Migration, Behaviour and Habitat Selection by Anadromous Brook Trout, *Salvelinus fontinalis* (Mitchell), in a Nova Scotia Southern Upland:

FFRC Year-End REPORT

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Accomplishments and Updates 2010

Capture, Tagging and Monitoring

This project was an extension of the 2009 acoustic telemetry project conducted in West River, Sheet Harbour (WRSH). Funds from the 2010 FFRC were used to purchase 16 acoustic tags. These tags were implanted in wild anadromous trout in late April and early May 2010 and monitored until they returned to freshwater in the end of June (Table 1). Trout were captured via rotary screw trap (RST, aka "Smolt Wheel") situated on the main brand WRSH approximately 7.5 km upstream from the head of tide (HoT) and a fyke net situated at the mouth of Little River, the second largest tributary to the WRSH , approximately 6.7 above HoT. Trout capture piggy-backed the WRSH smolt estimation program run by the Nova Scotia Salmon Association.

Table 1 – Summary of trout outfitted with acoustic tags. TD-ID tags are temperature + depth _+ ID. Tag-to-body-weight ratio calculated based on a tag weight of 6.4g for TD-ID tags and 4.9g for ID-only tags.

Year	Total # Tagged	# TD-ID tags	# ID-only tags	Mean Fork Length (cm)	Body Weight (g)	Tag-to-weight Ratio (%)	Release Dates (n)
2009	16	3	13	25.4 (sd = 3.2)	157 (sd = 65)	3.5% (sd = 0.8%)	April 30 (3), May 3 (2), May 6 (3), May 9 (5) May 14 (3)
2010	16	6	10	25.4 (sd = 3.2)	155 (sd = 58)	3.7% (sd = 0.9%)	April 22 (3), April 26 (7), April 29 (3), May 12 (3)

In addition to collecting trout for acoustic tracking, we also conducted a capture-mark-recapture study to estimate the population of downstream-migrating trout, assumed to represent the anadromous population. A total of 98 trout were captured in the RST leading to an single strata estimate of 350 downstream migrating trout (95% C.I. = 190, 511). In the fyke

nets set on Little River, a total of 209 trout were captured. Based on two strata, the total estimate of downstream-migrating trout was 1188 (95% C.I. = 668, 1708). Capture efficiency for the RST was approximately 26.5% while efficiency at the fyke net was 11.5% and 18.3% for strata 1 and strata 2, respectively. Total catch was related to flow (ANCOVA, $p<0.01$) and mean daily water temperature (ANCOVA, $p<0.01$).

Table 2 – Results of ANCOVA analysis of trout capture (response variable) vs. Capture Platform (RST vs. Fyke Net), Day-of-year, Water Level (at gauge located ~ 30km above HoT) and Mean Daily Water Temperature (at each site).

	Df	**Sum Sq**	**Mean Sq**	**F value**	**Pr(>F)**	
Capture Platform	1	29.434	29.434	3.6737	0.065534	.
Day-of-year	1	8.695	8.695	1.0853	0.306424	
Water Level	1	88.15	88.15	11.0024	0.002528	**
Mean Daily Water Temperature	1	173.63	173.63	21.6715	7.12E-05	***
Residuals	28	224.333	8.012			

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36 observations deleted due to missingness

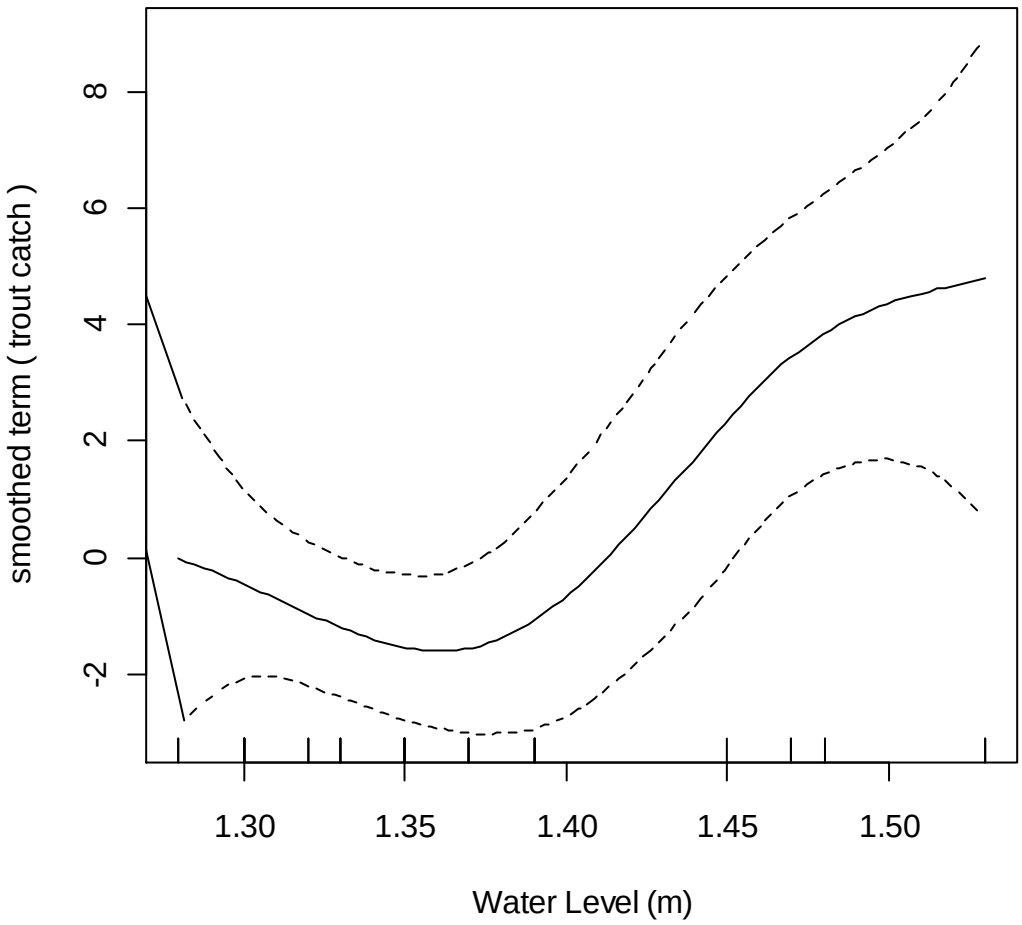

Figure 1 – The influence of water level on trout catches as predicted by the general additive model catch ~ s(water level). Model parameters are as follows: R^2 = 0.26, p <0.01 and total deviance explained = 33.1%.

In 2010, a total of 16 acoustic receiver s were moored throughout the lower river, estuary and harbour to track movements of brook trout. Based on this passive monitoring, a total of 41 666 detections were recorded, providing ample data to elucidate migration patterns, habitat use and survival. Additionally, active tracking using a mobile receiver was conducted from early May until mid-June and provided positional estimates for trout outside the area being monitored by moored receivers.

Trout Migration

Of the 16 trout released in 2010, only 12 were detected entering the estuary. Of the 12 that entered the estuary, only 3 were detected re-entering the river at the end of their marine sojourn. The mean date of entry into the estuary was May 5th (sd=9.1 days, n=12) and the mean date of re-entry into the river was July 1st (sd = 7.7 days, n=3), resulting in a mean saltwater residency of 55.9 days (sd=13.1 days, n=3).

Of the four trout that were not detected in the estuary, two of these were detected on the receiver situated at the downstream end of Sheet Harbour Lake, immediately upstream of HoT. These trout either reversed migration direction and migrated back into the river and/or tributaries or died en route to the salt water. A third trout was located via active tracking at the mouth of Little River (the release site)on June 10th . This fish had not been detected at this location during previous active tracking searches in that area nor ever again.

For the 9 trout assumed to have died in the saltwater, only one was last detected in the inner estuary (last detection = 1.4 km seaward of HoT) while all other successfully migrated past the outer extremities of the monitoring program (~11 km seaward or HoT) and failed to return inside the monitored area. Based on "sweeps" during active tracking where the presence/absence of tags in a given area is determined with reasonable confidence, the tag of the one trout assumed to have died in the inner estuary could not be located and thus it was assumed that the tag was removed from the water. Time relative to death is unknown (i.e. scavenging vs. predation).

As an interesting point, one of the trout lost in the outer estuary was detected seeming alive on June 5th, swimming in water less than 0.5 m deep and at temperatures of approx.. 11° C. However, on June 6th, and again on June 11th, that same tag was detected on neighbouring receivers at depths of 8 to 11m and at an ambient temperature of 35° C. Thus, it is most plausible that this tag was within the gastro-intestinal tract of a marine mammal. Having reported no porpoise sighting during approximately 35 days on the water in Sheet Harbour over

the two field season, and approximately 40-60 seal sightings over that same period, it is likely that the mammal was a seal.

Migration within the salt water generally followed one of two patterns. First, trout quickly migrated through the estuary and arrived in the harbour (e.g. Fig. 2). These fish continued to migrate past the outer limits of our receivers and are assumed to have moved along the coast, as verified by active tracking. Other trout quickly moved to the outer estuary and harbour, however unlike the first movement pattern, these fish continually revisited the middle section of the estuary and harbour (e.g. Fig. 3).

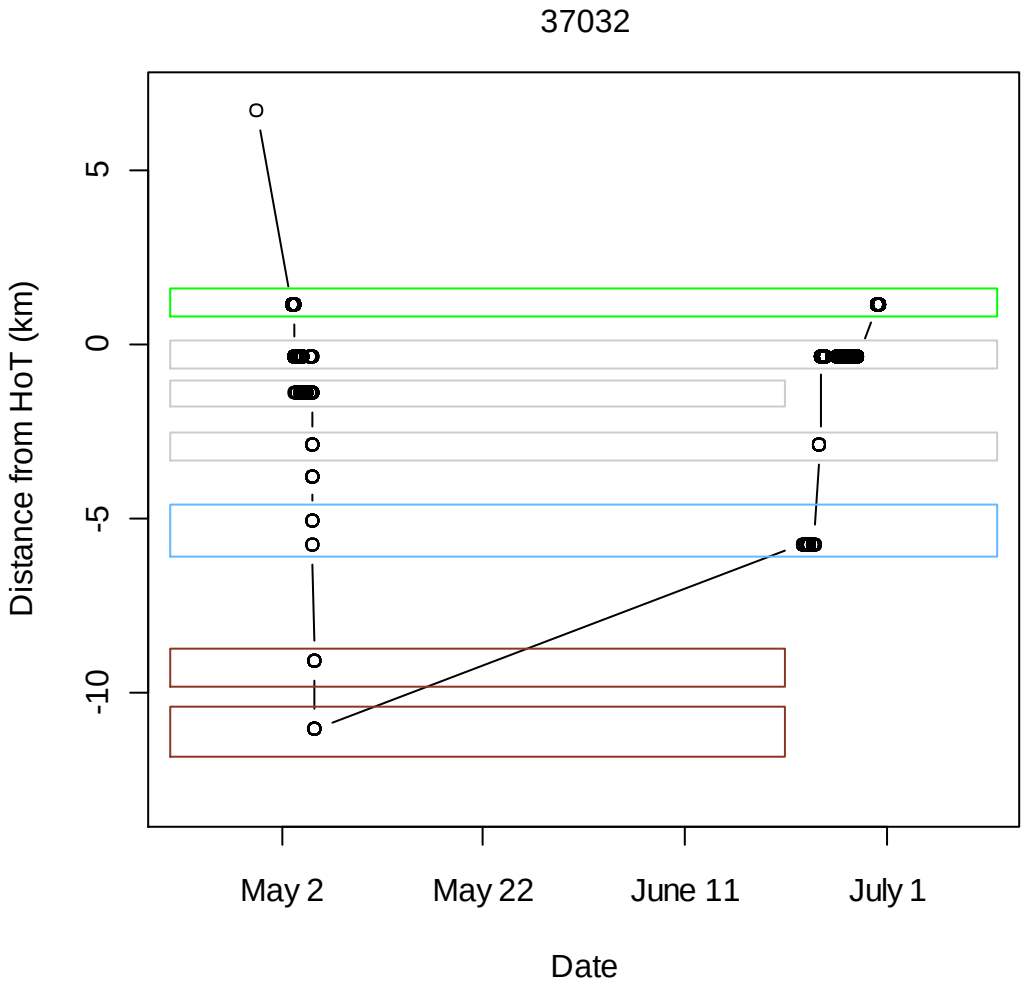

Figure 1 – An example of trout movement exhibited by those quickly exiting the monitored portion of the harbour. This particular trout remained at-large and returned to the river at the end of June. The horizontal bars represent zones monitored by moored receivers, both spatially (y-axis) and temporally (x-axis). The green box is at the base of Sheet Harbour Lake, the three grey boxes at in the inner estuary , the blue box represents two successive receivers in the outer estuary and the two brown boxes are the outer limits of the harbour.

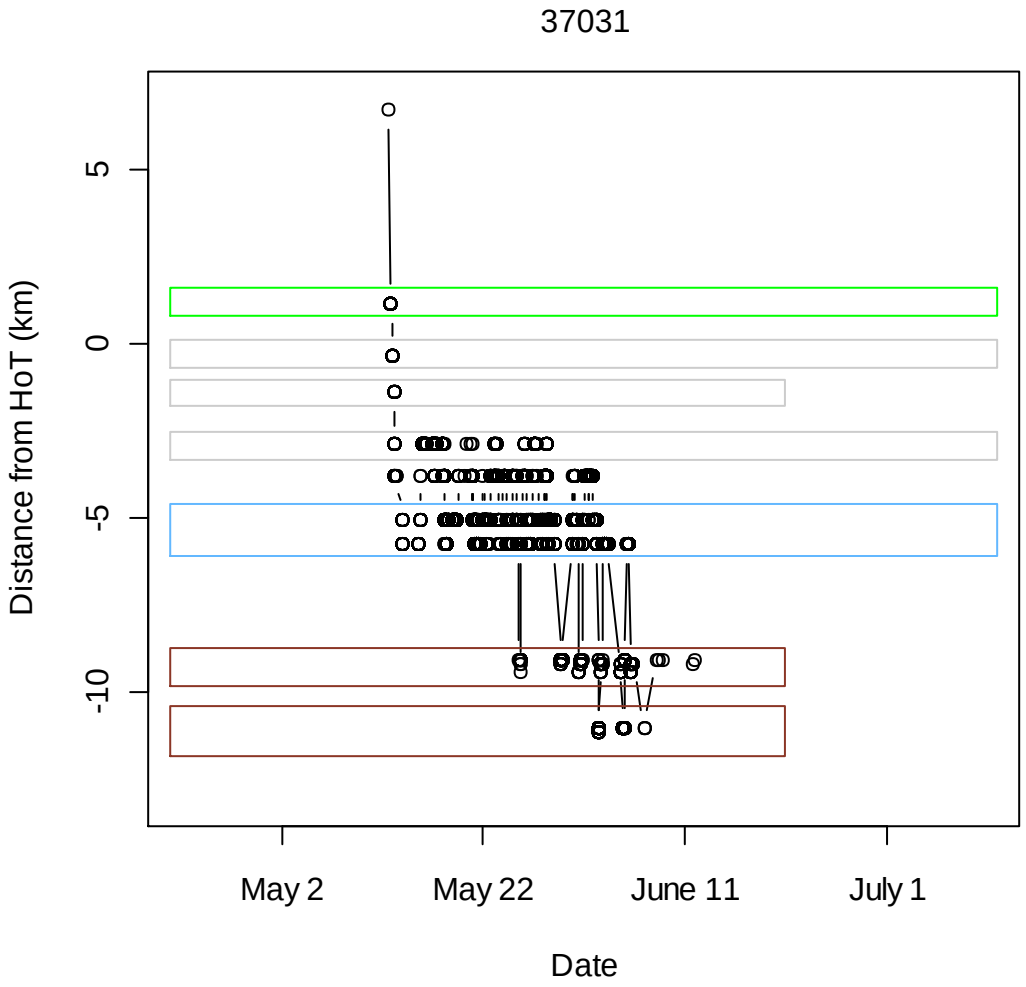

Figure 2 – An example of trout movement exhibited by those moving quickly to the outer estuary and harbour, and then returning regularly too the middle reaches of system. The horizontal bars represent zones monitored by moored receivers, both spatially (y-axis) and temporally (x-axis). The green box is at the base of Sheet Harbour Lake, the three grey boxes at in the inner estuary , the blue box represents two successive receivers in the outer estuary and the two brown boxes are the outer limits of the harbour.

Outstanding Issues

- Full analysis and manuscript writing must be completed.

- The VR100 active tracking receiver containing the first 3 weeks of active tracking data is currently in Resolute, Nunavut and must be recovered for all data to be retrieved.

- Insufficient stomach samples (n=12) were collected from Sheet Harbour in 2010 to perform stomach analyses and stable-isotope analysis and additional samples need to be collected in 2011.

- An assessment of habitat preferences, based on physical habitat parameters, will be completed in 2011. Using data collected in 2009 and 2010, areas of High, Moderate and Low occupancy will be created and following a stratified random selection process, sites will be surveys via snorkelling to quantify each site.

- In 2010, predator surveys were conducted in the estuary of the West River. These surveys provide an estimate of the abundance, diversity and spatio-temporal distribution of predators that may consume trout. Analyses will be completed in 2011 and will examine the total potential consumption of brook trout and Atlantic salmon smolts, using both quantitative diet models and bioenergetics models.