrieved July 13, 2012 from www.earth.google.com).

2.5. ROTARY SCREW TRAP

Songhees Creek is a relatively small creek that drains Georgie Lake to the Pacific Ocean (Figure 3). During surveys of this system conducted by consultants in previous years, using a rotary screw trap (RST), a relatively high number of out-migrant Atlantic salmon smolts were observed (Pacificus, 2008. Pacificus Biological Service Ltd., Box 2760 Port Hardy, BC V0N 2P0, unpublished data). It is presumed that these fish represented escapees from the freshwater smolt production facility on Georgie Lake above. For this reason, the Songhees Creek system was identified as having among the highest risk of established Atlantic salmon populations of any of the systems previously surveyed due to the presence of smolts that may have imprinted on the system. One of the primary considerations in the likelihood of escaped fish surviving to breed is the age at escape.

Mature fish reared in containment have extremely high caloric requirements and have reached adulthood without ever having to find food on their own. It is presumed that fish that escape as juveniles and subsequently survive to adulthood would have a more natural dietary regime and caloric requirements similar to wild fish. In order to best assess Songhees Creek, which is too small for conventional snorkel survey techniques, a RST was installed for 3 weeks, capturing the observed peak of the bell curve for out-migration previously established by surveys in the past (Figure 4). This survey method replicated that used in 2008, when the greatest numbers of Atlantic salmon smolts were previously recorded (Figure 5) (Pacificus, 2008. Pacificus Biological Service Ltd., Box 2760 Port Hardy, BC V0N 2P0, unpublished data).

Figure 4: Looking downstream at the RST located in Songhees Creek (Photo: Byron Andres, May, 2012).

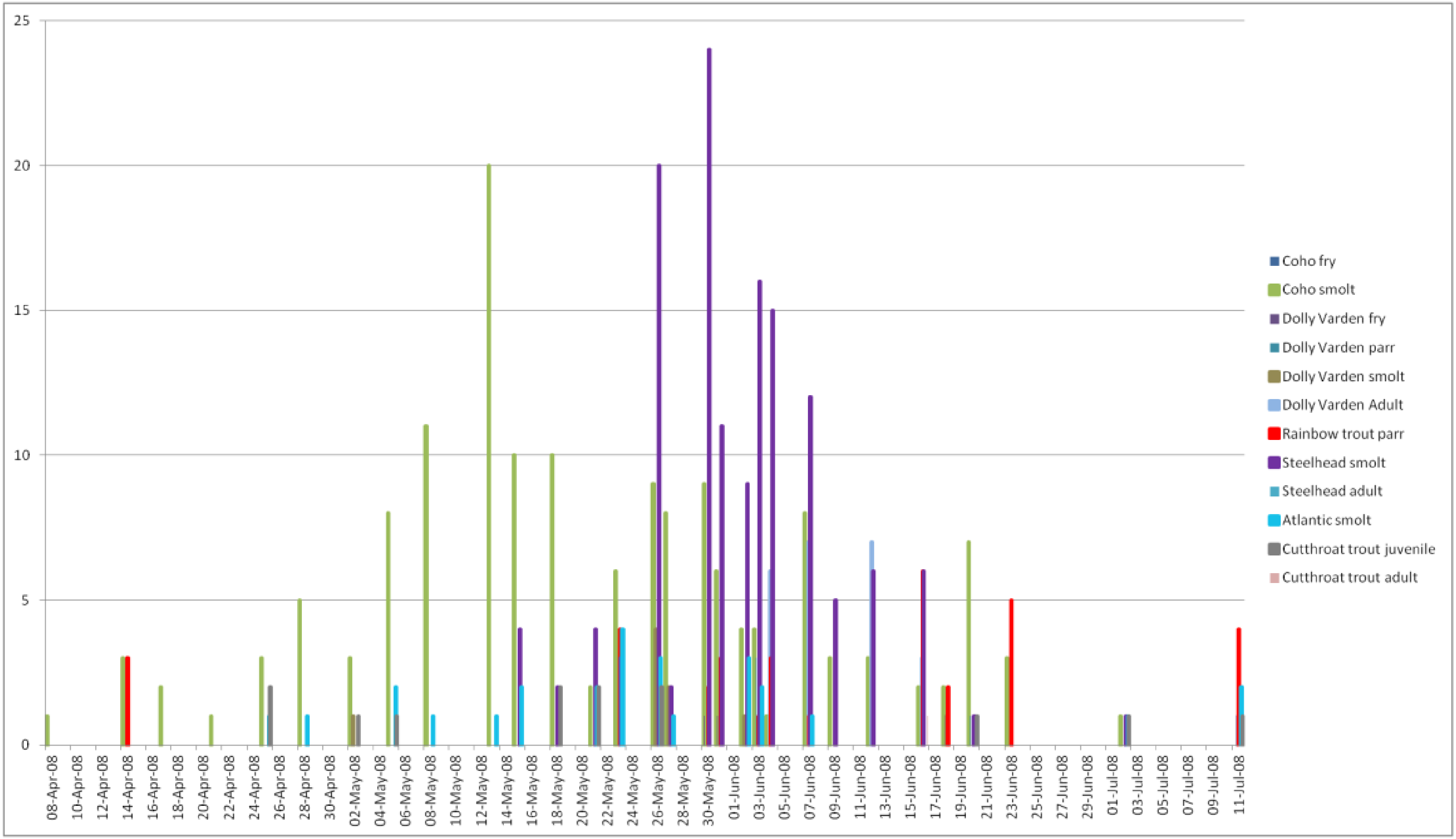

Figure 5: Histogram of out-migration timing for species captured in the lower Songhees Creek watershed trap in 2008. The number of fish is shown on the x-axis and the date of capture on the y-axis (Pacificus, 2008. Pacificus Biological Service Ltd., Box 2760 Port Hardy, BC V0N 2P0, unpublished data).

During operations, a mark recapture program was conducted to determine trap efficiency using coho salmon smolts that were fin clipped for identification purposes. A portion of fish captured were marked using fin clips and subsequently released upstream of the trap location. The proportion of these fish that are subsequently recaptured provides an estimate of the proportion of total out-migrants that the trap is likely to intercept, known as trap efficiency.

3.0 RESULTS

3.1. OVERALL FINDINGS

Based on the 2011-12 assessed risk analysis for Atlantic salmon establishment the watersheds identified as highest risk were:

1. Songhees Creek
2. Adam/Eve River
3. Tsitika River
4. Salmon River
5. Amor de Cosmos River
6. Gold River
7. Campbell River
8. Thasis River
9. Zeballos River
10. Nimpkish River

Table 2 summarizes the results for snorkel surveys conducted in 2011 and 2012. No Atlantic salmon were identified during any of the stream surveys conducted. In general, survey conditions were favorable with good water clarity and the number of surveyors was appropriate for the size of the system to ensure good coverage. In 2011, stream clarity was given a subjective rating by surveyors; however, this rating system was aligned with the more readily used system by the department for 2012. In 2011, a rating of good equates to a visibility of more than 5m, and fair to clarity from 0 - 5m. Surveys were conducted during fall migrations of Pacific salmon species. In many instances, the first pass through a pool was not sufficient to determine with confidence that all of the fish had been seen and a second or third pass was conducted. It should be noted that in 2011, the Salmon River was swum as part of staff training; however, training was being provided by Mike Lough, a recognized expert in the survey of Atlantic salmon in freshwaters.

Table 2: Summary of snorkel swim data from Atlantic Salmon Watch Program swim surveys in 2011 and 2012. NR= Not Recorded

			Salmonid Species									
Year	System	Visibility	Coho	Chinook	Pink	Chum	Sockeye	**Atlantic**	Cutthroat	Steelhead	Unidentified trout	Dolly Varden
2011	Marble	good	200	300	0	0	0	**0**	NR	NR	NR	NR
2011	Nimpkish	good	200	100	100	3	500	**0**	NR	NR	30	NR
2011	Adam/Eve	fair	NR	NR	NR	NR	NR	**0**	NR	NR	NR	NR
2011	Salmon	fair	NR	NR	NR	NR	NR	**0**	NR	NR	NR	NR
2011	Colonial	good	500	300	20	3000	0	**0**	NR	NR	NR	NR
2011	Cayeghle	good	300	200	5	3000	0	**0**	NR	NR	NR	NR
2012	Marble	10m	6	0	0	0	0	**0**	12	6	NR	NR
2012	Amor de Cosmos	8m	20	NR	NR	NR	NR	**0**	7	5	550	15
2012	Nimpkish	10m	200	150	30	0	5050	**0**	25	40	140	NR
2012	Adam/Eve	6m	12200	40	30000	NR	1	**0**	NR	NR	6100	NR
2012	Salmon	8m	2300	160	84000	NR	NR	**0**	260	300	200	20
2012	Tsitika	5m	1300	9	1210	0	0	**0**	NR	NR	2500	52
2012	Campbell	4m	NR	12	NR	15	0	**0**	1	3	1	NR
2012	Quinsam	1 m	60	NR	300	NR	0	**0**	5	3	5	NR

Surveys were planned for the Mahatta River and Gold River in 2012, but were not completed due to budget constraints. These systems were identified as survey priorities due to the incidences of escapes that have been reported near to them in the recent past and remain priority survey locations for the next period of intensive survey.

3.2. GEORGIE LAKE

Table 3 summarizes the capture results for the Georgie Lake trap set. Although a relatively high number of fish were captured, none of these were identified as Atlantic salmon. A large number of coho salmon smolts were identified as the trapping period (mid-may) corresponds with normal peak coho salmon smolt outmigration on this system (Pacificus, 2008. Pacificus Biological Service Ltd., Box 2760 Port Hardy, BC V0N 2P0, unpublished data). A large proportion of Dolly Varden char were also captured as well as lesser numbers of cutthroat trout. These trapping results indicated Atlantic salmon smolts were captured between April 8 and 11th of July 2008 and the trapping period in 2012 was chosen to fall within that time frame.

Some of the trout species captured were not identified to species. This was due to their relatively small size which would significantly increase the handling time required to identify them to species.

Table 3: Summary of data from a "box" lake trap set in Georgie Lake from May 14-17, 2012. No fish were recorded on May 14 as the trap was not set on that day.

	Salmonid Species					
Date	Coho	Dolly Varden	Steelhead	Cutthroat	Unidentified Trout	**Atlantic**
15-May-12	23	115	1	4	9	**0**
16-May-12	14	77	0	8	0	**0**
17-May-12	25	17	0	2	2	**0**

3.3. SONGHEES CREEK

Table 4 summarizes the capture results for the RST trap on Songhees Creek. The vast majority of fish captured were Salmon smolts and steelhead trout smolts. A few adult steelhead trout were also captured as well as a few Dolly Varden char and cutthroat trout of various sizes. The rise of relative capture numbers of coho salmon smolts as well as the steadily increasing number of steelhead trout smolts captured indicates that the trap was set in a period likely to capture out migrant Atlantic salmon in the event that they occurred in the system when compared to the capture results reported by Pacificus (2008, Pacificus Biological Service Ltd., Box 2760 Port Hardy, BC V0N 2P0, unpublished data). The mark recapture program using coho salmon smolts determined that the trap was operating at an efficiency of 22.2%, with 12 of the 54 fish marked being recaptured within the time frame of the operation (note that this is a conservative estimate as it assumes 100% survival of marked fish after handling and that all would have passed back through the area where the trap was set during the time frame analyzed).

Table 4: Summary of RST capture data from Songhees Creek in May, 2012.

	Salmonid Species				
Date	Coho	Cutthroat	Dolly Varden	Steelhead	**Atlantic**
02-May-12	3	0	0	1	**0**
03-May-12	0	0	2	1	**0**
07-May-12	7	0	0	0	**0**
10-May-12	22	0	0	0	**0**
14-May-12	45	0	3	2	**0**
17-May-12	102	0	2	3	**0**
18-May-12	12	0	1	4	**0**
19-May-12	16	2	0	4	**0**
22-May-12	44	0	2	10	**0**
25-May-12	27	5	1	10	**0**
28-May-12	48	0	1	17	**0**
31-May-12	62	0	8	41	**0**

4.0. DISCUSSION

Abundant pink salmon runs on the Adam/Eve in 2011 and 2012 and on the Salmon River in 2012 posed challenges due to the high number of fish throughout the system with groups of fish in pools or riffles frequently exceeding 1000 in number, making the likelihood of identifying single Atlantic salmon individuals less likely. A common method of survey employed here was to hold station in pools and allow fish to return in small numbers after having been spooked from a pool.

Snorkel surveys are an effective means of counting fish; however, there are some challenges that bear mentioning in the context of identifying individuals of one species among relatively high numbers of another species. This is made more difficult by the relative similarity of adult salmon species to one another and by the fact that individual fish rarely stay still or swim slow enough for specific characters such as the number of anal fin rays to be counted. The primary character for identifying Atlantic salmon is the large, dark spots on the operculum. When fish are holding position over the bottom or near a root wad or other structure, these spots would be relatively easy to distinguish; however, fish most often exhibit an avoidance response to surveyors as they move through the system. When numbers of fish are high, such as during pink salmon runs, there can be many hundreds of fish swimming past the observer at high speed. Even high quality video record of swims (recorded for portions of swims in 2011 and 2012) does not facilitate the accurate assessment of these characters when analyzed in office.

In circumstances where fish were observed at lower densities and/or at slower speeds, there is a high level of confidence that an Atlantic salmon would have been identified if present. In some circumstances; however, where a single fish might be present among an estimated 20,000 wild pink salmon, confidence is reduced. Thus, the value of these surveys would be in the identification of Atlantic salmon when occurring in numbers in the system, as would be expected in the incidence of an established feral population. Single individuals or individuals occurring below detection limits are assumed to represent a low risk of colonization. It is further recognized that snorkel surveys represent a "snapshot" look at the fish present in a system and, in ideal circumstances, would be repeated several times on each system. As budget constraints made this level of effort prohibitive, it was decided that the approach would be to swim multiple rivers once instead of single rivers multiple times. This is because the primary goal of the surveys is to identify established feral populations rather than individual stray fish. Single surveys are considered a viable means of meeting this goal.

The efforts that were undertaken in the Atlantic Salmon Watch Program in 2011 and 2012 were focused on freshwater systems determined to be of the highest risk of feral

Atlantic salmon population establishment. Colonization of a river system would be expected to be characterized by the presence of juvenile life stages as well as adult life stages at the time surveys were conducted. Snorkel surveys were conducted in 10 river systems between 2011 and 2012. All three river systems identified by Ginetz (Ginetz, R. 2002. BC Salmon Farmers Association, #201-909 Island Highway, Campbell River, BC V9W 2C2, unpublished data) and Volpe (Volpe, J. P. 2000. Department of Biology and Centre for Environmental Health, University of Victoria, Box 3020, Victoria BC, V8W 3N5, unpublished data) were surveyed. Georgie Lake and the associated drainage of Songhees Creek were surveyed intensely and no Atlantic salmon of any life stage were identified in any of these surveys. As a result of these survey efforts, it can reasonably be concluded that despite the unintended introduction of both adult and juvenile Atlantic salmon into a number of systems in BC, the establishment of feral populations has not occurred. Further, at present levels and current conditions, the occasional escape of Atlantic salmon from culture can be considered low risk.

Despite these findings, continually changing oceanic and freshwater conditions may function to alter the ability of escaped Atlantic salmon to occupy and colonize BC waters (Ginetz, R. 2002. BC Salmon Farmers Association, #201-909 Island Highway, Campbell River, BC V9W 2C2, unpublished data); either by altering overall environmental conditions or by altering the competitive environment that escaped fish would need to exist in. Although the occurrence of large escape events has declined significantly over time as a result of improved infrastructure and industry practices, escapes remain an inevitable consequence of the industry (Cote, Fleming, Carr, and McCarthy, 2012).

The department continues to encourage and monitor reports of Atlantic salmon encounters from the public and other DFO sectors to the Atlantic Salmon Watch Hotline as well as escape information from industry in order to continually assess the risk of feral Atlantic salmon establishment and to inform future survey efforts. If there is reason to suspect that some systems are at higher risk of colonization as a result of significant escape events or by reports of encounters on that system, more intensive survey effort may again be implemented to determine if colonization by feral Atlantic salmon populations has occurred.

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6.0. ACKNOWLEDGEMENTS

This project is made possible through funding from the Aquaculture Management Program, Pacific Region, Fisheries and Oceans Canada.

Special thanks are due to the biologists Erika Grebeldinger, Steven Schut, Shane Peterson, and Nathan Blasco, for their participation in field studies. Pacificus Biological Services Ltd. provided invaluable assistance in setting up and monitoring rotary screw trap operations.

Additional thanks are due to Gary Taccogna, Regional Manager of Aquaculture Environmental Operations for several reviews of draft manuscripts of this report. Additional reviewers include March Klaver, Andy Thomson, Jon Chamberlain, of Fisheries and Oceans Canada, and finally, Angela Spooner who provided final edits and formatting.