

# 2010 RAINBOW SMELT REPORT

The annual spawning migration in streams throughout  
the Lake George Watershed



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Photo by Jeremy Parnapy: Smelt in English Brook, Town of Lake George. Cover Photo by Jeremy Parnapy: Smelt in West Brook, Town of Lake George. Opposite Photo: Underwater photo of a streambed.

**The collection or possession of rainbow smelt in the Lake George watershed is prohibited by the New York State Department of Environmental Conservation who continue to be concerned about the stability of smelt populations in Lake George in the face of abundant predator fish populations and variable spawning success.**

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by Corrina Parnapy  
Contract Biologist  
The Lake George Waterkeeper



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# Executive Summary

The Lake George Waterkeeper is a program of the FUND for Lake George and defends the natural resources of Lake George and its watershed. In 2009, the Stream Assessment Project of the Lake George Waterkeeper, in cooperation with the New York State Department of Environmental Conservation (NYSDEC) and the Lake George Fishing Alliance, started recording observations of the annual spawning migration of rainbow smelt within streams tributary to Lake George. A report was issued about the 2009 smelt run on Lake George. Rainbow smelt are a small, dark, slender fish that have fang-like teeth, a protruding lower jaw, deeply forked caudal fin and like other Salmoniformes, possesses an adipose fin. While smelt typically live in salt water and spawn in freshwater streams, landlocked populations have been introduced as forage for larger game species of fish such as landlocked salmon and lake trout. In Lake George smelt were introduced in the early years of the 20th century. Smelt begin to enter streams to spawn just after ice-out in early to mid April.

The Stream Assessment Project of the Lake George Waterkeeper became interested in monitoring the annual migration of smelt in Lake George streams to assess the presence of smelt and determine factors that may influence their spawning habits. This may provide information on the health of streams within the Lake George watershed and water quality in general of Lake George. Smelt have become an important component of the Lake George fishery because landlocked salmon and lake trout populations have switched from eating ciscoe to smelt. There is also concern over the stability of the rainbow smelt populations in Lake George. In the late 1980s these concerns resulted in a ban on the collection or possession of smelt in the Lake George watershed by the NYSDEC and these restrictions remains in effect today. To this day, little data exist on smelt populations in Lake George except for anecdotal observations made by the public and the NYSDEC. Therefore, this study was initiated by the Lake George Waterkeeper and sixteen streams were monitored along the west shoreline of Lake George during this study. Observations on the presence and estimated abundance of smelt and smelt

eggs were made during the daytime and after dark within a two-week time period. Chemical and physical data on the streams were collected at each visit. Data indicated that rainbow smelt migrated into all of the 16 streams monitored in this study. Relatively strong runs were observed in 5 streams. It is reasonable to assume that the number of smelt has increased since the ban was implemented in the 1980s; however observations by volunteers and fishermen indicate the number of rainbow smelt is still not what it historically was.

A variety of factors may be affecting smelt spawning and populations in Lake George including structural impedance in streams, siltation of the streambed, foraging pressure from other fish and birds, competition for food or habitat, poaching, physiological stressful conditions and alterations to the environment. It has been proven that upland development, stormwater runoff, nutrient pollution, road salt and loss of riparian zones have negative impacts to streams. Therefore, these negative impacts to our streams place risks on the spawning success of smelt. Further research and data is needed to determine the potential influence of these factors to the annual smelt spawning migration. All data collected is contained in this report and is available to the public. We encourage the application of this data be used for land-use and policy decisions and for better management and protection of the Lake George watershed.



Christopher Navitsky, PE  
Lake George Waterkeeper

## About the Author

Corrina Parnapy conducted the 2010 Annual Smelt Spawning Migration Study. She is a contract biologist working with the Lake George Waterkeeper Program of the FUND for Lake George. Corrina received her B.A. in biology from Skidmore College where she concentrated in limnology and wrote her thesis “A Guide to the Common Algae of the Lake George Watershed.” She also received her A.A.S in environmental studies from SUNY Cobleskill with a concentration in fisheries. Prior to conducting the smelt study, Corrina was employed by the Lake George Waterkeeper as the field technician in the Stream Assessment Project for both 2008 and 2009 where she conducted physical, chemical, and biological monitoring of streams tributary to Lake George in northern New York, as well as conducted the first comprehensive study of algae as indicators of water quality in streams tributary to Lake George (published 2010).



# Abstract

In 2009 the Stream Assessment Project of the Lake George Waterkeeper initiated a study of the annual spawning migration of streams tributary to Lake George in cooperation with the NYSDEC and the Lake George Fishing Alliance. In 2010 the study was expanded with the addition of new parameters and the use of volunteers. Accessible streams tributary to Lake George were monitored during the daytime and after dark for two weeks during the spawning period in early to mid-April. Observations on the presence and estimated abundance of smelt and smelt eggs were made during each site visit.

Physical parameters were measurement on multiple visits during the spawning period and included the stream wetted width, depth, velocity, streambed composition, water temperature, riparian buffer, algae present and air temperature. Chemical parameters were also measured during the spawning period on multiple visits and included pH, specific conductance, and dissolved oxygen. Data indicated rainbow smelt migrate in all of the 16 streams monitored in this study. Many factors could be affecting the smelt populations such as structural impedance, siltation, foraging pressure, habitat alteration, physiologically stressful conditions, and poaching. Future monitoring is recommended to determine the influence of these factors on the annual spawning migration of rainbow smelt in streams tributary to Lake George in northern New York.



Corrina A. Parnapy  
Contract Biologist

# Introduction

Rainbow smelt (*Osmerus mordax*) are a small, dark, slender fish that have fang-like teeth, a protruding lower jaw, deeply forked caudal fin and like other Salmoniformes, possesses an adipose fin.



Picture of a rainbow smelt.

Rainbow smelt are anadromous: residing in saltwater and entering freshwater streams to spawn. Landlocked populations also occur in freshwater lakes, rivers and ponds through stocking practices both intentional and accidental. Smelt are stocked into bodies of water as a prey species for game fish including lake trout and landlocked salmon. In Lake George smelt are replacing ciscoe as the primary prey species of landlocked salmon and lake trout. Smelt reach sexual maturity between 2 and 3 years of age, live for 5-9 years and can grow to 9+ inches in length.

The first reported introduction of smelt into Lake George was conducted to enhance the Lake trout fishery in 1918, when approximately 2.5 million smelt were released and again in 1921 when 5 million were released. (Moore 1930) The most recent release was in 2002 when the Lake George Fishing Alliance collected approximately 1 million eggs from tributaries around Indian Lake. Mats laden with smelt eggs were then placed into Smith Brook and Jenkins Brook. (LGFA)

Rainbow smelt within Lake George spawn after ice-out when stream water temperatures reach between 42 degrees and 45 degrees F. Spawning will last for a

couple of weeks, generally in early to mid April. During the spawning migration adult fish, like other Salmoniformes, show some preference to their natal stream. (Maine Department of Inland Fish and Wildlife)

Spawning occurs at night; however smelt can be seen migrating into the streams during the day. Males are first to move into the spawning grounds followed by the females. Females tend to live longer, grow faster and are larger than the males. (NCR) Once in the streams, the female hover just above the streambed and move their bodies slowly side to side releasing small groups of eggs, which the males then fertilize. (Crestin 1973) The eggs are adhesive, 1.0mm to 1.2mm in size and can number up to 93,000 per female. The outer membrane of the egg ruptures during water-hardening and will remain attached to the substrate by a stalk, allowing the egg to sway in the water to optimize dissolved oxygen uptake. (NCR) Eggs hatch by early to mid May depending on water temperature. Larvae smelt drift downstream where they will remain close to shore negatively buoyant and hide within vegetation not far from the mouth of the stream. (Bradbury 2006)

Smelt spawning migrations have been recorded in many streams tributary to Lake George in northern New York. (George and Gordon 1976; NYSDEC unpublished data) In 1988, concern over the decline in smelt populations and the potential effect on the multi million dollar fishing industry led to the ban of the collection and possession of smelt within the Lake George watershed. The NYSDEC continues to be concerned about the stability of the smelt population. (Keppler 2010)



Smelt in Hague Brook, Town of Hague.

Little data has been collected on the annual smelt spawning migrations, with the exception of the baseline data collected by the Lake George Waterkeeper Stream Assessment Project in 2009 and anecdotal observations by the NYSDEC and the public. Therefore, the Lake George Waterkeeper along with volunteers, in cooperation with the NYSDEC and the Lake George Fishing Alliance initiated efforts to monitor the annual smelt spawning

migration in streams tributary to Lake George.

The Lake George Waterkeeper is a program of the FUND for Lake George and is dedicated to defending the lake's natural resources. In 2006, the Lake George Waterkeeper initiated the Stream Assessment Project to collect data, research streams and develop a better understanding of the Lake George watershed.

This report was the continuation of monitoring the spawning migration of smelt populations in streams tributary to Lake George. Observations were made of the abundance and overall health and data was collected on various parameters to determine factors potentially effecting the spawning migration.

All data collected can be found in the appendices and is arranged by stream name.

# Methods

Sixteen accessible streams along the west shoreline of Lake George were monitored during the day and night from April 4 to April 19, 2010. Staff walked from the mouth of the stream to the first impassible obstacle. Notes were taken if smelt and smelt eggs were present. If observed, the abundance was estimated as either: (L) low, only a few smelt or eggs observed; (M) medium/ moderate, more than a few smelt or eggs observed but not hundreds; or (H) high, likely hundreds or thousands of smelt or eggs observed. These categories and methodology were established to compare streams during the 2009 sampling season.



YSI 556 MPS.

Chemical and physical parameters were recorded during the day at each site above the first impassible obstacle.

**Chemical parameters** were measured with a YSI 556 MPS and included:

Dissolved oxygen (% saturation): the amount of oxygen dissolved in water, measured in % saturation. Suitable dissolved oxygen levels are important for smelt egg and larvae development.

pH (units): the acidity or alkalinity of water measured on a scale from 0 to 14, where 0 is acidic, 7 is neutral and 14 is basic. The pH of a stream

shall not be less than 6.5 or more than 8.5, which is the optimal range for smelt egg development. Low or high pH will prevent the development of smelt egg.

Specific conductance ( $\mu\text{S}/\text{cm}$ ): the measurement of the electrical conductance of water, which is used as an indicator of in stream pollution and is measured in  $\mu\text{S}/\text{cm}$ . Typically, specific conductance levels increase with instream pollution. Streams with higher specific conductance generally have algal blooms, which may cover eggs, thereby increasing mortality rates.

**Physical data** included pebble count, flow measurements, water temperature, habitat evaluation, riparian buffers, algae present, air temperature, precipitation and volunteer observations.

Pebble count: the size of the rocks or substrate on the streambed. A pebble count was used to estimate stream bed composition by determining the sizes of substrate at several points of a representative transect of the stream bed.

Flow measurement (cfs): the rate water moves in a stream, measured in cubic feet per second. High flows often dilute chemicals while low flow often concentrates them. Velocity and depth were measured with a Marsh-McBirney, Inc. Model 2000 Portable Flowmeter at several points along a representative stream transect. Data was used to calculate flow, average depth, and average width.

Water temperature (degrees C): an important component of streams that triggers the start and length of the spawning migration and can affect the dissolved oxygen of the water. Temperature was recorded in conjunction with other chemical data with the YSI 556 MPS in degrees C.

Habitat evaluation (spawning suitability): the evaluation of the physical characteristics that may affect smelt spawning. Primary characteristics evaluated were: velocity/ depth regime, and substrate. Secondary conditions evaluated were: sediment deposition, channel alternation, riparian buffers, and algal growth. Habitat evaluation was used to determine the overall spawning capacity of each stream. Spawning capacity was estimated as either; low (L); medium/ moderate (M); or high (H). These categories and methodology were established to compare streams during the 2009 sampling season.

Riparian buffer: the estimated width in feet of the vegetation protection of the stream banks that will remove pollutants, provide shade, maintain lower water temperatures, and stabilize the banks. Lack of shade and higher water temperatures from inadequate riparian buffers result in higher smelt egg mortality.

Algae present: the stage of algal development that may impede egg and larvae development. Algae growth was determined to be either; Initial (algae not visible, to few rocks covered with diatoms, few filamentous forms present); Colonization (algae visible and covering some available substrates, rocks are slimy to the touch and visible patches of filamentous algae may be present); or Bloom (algae covering much of available substrate, large quantities of filamentous algae present).

Air temperature (°F): an important influence on the temperature of the water within the streams and lakes.

Precipitation: Rain events will influence water temperature and flow. Higher flow and lower water temperatures caused by precipitation may inhibit and delay the spawning practices of the smelt.

Volunteer observations: observational data from volunteers who visited streams around the lake on the abundance of smelt and smelt eggs.

# Results

## Smelt Observations

Observational data on smelt varied between streams. Smelt and or smelt eggs were observed in all 16 of the monitored streams.

### Smelt observed

Smelt were observed in all 16 streams. The streams with the highest abundance of smelt were: English Brook, Finkle Brook, Hague Brook, Indian Brook and West Brook. Other streams that had high numbers of smelt were: Edmunds Brook, Sabbath Day Point Tributary and Stebbins Brook.

Streams with moderate numbers of smelt were: Jenkins Brook, Northwest Bay Brook, Silver Bay Tributary, Smith Brook, and Still Bay Tributary. Streams that had low numbers of smelt were: Huddle Brook, Mohican Road Tributary, and Stewart Brook. (Observational volunteer data on smelt presence in streams tributary to Lake George can be found in appendix C.)



Smelt in Sabbath Day Point Tributary, Town of Hague. Photo by Jeremy Parnapy.

**Table 1:** 2010 smelt migration observational data in 16 streams tributary to Lake George where N= none, Y= present, L= low, M= moderate, and H= high.

Stream Name	DEC Stream	Smelt Observed	Smelt Abundance	Eggs Observed	Spawning Suitability
Edmunds Brook	49	Y	H	Y	H
English Brook	41	Y	H	Y	H
Finkle Brook	56	Y	H	Y	H
Hague Brook	86	Y	H	Y	H
Huddle Brook	53	Y	L	Y	L
Indian Brook	59	Y	H	Y	H
Jenkins Brook	84	Y	M	Y	H
Mohican Road Trib.	54	Y	L	Y	L
Northwest Bay Brook	64	Y	M	Y	H
Sabbath Day Trib.	78	Y	H	Y	H
Silver Bay Trib.	81	Y	M	Y	M
Smith Brook	47	Y	M	Y	M
Stebbins Brook	43	Y	H	Y	H
Stewart Brook	55	Y	L	N	L
Still Bay Trib.	44	Y	M	Y	M
West Brook	38	Y	H	Y	H

Smelt eggs observed

Smelt eggs were observed in 15 of 16 streams. The streams with the most abundance of smelt eggs were: English Brook, Finkle Brook, Hague Brook, Indian Brook, and West Brook. Other streams that had high numbers of eggs were: Edmunds Brook,



Mats of smelt eggs in English Brook, Town of Lake George.

Northwest Bay Brook, Sabbath Day Point Tributary, and Stebbins Brook. Streams with moderate numbers of smelt eggs present were: Silver Bay Tributary, Smith Brook, and Still Bay Tributary. Streams that had low numbers of smelt eggs were: Huddle Brook, Jenkins Brook and Mohican Road Tributary. Stewart Brook had no eggs present. (Observational volunteer data on smelt egg presence in streams tributary to Lake George can be found in appendix C.)

### Estimated spawning suitability

The suitability of streams for spawning varied between streams. Of the 16 streams monitored 10 appeared to have high substrate and high potential for spawning, and included: Edmunds Brook, English Brook, Finkle Brook, Hague Brook, Indian Brook, Jenkins Brook, Northwest Bay Brook, Sabbath Day Point Tributary, Stebbins Brook, and West Brook. Three streams appeared to have moderate potential for spawning, and included: Silver Bay Tributary, Smith Brook and Still Bay Tributary. Three streams appeared to have poor potential for spawning, and included: Huddle Brook, Mohican Road Tributary and Stewart Brook.

### **Physical and Chemical Data**

#### Wetted width (ft)

The wetted width of streams varied and ranged from 2.1 ft to 24 ft. (See Appendix A, Figure 1.) The Mohican Road Tributary had the lowest measured width and Northwest Bay Brook and West Brook had the highest. The wetted width of streams with high amounts of smelt observed ranged from 6 ft to 24 ft. The wetted width of streams with moderate amounts of smelt observed ranged from 3 ft to 24 ft. The wetted width of streams with low amounts of smelt observed ranged from 2.1 ft to 10 ft.

#### Water depth (ft)

The mean water depth in streams varied and ranged from 0.22 ft to 1.66 ft. (See Appendix A, Figure 2.) The Silver Bay Tributary had the lowest mean depth and Stewart Brook had the highest. The mean depth of streams with high amounts of smelt observed ranged from 0.33 ft to 1.26 ft. The mean depth of streams with moderate amounts of smelt observed ranged from 0.22 ft to 1.22 ft. The mean depth of streams with low amounts of smelt observed ranged from 0.80 ft to 1.66 ft.

#### Flow (cfs)

The flow in streams varied and ranged from 0.64 cfs to 23.31 cfs. (See Appendix A, Figure 3.) Mohican Road Tributary had the lowest recorded flow and West Brook had the highest. The flow in streams that had high amounts of smelt observed ranged from 1.68 cfs to 23.31 cfs. The flow of streams that had moderate amounts of smelt observed ranged from 0.90 cfs to 19.02 cfs. The flow of streams that had low amounts of smelt observed ranged from 0.64 cfs to 17.4 cfs.

#### Streambed composition (%)

Streambeds consisted of 0% to 70% fine material including silt, clay, and sand. (See Appendix A, Figure 4.) Nine streams appeared to have the least amount of fine

material in the sampled reach, and included: Edmunds Brook, English Brook, Finkle Brook, Indian Brook, Jenkins Brook, Northwest Bay Brook, Sabbath Day Point Tributary, Silver Bay Tributary, and Smith Brook. Stewart Brook appeared to have the highest amount of fine material. The percent of fine material in streams that had high amounts of smelt observed ranged from 0% to 40%. The percent of fine material in streams that had moderate amounts of smelt observed ranged from 0% to 5%. The percent of fine material in streams that had low amounts of smelt observed ranged from 10% to 70%.

#### Riparian buffer (estimated width in ft)

Riparian buffers ranged from 0(ft) to 100+ (ft), with Hague Brook, Huddle Brook, Mohican Road Tributary, and Still Bay Tributary having the no riparian buffers. (See Appendix A, Figure 5.) Edmunds Brook and Northwest Bay Brook had the largest riparian buffers. The estimated width of riparian buffers around streams that had high amounts of smelt observed ranged from 0 ft to 100+ft. The estimated width of riparian buffers around streams that had moderate amounts of smelt observed ranged from 0 ft to 10 ft. The estimated width of riparian buffers around streams that had low amounts of smelt observed ranged from 0 ft to 100 ft.

#### Algae present

Amounts of filamentous algae varied by stream. Streams with full algal blooms noted were: Finkle Brook and Mohican Road Tributary. Streams with colonization of algae growth were: Huddle Brook and West Brook. Stream with initial colonization of algae growth were: English Brook, Hague Brook, Northwest Bay Brook, Smith Brook, and Stebbins Brook. All others were within normal growth range.

#### Temperature (°C)

Water temperature ranged from 5.58°C to 12.48°C depending on date, time and stream. (See Appendix A, Figure 6.) (See appendix B, Stream Inventory sheets.) Still Bay Tributary had the lowest recorded temperature and Stewart Brook had the highest recorded temperature. The mean site temperature in streams that had high amounts of smelt observed ranged from 7.21 (+/- 0.58)°C to 8.94 (+/- 2.30)°C. The mean site temperature in streams that had moderate amounts of smelt observed ranged from 7.45 (+/- 0.77)°C to 8.30 (+/- 0.95)°C. The mean site temperature in streams that had low amounts of smelt observed ranged from 8.64 (+/- 1.50)°C to 10.50 (+/- 1.71)°C.

#### Air temperature (°F)

Air temperature ranged from 44°F to 60°F depending on the date and weather. The coolest dates were April 12 and April 13 and the warmest days were April 7 and April 8.

### Precipitation (in)

Precipitation ranged from 0 inches to 0.44 inches depending on the date. The wettest date was April 9. Eight of the sample dates had a trace or more of precipitation.

**Table 2 :** 2010 smelt migration air temperature and precipitation data.

<b>Date</b>	<b>Mean Air Temp (°F)</b>	<b>Max. Air Temp (°F)</b>	<b>Min. Air Temp. (°F)</b>	<b>Daily Precipitation</b>
4/5/10	51	71	31	Trace
4/6/10	48	58	38	0.08”
4/7/10	60	82	38	0
4/8/10	59	71	46	0.02”
4/9/10	48	56	39	0.44”
4/11/10	50	64	36	Trace
4/12/10	44	57	30	0
4/13/10	44	60	27	0
4/14/10	48	67	28	0
4/15/10	46	63	29	0.11”
4/17/10	45	49	40	0.15”
4/19/10	48	60	36	0.02”

### pH (units)

pH averages ranged from 6.59 units to 7.59 units. (See Appendix A, Figure 7.) Sabbath Day Point Tributary had the lowest pH and Hague Brook had the highest pH. The mean pH from streams with high amounts of smelt observed ranged from 6.59 (+/- 0.25) units to 7.59 (+/- 0.12) units. The mean pH from streams with moderate amounts of smelt observed ranged from 7.08 (+/- 0.24) units to 7.58 (+/- 0.08) units. The mean pH from streams with low amounts of smelt observed ranged from 7.32 (+/- 0.06) units to 7.47 (+/- 0.12) units.

### Specific conductance (µS/cm)

The average specific conductance within streams ranged from 26 to 285 µS/cm. (See Appendix A, Figure 8.) Sabbath Day Point Tributary had the lowest specific conductance while Mohican Road Tributary had the highest. The mean specific conductance from streams with high amounts of smelt observed ranged from 26 (+/- 0.95) µS/cm to 128 (+/- 10.15) µS/cm. The mean specific conductance from streams with moderate amounts of smelt observed ranged from 43 (+/- 9.98) µS/cm to 94 (+/- 5.19) µS/cm. The mean specific conductance from streams with low amounts of smelt observed ranged from 75 (+/- 4.08) µS/cm to 285 (+/- 13.40) µS/cm.

### Dissolved oxygen (% saturation)

The average dissolved oxygen within streams ranged from 93.6 to 104.5 (%). (See Appendix A, Figure 9.) Stewart Brook had the lowest dissolved oxygen while Mohican Road Tributary had the highest. The mean dissolved oxygen from streams with high amounts of smelt observed ranged from 98.4 (+/- 4.24) to 104 (+/- 5.44) (%). The mean dissolved oxygen from streams with moderate amounts of smelt observed ranged from 94.1 (+/- 8.30) to 101.4 (+/- 5.65) (%). The mean dissolved oxygen from streams with low amounts of smelt ranged from 93.6 (+/- 0.21) to 104.5 (+/- 5.60) (%).

### **Historical Comparison**

Our study found smelt migrated in all 16 of the observed streams. The greatest number of smelt were witnessed in English Brook, Finkle Brook, Hague Brook, Indian Brook and West Brook. In 1974, observations indicated that smelt were migrating into Hague Brook. (George 1981) In 2001, observations indicated that smelt were migrating into Finkle Brook, Hague Brook, Huddle Brook, Indian Brook, Sabbath Day Point Tributary, and the Silver Bay Tributary. (NYSDEC unpublished) In 2009 the Lake George Waterkeeper Stream Assessment Project conducted baseline data on the smelt migration and smelt were observed in Edmunds Brook, English Brook, Finkle Brook, Hague Brook, Huddle Brook, Indian Brook, Jenkins Brook, Sabbath Day Point Tributary, Silver Bay Tributary, Smith Brook, Still Bay Tributary and West Brook. (Keppler 2009) The results of our study differed from historical observations in the fact that smelt were observed within Jenkins Brook in 2010.

**Table 3:** Historical comparison of smelt abundance within streams where H= high, M= medium/moderate, L= low, P= present.

<b>Stream Name</b>	<b>Parnapy 2010</b>	<b>Keppler 2009</b>	<b>NYSDEC 2001</b>
Edmunds Brook	H	L	P/M
English Brook	H	H	P/M
Finkle Brook	H	L	P/M
Hague Brook	H	H	P
Huddle Brook	L	M	P/L
Indian Brook	H	H	P
Jenkins Brook	M	None	None
Mohican Road Tributary	L	None	Not Sampled
Northwest Bay Brook	M	None	P
Sabbath Day Point Trib.	H	L	P/M
Silver Bay Trib.	M	L	P/L
Smith Brook	M	L	P/L
Stebbins Brook	H	Not Sampled	P/L
Stewart Brook	L	None	Not Sampled
Still Bay Tributary	M	L	None
West Brook	H	H	P/L

# Discussion

It is possible that smelt have recovered to a certain degree since the ban on the possession and collection of smelt in the Lake George watershed was implemented by the NYSDEC in 1988. However, through conversations with volunteers, fishermen and the general public, the numbers are still not at the levels that were previously observed. Many factors could be affecting the smelt populations such as structural



Sea gulls preying on smelt at the mouth of English Brook, Town of Lake George.

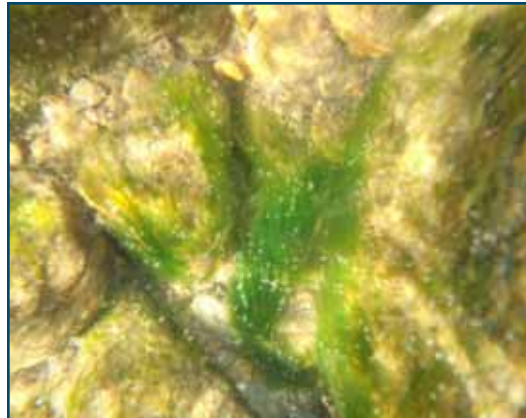
impedance, siltation, foraging pressure, habitat alteration, physiologically stressful conditions, and poaching.

Streams that were determined to have a low spawning suitability had fine substrate, channelization, algal blooms, headcuts, in-stream sediment ponds and loss of riparian buffers. Any obstacle (man made or natural) that can raise water temperature, reduce riparian buffers, add nutrients, reduce dissolved oxygen, raise specific conductance and add fine substrate may affect the spawning suitability. The human alteration to the natal (birth) stream may force the smelt to

spawn off shore, greatly increasing the mortality rate of adults, eggs and larvae. The average mortality rate for adult smelt without added obstacles can be as high as 70-80%. (Dahlberg 1979)

It was noted that streams had algae present, with some in full algal bloom. While small fish may eat small amounts of algae, fish eggs that are attached to algae may have a higher rate of mortality due to allelochemical affects of the algae.

Furthermore, if additional nutrients are introduced to the water while the eggs are developing, any algal blooms will cover the eggs thereby smothering them. (Baker 2010) Embryo smelt that are exposed to high specific conductance, low pH, or low dissolved oxygen will have higher rates of mortality. (Chase 2009) Eggs under full shade conditions have significantly higher survivorship than eggs under partial shade or no shade conditions (Dinnel 2010) indicating the need for adequate riparian buffers along streams.



Smelt eggs attached to filamentous algae in Hague Brook, Town of Hague.

Adult smelt numbers appear to be on the rise; however adequate historical data is not present to make comparisons. The previous study conducted by the Waterkeeper only visited the streams on one or two days to determine abundance, while our 2010 study visited on multiple days. It was determined that the 2009 data was collected at the end of the spawning migration, thereby making comparisons between the 2010 and 2009 studies difficult.

The smelt seen during the study were sexually mature, 2 years old or older. Between the time that the current spawning smelt population hatched and returned to the stream, possible stream modification, nutrient addition, removal of riparian buffers, or other stream habitat degradation could have taken place, thereby altering the spawning suitability of the stream. Adult fish can be affected by physiological stress and over excessive energy demands in the environment such as avoidance behavior of hypoxic or dead zones. This may lead to poor egg quality and smaller eggs with smaller stores of energy. (Chase 2009)

During our study large mats of eggs over 2” deep were observed within the streams, generally below the first impassible obstacle. Eggs that are laid in thick mats result in higher mortality rates due to the lack of dissolved oxygen that the covered eggs receive.(Chase 2009) Any smothering of eggs by sediment, algae, or other eggs will result in lack of dissolved oxygen and higher mortality rates.

The fact that smelt spawn in the streams puts them at risk from upland development, stormwater runoff, nutrient pollution, road salt, and any activity that takes place within land adjacent to the riparian zone. Further research and data is needed to determine the impacts of these various factors on the annual smelt spawning migration.

# Conclusion

All of the 16 sampled streams had smelt observed and in 15 of the 16 sampled streams smelt eggs were observed. Ten streams appeared to have high spawning suitability, while three streams had moderate spawning suitability, and three streams had low spawning suitability. Many factors could be affecting the smelt spawning, migration and populations such as structural impedance, siltation, foraging pressure, habitat alteration, physiologically stressful conditions, and poaching. Unless actions are taken to protect stream corridors, conditions, such as lack of riparian cover, inadequate substrate, and excessive nutrients, will likely worsen. In order to protect the annual smelt spawning migration, vegetated buffers must exist on both sides of a stream. Habitat alternations to instream conditions should be avoided as well as adequate stormwater controls should be implemented to reduce any physiologically stressful conditions that may affect all age classes found within the lake and streams.



Underwater view of smelt congregating in Indian Brook, Town of Bolton.

# Recommendations

Monitoring the smelt migration in streams tributary to Lake George is a daunting task, primarily due to the temporal requirements. Regardless, smelt are an important component of Lake George and future data collection is important. The methods used here can be improved for future monitoring efforts through the following actions:

- Estimate the percentage of fertilized vs. unfertilized eggs within streams.
- Continue monitoring streams following the smelt migration to determine the amount of egg hatch, and smelt larvae that drift back to the lake.
- Continue monitoring chemical and physical parameters within streams after spawning migration to better determine affects and limitations to egg development and larvae survival.
- Expand volunteer base to include the observation of more streams tributary to Lake George in northern New York.
- Monitor stream temperatures daily following ice-out to better predict the beginning of the annual spawning migration.
- Monitor larvae distribution distance from mouth of stream.

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Lodges at Cresthaven  
Silver Bay Association  
Snug Harbor Cottages  
The O'Conner's Resort Cottages

### Participating Volunteers:

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# Appendices

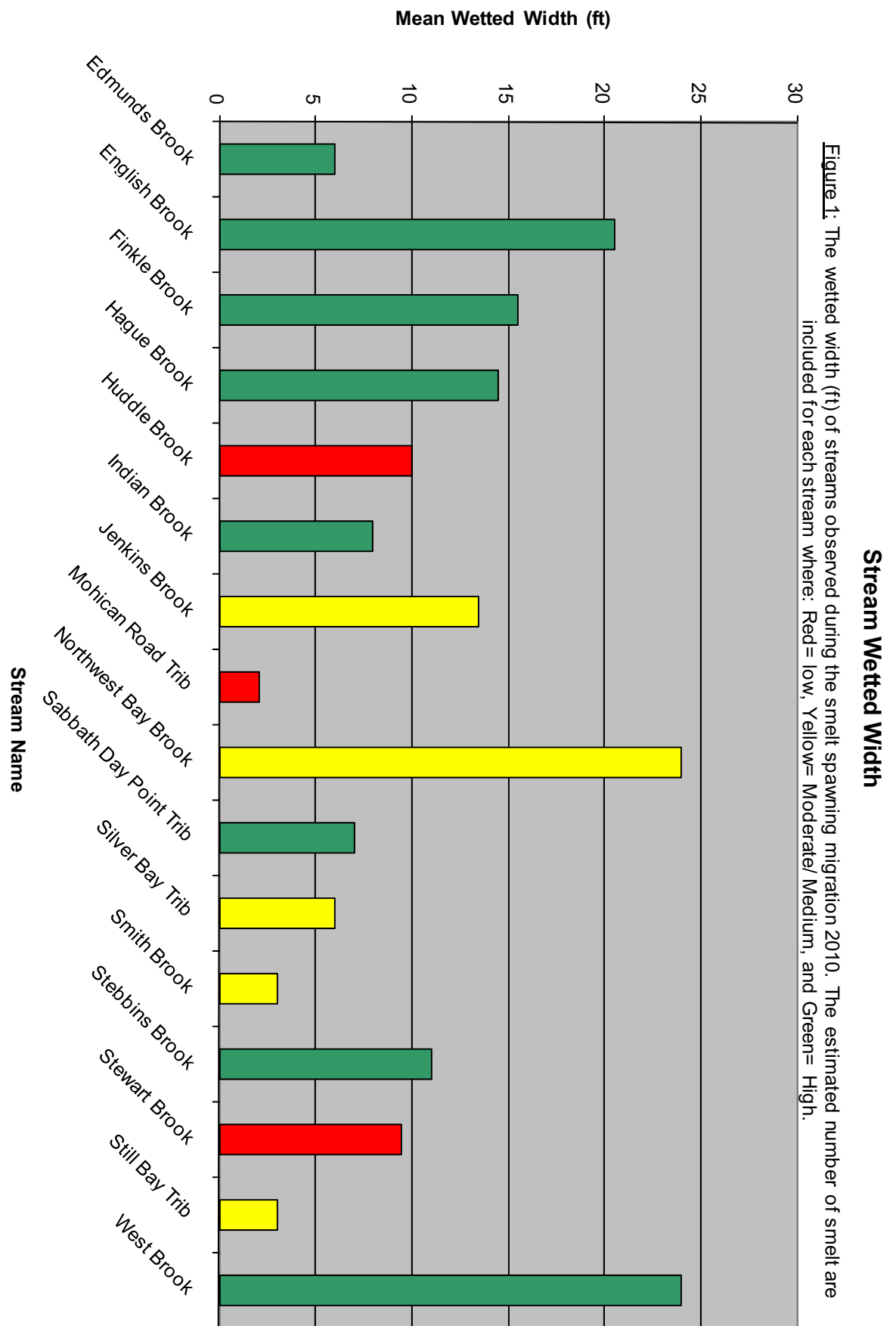
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## Appendix A: Figures

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**Figure 1:** The wetted width (ft) of streams observed during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red = low, Yellow = Moderate/ Medium, and Green = High.

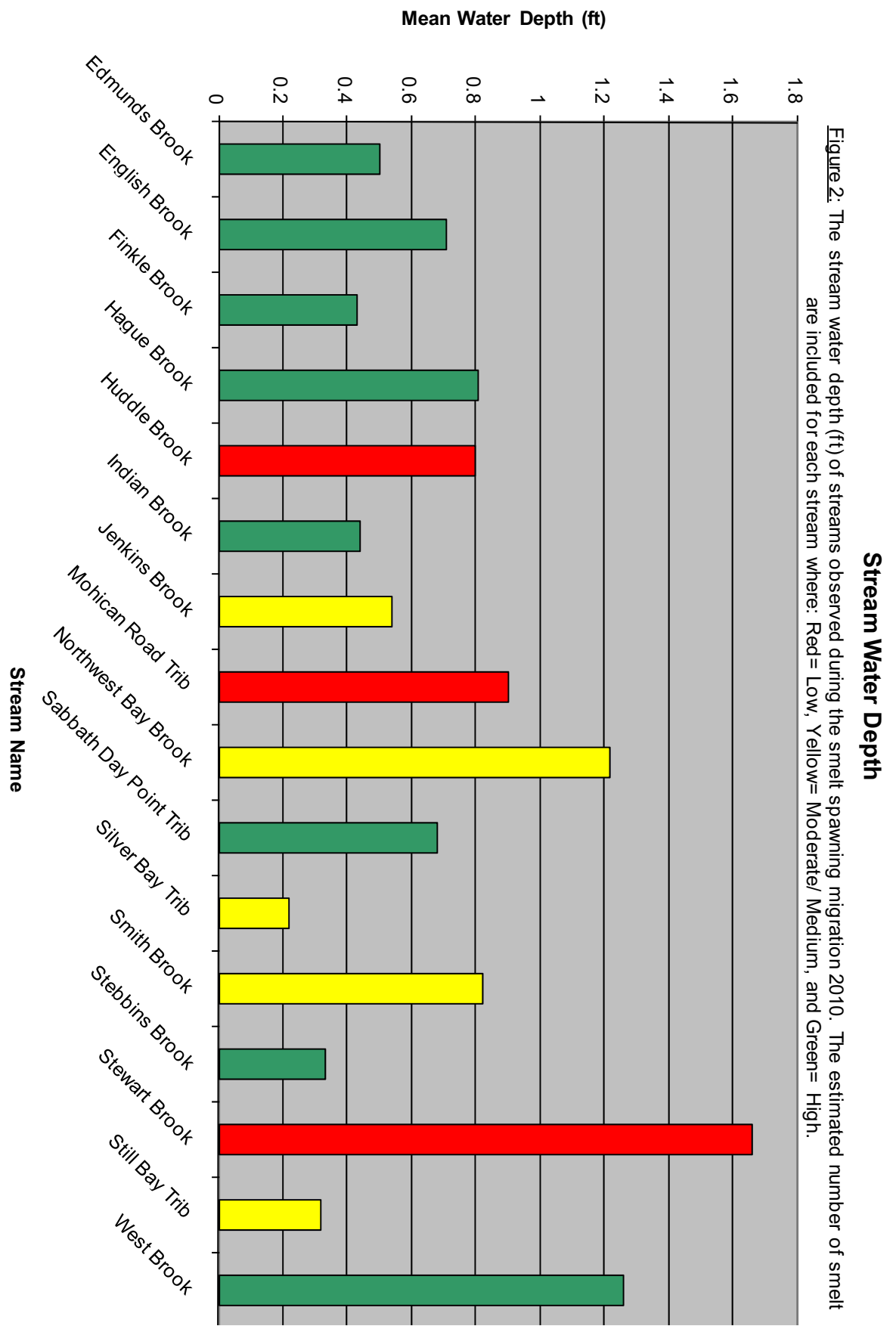


Figure 2: The stream water depth (ft) of streams observed during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red = Low, Yellow = Moderate/ Medium, and Green = High.

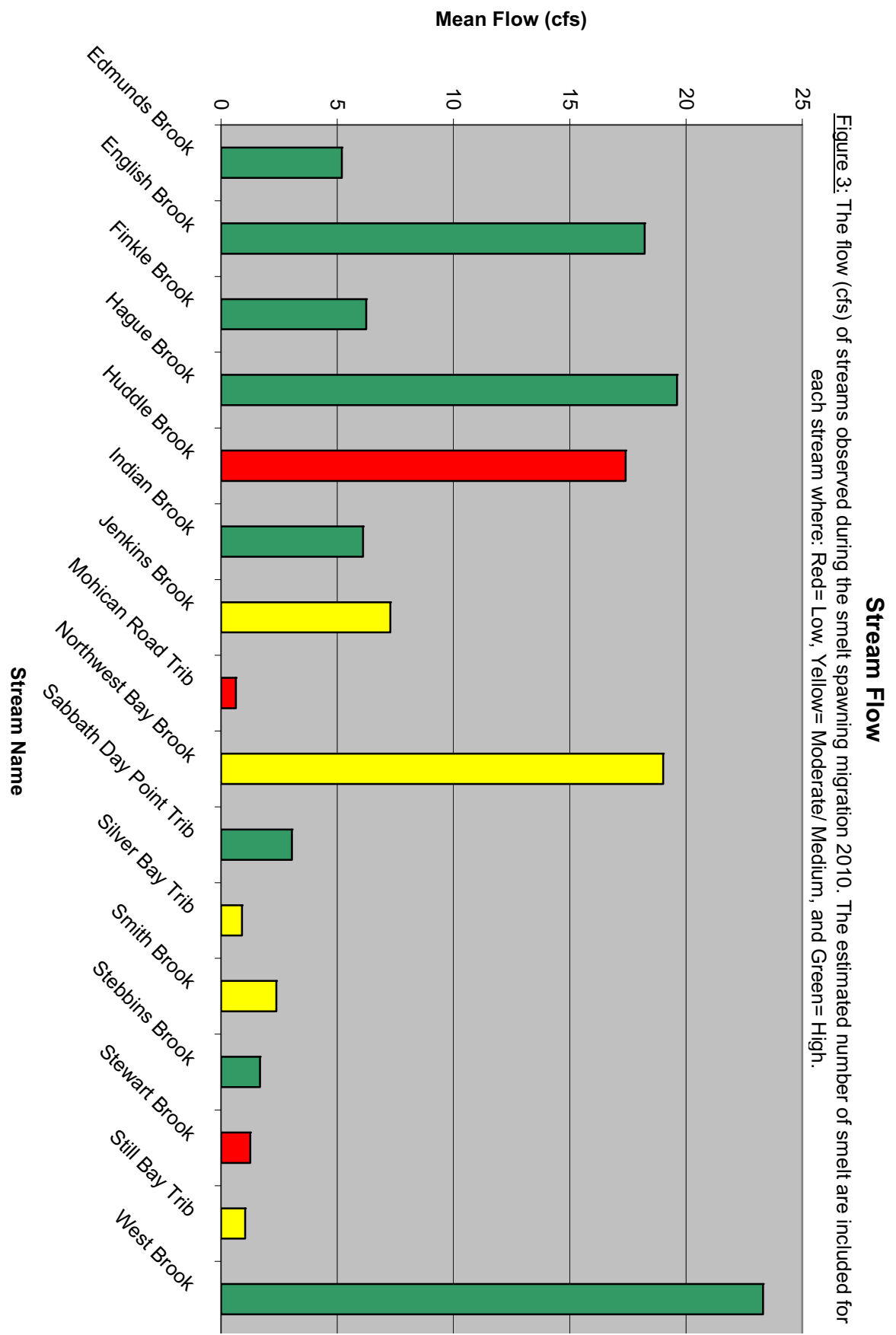


Figure 3: The flow (cfs) of streams observed during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red= Low, Yellow= Moderate/ Medium, and Green= High.

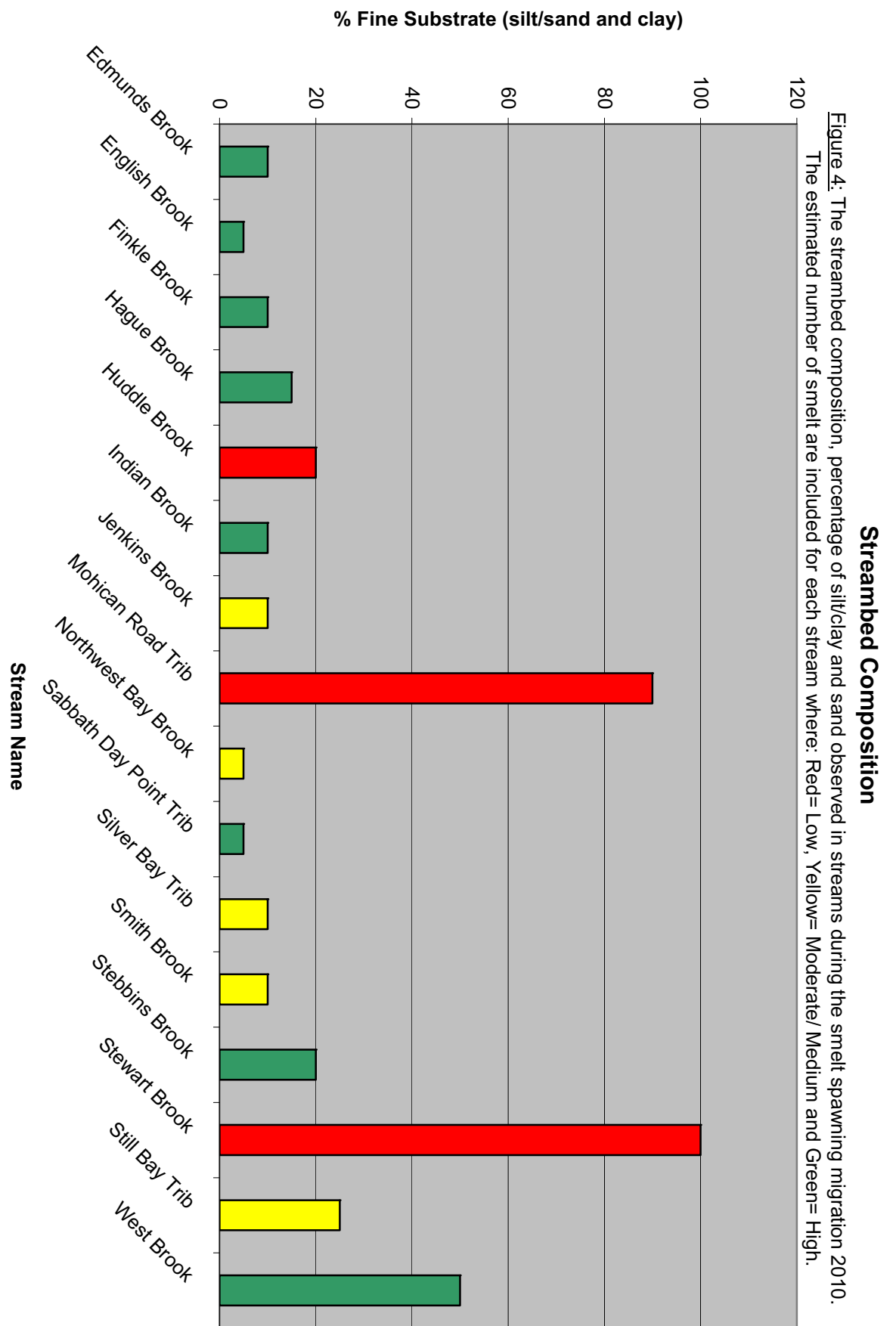


Figure 4: The streambed composition, percentage of silt/clay and sand observed in streams during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red= Low, Yellow= Moderate/ Medium and Green= High.

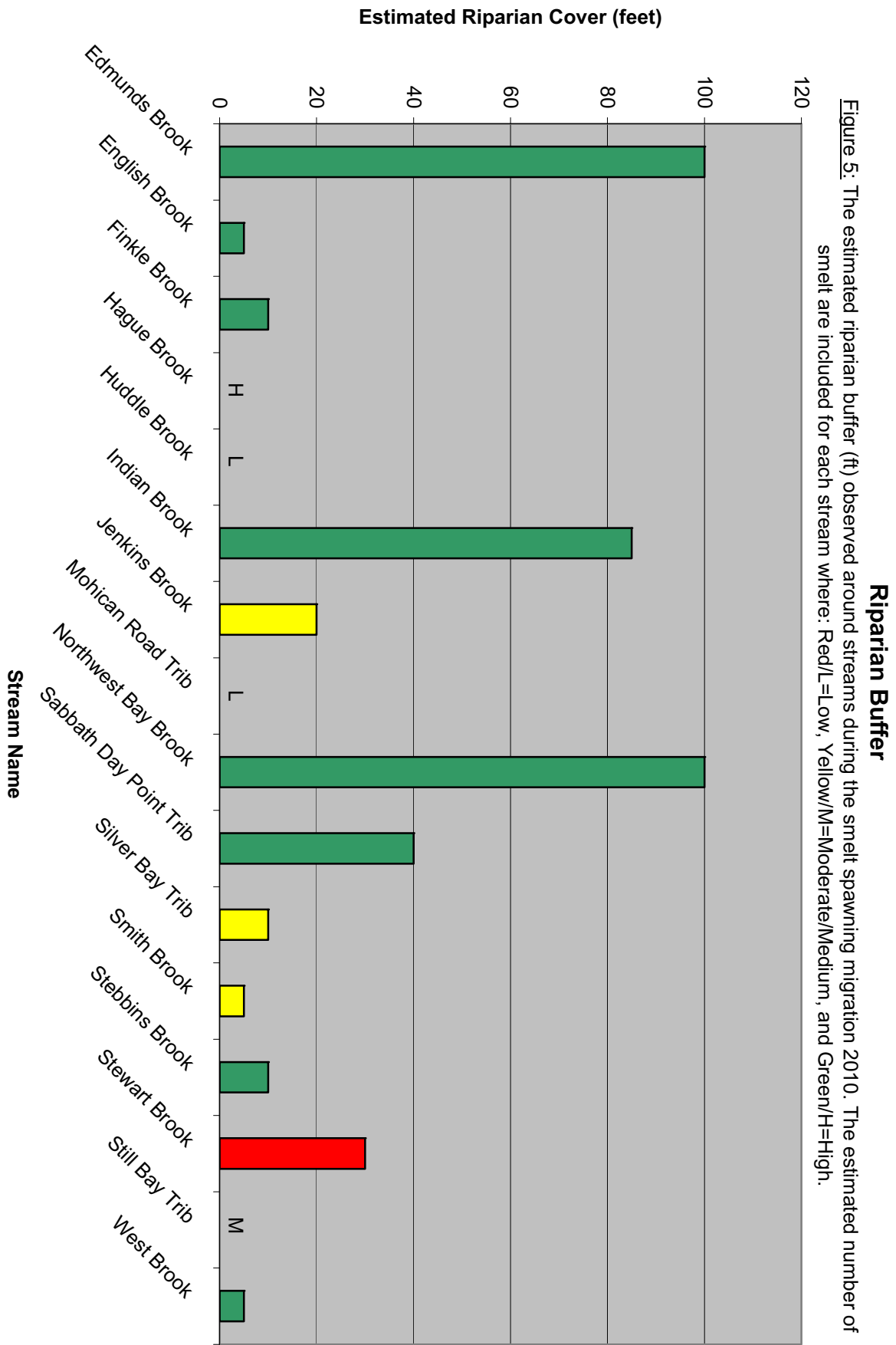


Figure 5: The estimated riparian buffer (ft) observed around streams during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red/L=Low, Yellow/M=Moderate/Medium, and Green/H=High.

### Riparian Buffer

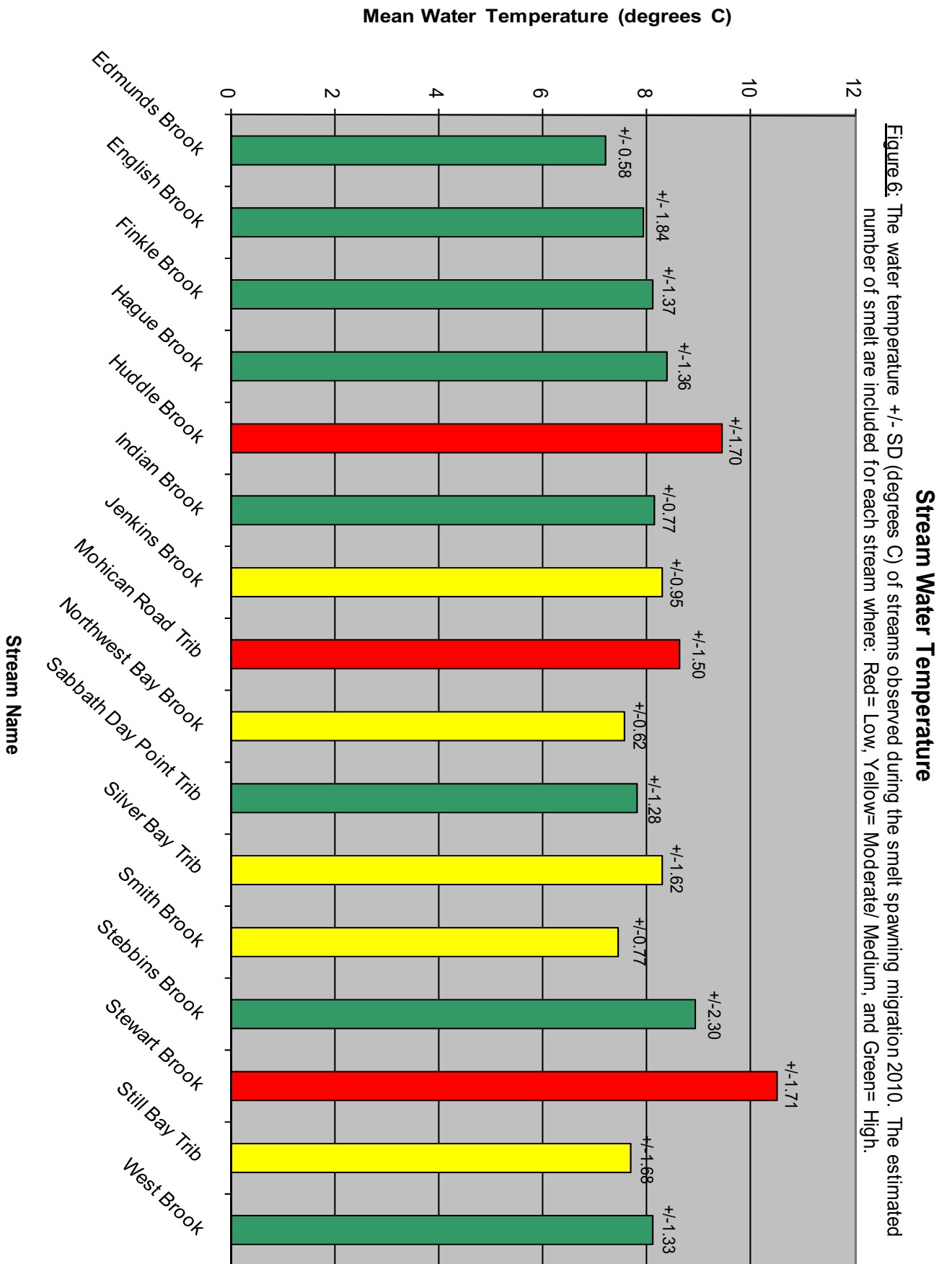
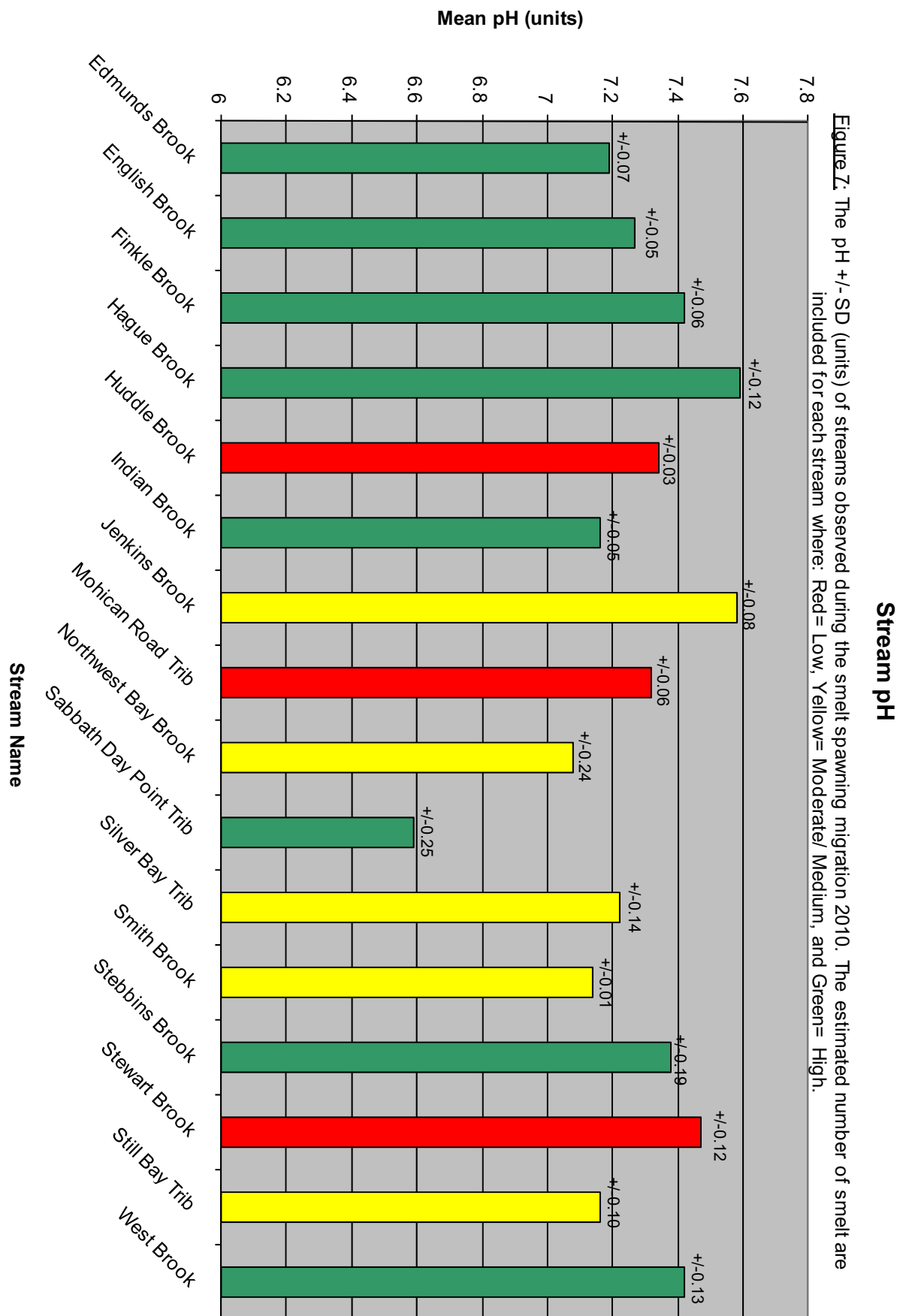
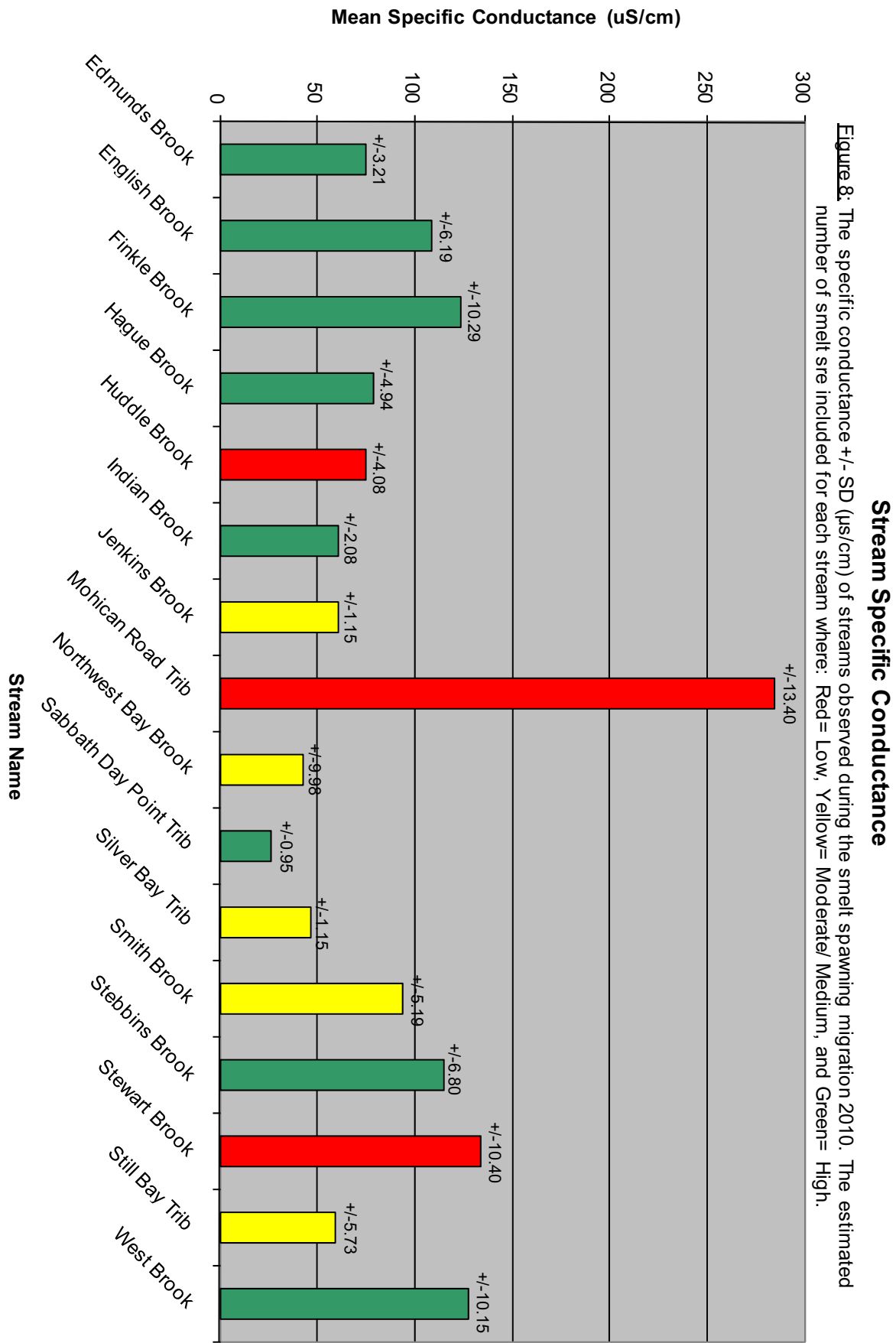


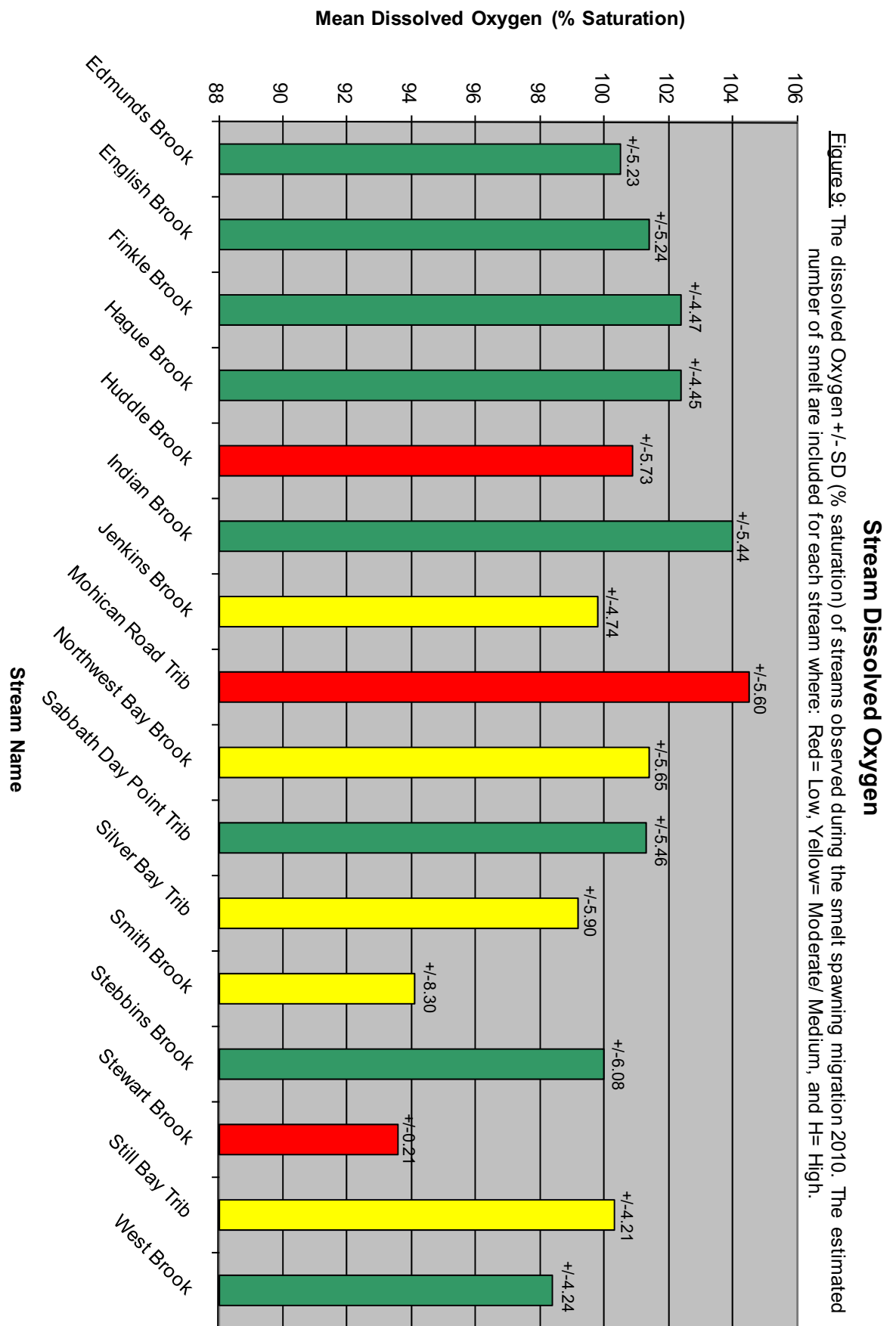
Figure 6: The water temperature +/- SD (degrees C) of streams observed during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red = Low, Yellow = Moderate/ Medium, and Green = High.



**Figure Z:** The pH +/- SD (units) of streams observed during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red= Low, Yellow= Moderate/ Medium, and Green= High.



**Figure 8:** The specific conductance +/- SD (uS/cm) of streams observed during the smelt spawning migration 2010. The estimated number of smelt stre included for each stream where: Red= Low, Yellow= Moderate/ Medium, and Green= High.



**Figure 9:** The dissolved Oxygen +/- SD (% saturation) of streams observed during the smelt spawning migration 2010. The estimated number of smelt are included for each stream where: Red= Low, Yellow= Moderate/ Medium, and H= High.

# Appendix B: Lake George Tributary Smelt Inventory

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Lake George Tributary Smelt Inventory 2010

Stream: Edmunds Brook  
 NYS DEC trib. #: 49  
 Latitude: 43 29.342  
 Longitude: 073 40.801

Average depth: 0.5 ft  
 Average width: 6 ft  
 Flow: 5.2 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 0 %  
 Sand (0.062-1.9mm) 0 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 10 %  
 Cobble (65-256mm) 50 %  
 Boulder (256-1096mm) 30 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 100 (ft)  
 Right bank: 100 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature °C	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	7.43	76	7.25	97.7	N	N
4/7/10 am	7.66	77	7.10	97.2	H	H
4/11/10 am	6.56	71	7.21	106.5	H	H

Notes:

Stream is relatively shallow, and lacks adequate depth regimes for full spawning potential. Large mat of eggs were observed in a 20ft reach of stream below first impassible obstacle. White suckers were noted in the stream on the final day of sampling.

## Lake George Tributary Smelt Inventory 2010

Stream: English Brook  
 NYS DEC trib. #: 41  
 Latitude: 43 25.923  
 Longitude: 073 42.480  
  
 Average depth: 0.71 ft  
 Average width: 20.5 ft  
 Flow: 18.22 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 0 %  
 Sand (0.062-1.9mm) 0 %  
 Fine gravel (2-24mm) 5 %  
 Coarse gravel (25-64mm) 20 %  
 Cobble (65-256mm) 50 %  
 Boulder (256-1096mm) 25 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 3 (ft)  
 Right bank: 5 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	7.62	109	7.27	97.4	H	H
4/6/10 pm	/	/	/	/	H	H
4/7/10 am	7.79	104	7.32	96.8	H	H
4/7/10 pm	10.91	116	7.36	96.3	H	H
4/8/10 am	10.02	102.3	7.26	11.54	H	H
4/8/10 pm	/	/	/	/	H	H
4/12/10 am	6.61	110	7.20	106.4	H	H
4/12/10 pm	/	/	/	/	H	H
4/15/10 am	6.03	118	7.26	108.1	H	H
4/19/10 am	6.65	104	7.22	103.5	H	H

Notes:

Stream had suitable substrate and depth regimes for spawning. Substantial numbers of fish and eggs were observed both night and day. Waterfall upstream is first impassible obstacle. Many birds at mouth of stream preying on smelt. Lower section of stream reach is channelized, contains fine sediment and lacks adequate riparian buffers.

Lake George Tributary Smelt Inventory 2010

Stream: Finkle Brook  
 NYS DEC trib. #: 56  
 Latitude: 43 33.816  
 Longitude: 073 39.119

Average depth: 0.43 ft  
 Average width: 15.5 ft  
 Flow: 6.25 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 0 %  
 Sand (<math>0.062\text{-}1.9\text{mm}</math>) 0 %  
 Fine gravel (<math>2\text{-}24\text{mm}</math>) 10 %  
 Coarse gravel (<math>25\text{-}64\text{mm}</math>) 20 %  
 Cobble (<math>65\text{-}256\text{mm}</math>) 20 %  
 Boulder (<math>256\text{-}1096\text{mm}</math>) 50 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 10 (ft)  
 Right bank: 10 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/5/10 am	7.03	105	7.33	99.9	N	N
4/6/10 am	8.26	117	7.45	97.5	N	N
4/6/10 pm	/	/	/	/	L	N
4/7/10 am	9.28	126	7.47	97.9	N	L
4/8/10 am	10.57	133	7.42	/	M	M
4/9/10 am	/	/	/	/	M	M
4/12/10 am	7.60	126	7.42	105.5	H	H
4/12/10 pm	/	/	/	/	H	H
4/13/10 am	6.71	128	7.51	106	H	H
4/14/10 am	7.41	135	7.347	107.6	H	H

Notes:

Substrate within stream reach and depth regime is conducive to spawning. However algal bloom may affect egg development and larvae. Lack of riparian vegetation in combination with higher specific conductance may affect egg development.

## Lake George Tributary Smelt Inventory 2010

Stream: Hague Brook  
 NYS DEC trib. #: 86  
 Latitude: 43 44.734  
 Longitude: 073 29.951  
  
 Average depth: 0.81 ft  
 Average width: 14.5 ft  
 Flow: 19.61 cfs



**Estimated streambed composition:**

Silt/clay (<0.062 mm)	0	%
Sand (0.062-1.9mm)	5	%
Fine gravel (2-24mm)	10	%
Coarse gravel (25-64mm)	10	%
Cobble (65-256mm)	50	%
Boulder (256-1096mm)	25	%
Bedrock	0	%

**Estimated riparian cover:**

Left bank: 0 (ft)  
 Right bank: 0 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

**Table: Dates and measurement parameters obtained with the YSI MPS 556.**

date (am/pm)	temperature (°C)	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/5/10 am	7.71	73	7.36	100.6	H	H
4/6/10 pm	8.95	79	7.71	96.1	H	H
4/6/10 pm	/	/	/	/	L	H
4/7/10 am	11.15	83	7.72	97.2	H	H
4/9/10 pm	7.46	76	7.53	105.7	H	H
4/11/10 am	8.72	82	7.65	106.2	H	H
4/15/10 am	7.52	88	7.57	105.1	H	H
4/19/10 am	7.35	78	7.59	106.5	H	H

**Notes:** Instream sediment pond is allowing for substantial loss of smelt adults by predators. Substantial amounts of smelt and smelt eggs were observed on multiple visits both day and night. Due to lack of riparian buffers smelt are utilizing bridge for cover. Eggs were in thick mats in slower moving water attached to substrate and algae.

Lake George Tributary Smelt Inventory 2010

Stream: Huddle Brook  
 NYS DEC trib. #: 53  
 Latitude: 43 32.190  
 Longitude: 073 39.868

Average depth: 0.8 ft  
 Average width: 10 ft  
 Flow: 17.4 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 0 %  
 Sand (0.062-1.9mm) 10 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 10 %  
 Cobble (65-256mm) 60 %  
 Boulder (256-1096mm) 10 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 0 (ft)  
 Right bank: 0 (ft)

Spawning capacity: Low  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	8.99	72	7.33	96.4	N	N
4/6/10 pm	/	/	/	/	M	M
4/7/10 am	9.54	73	7.34	95.6	N	Y
4/8/10 am	12.45	82	7.31	/	L	L
4/8/10 pm	/	/	/	/	L	L
4/12/10 am	8.40	74	7.34	106.2	L	L
4/13/10 am	7.89	73	7.40	105.6	N	N

Notes:

Instream sediment pond located just upstream of mouth, is dominated by organic debris and fine sediment. The reach above sediment pond, while having suitable substrate, lacks adequate depth regimes for full spawning potential. Headcut at inflow of sediment pond appears to be impassible to smelt. Algae starting to proliferate within stream and within sediment pond. Smelt were noted within sediment pond, while only five were noted above headcut.

Lake George Tributary Smelt Inventory 2010

Stream: Indian Brook  
 NYS DEC trib. #: 59  
 Latitude: 43 35.202  
 Longitude: 073 38.448

Average depth: 0.44 ft  
 Average width: 8 ft  
 Flow: 6.11 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 0 %  
 Sand (0.062-1.9mm) 0 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 15 %  
 Cobble (65-256mm) 25 %  
 Boulder (256-1096mm) 50 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 85 (ft)  
 Right bank: 0 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	9.04	59	7.22	97.8	H	H
4/9/10 am	/	/	/	/	H	H
4/11/10 am	7.68	63	7.11	106.8	H	H
4/12/10 am	7.70	62	7.16	107.6	H	H

Notes:

Stream appeared to have some of the highest smelt and smelt eggs when compared to other streams. Falls located 300 feet upstream are impassible to both smelt and white suckers. Substrate and depth regimes appear to be adequate for spawning. Proximity of development and lack of riparian buffer may affect egg and larvae development.

Lake George Tributary Smelt Inventory 2010

Stream: Jenkins Brook  
 NYS DEC trib. #: 84  
 Latitude: 43 43.846  
 Longitude: 073 29.925

Average depth: 0.54 ft  
 Average width: 13.5 ft  
 Flow: 7.28 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 0 %  
 Sand (<math>0.062\text{-}1.9\text{mm}</math>) 0 %  
 Fine gravel (<math>2\text{-}24\text{mm}</math>) 10 %  
 Coarse gravel (<math>25\text{-}64\text{mm}</math>) 15 %  
 Cobble (<math>65\text{-}256\text{mm}</math>) 50 %  
 Boulder (<math>256\text{-}1096\text{mm}</math>) 25 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 30 (ft)  
 Right bank: 10 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C )	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	8.14	60	7.66	96.8	L	N
4/6/10 pm	/	/	/	/	L	N
4/7/10 am	9.33	62	7.61	97.4	L	L
4/9/10 pm	/	/	/	/	M	M
4/11/10 am	7.45	62	7.49	105.3	M	M

Notes: Stream appeared to have suitable substrate and depth regimes for full spawning potential, however sediment pond located at mouth of stream is dominated by sediment and fine substrate. The recent removal of riparian vegetation may have an affect on the spawning migration, egg development and smelt larvae. The majority of smelt were noted within the sediment pond and not in the stream.

## Lake George Tributary Smelt Inventory 2010

Stream: Mohican Road Trib  
 NYS DEC trib. #: 54  
 Latitude: 43 33.024  
 Longitude: 073 39.417  
  
 Average depth: 0.9 ft  
 Average width: 2.1 ft  
 Flow: 0.64 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm)	10	%
Sand (0.062-1.9mm)	20	%
Fine gravel (2-24mm)	60	%
Coarse gravel (25-64mm)	10	%
Cobble (65-256mm)	0	%
Boulder (256-1096mm)	0	%
Bedrock	0	%

Estimated riparian cover:

Left bank:	0	(ft)
Right bank:	0	(ft)

Spawning capacity:

Spawning capacity:	Low
Smelt observed:	Yes
Eggs observed:	Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	7.91	276	7.3	99.3	N	N
4/6/10 pm	/	/	/	/	N	N
4/7/10 am	8.71	280	7.36	103.8	M	L
4/8/10 am	10.75	305	7.38	/	N	L
4/8/10 pm	/	/	/	/	M	L
4/15/10 am	7.22	279	7.24	110.5	L	N

Notes:

Algal bloom may be impeding smelt migration into tributary. Stream is channelized, lacks riparian buffers, and is embedded with fine sediment. A pond constructed upstream is filled with algae and appeared to be impassible. High readings of specific conductance combined with the thick mats of algae present, may affect egg and larvae development.

Lake George Tributary Smelt Inventory 2010

Stream: Northwest Bay Brook  
 NYS DEC trib. #: 64  
 Latitude: 43 37.570  
 Longitude: 073 36.436

Average depth: 1.22 ft  
 Average width: 24 ft  
 Flow: 19.02 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 0 %  
 Sand (0.062-1.9mm) 0 %  
 Fine gravel (2-24mm) 5 %  
 Coarse gravel (25-64mm) 20 %  
 Cobble (65-256mm) 50 %  
 Boulder (256-1096mm) 25 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 100 (ft)  
 Right bank: 100 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/5/10 am	7.45	37	6.83	97.7	N	L
4/6/10 am	7.81	38	7.02	97.3	N	H
4/7/10 am	8.52	39	7.04	97.5	N	H
4/8/10 pm	/	/	/	/	L	H
4/9/10 am	/	/	/	/	N	M
4/11/10 am	7.15	61	7.04	104.8	M	H
4/15/10 am	6.93	43	7.5	109.8	N	H

Notes: Left channel of braided stream is more conducive for smelt spawning due to depth regime and flow. White suckers were present all but the last sampling date, indicating that the run in this stream starts earlier than other streams around the lake. Eggs are located in one 50ft section of stream in a thick mat. There is a wetland located between the stream and lake.

Lake George Tributary Smelt Inventory 2010

Stream: Sabbth Day Point Trib  
 NYS DEC trib. #: 78  
 Latitude: 43 39.990  
 Longitude: 073 30.925

Average depth: 0.68 ft  
 Average width: 7 ft  
 Flow: 3.05 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 0 %  
 Sand (<math>0.062\text{-}1.9\text{mm}</math>) 0 %  
 Fine gravel (<math>2\text{-}24\text{mm}</math>) 5 %  
 Coarse gravel (<math>25\text{-}64\text{mm}</math>) 20 %  
 Cobble (<math>65\text{-}256\text{mm}</math>) 50 %  
 Boulder (<math>256\text{-}1096\text{mm}</math>) 25 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 90 (ft)  
 Right bank: 40 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C )	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	7.99	25	6.53	96.9	H	M
4/6/10 pm	/	/	/	/	H	N
4/7/10 am	9.58	26	6.76	96.3	H	H
4/9/10 am	/	/	/	/	H	H
4/11/10 am	6.88	25	6.26	105.7	H	H
4/15/10 am	6.85	27	6.83	106.4	N	H

Notes: Stream substrate and depth regime are conducive to spawning. Many smelt were witnessed on multiple visits. Majority of eggs are located down stream of Rt 9N bridge in a thick mat. First impassible obstacle is 25ft upstream of culvert. Ducks were noted within stream feeding on eggs and smelt. pH levels were of concern, as optimal levels need to remain above 6.50 for egg development.

Lake George Tributary Smelt Inventory 2010

Stream: Silver Bay Tributary  
 NYS DEC trib. #: 81  
 Latitude: 43 41.785  
 Longitude: 073 30.235

Average depth: 0.22 ft  
 Average width: 6 ft  
 Flow: 0.9 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 0 %  
 Sand (0.062-1.9mm) 0 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 20 %  
 Cobble (65-256mm) 45 %  
 Boulder (256-1096mm) 25 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 10 (ft)  
 Right bank: 10 (ft)

Spawning capacity: Medium  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C )	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	8.16	47	7.34	96.2	N	N
4/6/10 pm	/	/	/	/	M	N
4/7/10 am	9.98	49	7.26	95.4	M	M
4/9/10 pm	/	/	/	/	M	M
4/11/10 am	6.73	47	7.06	106	M	M

Notes:

The stream appeared to lack adequate depth regimes and flow for full spawning potential. Obstacles close to mouth of stream appear to be impassible. Delta at mouth may restrict spawning . High mortality rates were noted within stream.

## Lake George Tributary Smelt Inventory 2010

Stream: Smith Brook  
 NYS DEC trib. #: 47  
 Latitude: 43 28.714  
 Longitude: 073 41.184  
  
 Average depth: 0.82 ft  
 Average width: 3 ft  
 Flow: 2.38 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 0 %  
 Sand (0.062-1.9mm) 0 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 90 %  
 Cobble (65-256mm) 0 %  
 Boulder (256-1096mm) 0 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 5 (ft)  
 Right bank: 0 (ft)

Spawning capacity: Medium  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	8.15	90	7.14	88.6	N	N
4/6/10 pm	/	/	/	/	M	H
4/7/10 am	8.07	93	7.13	87.2	M	L
4/7/10 pm	/	/	/	/	H	M
4/8/10 pm	/	/	/	/	M	L
4/11/10 am	6.57	101	7.16	105.6	M	M
4/13/10 am	7.04	90	7.13	95	M	H

Notes:

Stream substrate is not conducive to spawning. Substrate is comprised of primarily smaller particles covered with algae. Rt 9N culvert seems to be the first impassible obstacle. Stream is channelized and lacks adequate riparian buffers. The formation of a headcut 10ft above outflow, may affect spawning migration.

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Lake George Tributary Smelt Inventory 2010

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Stream: Stebbins Brook  
 NYS DEC trib. #: 43  
 Latitude: 43 26.968  
 Longitude: 073 41.608

Average depth: 0.33 ft  
 Average width: 11 ft  
 Flow: 1.68 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 0 %  
 Sand (0.062-1.9mm) 10 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 35 %  
 Cobble (65-256mm) 10 %  
 Boulder (256-1096mm) 25 %  
 Bedrock 10 %

Estimated riparian cover:

Left bank: 10 (ft)  
 Right bank: 75 (ft)

Spawning capacity: High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/7/10 am	8.76	110	7.42	95.7	H	H
4/8/10 am	11.33	123	7.56	/	H	H
4/13/10 am	6.74	113	7.18	104.3	H	H

Notes:

Stream reach appeared to have adequate substrate and depth regimes for spawning. Stream is channelized and has limited riparian buffers. Smelt were abundant compared to other streams this size. Outlet had large amounts of fine material.

Lake George Tributary Smelt Inventory 2010

Stream: Stewart Brook  
 NYS DEC trib. #: 55  
 Latitude: 43 33.197  
 Longitude: 073 39.284

Average depth: 1.66 ft  
 Average width: 9.5 ft  
 Flow: 1.26 cfs



Estimated streambed composition:

Silt/clay (<math>0.062\text{ mm}</math>) 35 %  
 Sand (<math>0.062\text{-}1.9\text{mm}</math>) 35 %  
 Fine gravel (<math>2\text{-}24\text{mm}</math>) 30 %  
 Coarse gravel (<math>25\text{-}64\text{mm}</math>) 0 %  
 Cobble (<math>65\text{-}256\text{mm}</math>) 0 %  
 Boulder (<math>256\text{-}1096\text{mm}</math>) 0 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 30 (ft)  
 Right bank: 90 (ft)

Spawning capacity: Low  
 Smelt observed: Yes  
 Eggs observed: No

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C )	specific conductance ( $\mu\text{S/cm}$ )	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	9.44	126	7.60	93.8	N	N
4/6/10 pm	/	/	/	/	N	N
4/7/10 am	9.60	131	7.48	93.5	N	N
4/8/10 am	12.48	146	7.35	/	N	N
4/8/10 pm	/	/	/	/	L	N

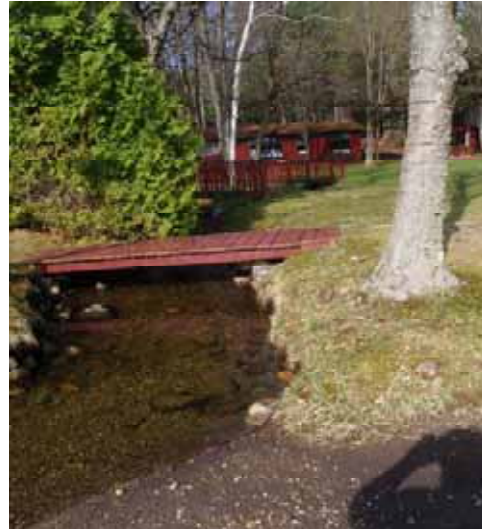
Notes:

Substrate near outflow of stream is relatively deep and consists primarily of sand and silt. 300ft upstream substrate is conducive to spawning, however depth regimes and flow are not. Only three smelt were noted within stream. No smelt eggs were noted. Warm water fish species were noted within stream reach.

Lake George Tributary Smelt Inventory 2010

Stream: Still Bay Tributary  
 NYS DEC trib. #: 44  
 Latitude: 43 27.855  
 Longitude: 073 41.311

Average depth: 0.32 ft  
 Average width: 3 ft  
 Flow: 1.04 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 0 %  
 Sand (0.062-1.9mm) 5 %  
 Fine gravel (2-24mm) 20 %  
 Coarse gravel (25-64mm) 20 %  
 Cobble (65-256mm) 30 %  
 Boulder (256-1096mm) 25 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 0 (ft)  
 Right bank: 0 (ft)

Spawning capacity: Medium  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C )	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/6/10 am	7.63	60	7.04	97.2	M	M
4/6/10 pm	/	/	/	/	L	L
4/7/10 am	7.87	52	7.12	98.6	H	H
4/8/10 am	9.69	66	7.23	/	L	L
4/8/10 pm	/	/	/	/	M	M
4/13/10 am	5.58	59	7.26	105.1	L	M

Notes:

Stream had suitable substrate and depth regimes for spawning. However delta at mouth and obstacles within stream may hinder full spawning potential. Lack of riparian cover may affect egg development and larvae smelt. Small groups of smelt were noted, mostly hiding under small bridges that cross stream.

Lake George Tributary Smelt Inventory 2010

Stream: West Brook  
 NYS DEC trib. #: 38  
 Latitude: 43 25.133  
 Longitude: 073 42.511

Average depth: 1.26 ft  
 Average width: 24 ft  
 Flow: 23.31 cfs



Estimated streambed composition:

Silt/clay (<0.062 mm) 20 %  
 Sand (0.062-1.9mm) 20 %  
 Fine gravel (2-24mm) 10 %  
 Coarse gravel (25-64mm) 40 %  
 Cobble (65-256mm) 10 %  
 Boulder (256-1096mm) 0 %  
 Bedrock 0 %

Estimated riparian cover:

Left bank: 5 (ft)  
 Right bank: 3 (ft)

Spawning capacity:

High  
 Smelt observed: Yes  
 Eggs observed: Yes

Table: Dates and measurement parameters obtained with the YSI MPS 556.

date (am/pm)	temperature (°C)	specific conductance (µS/cm)	pH (units)	dissolved oxygen (%)	smelt (amount)	eggs (amount)
4/5/10 am	7.93	110	7.28	97.6	N	N
4/6/10 am	8.27	116	7.37	94.6	M	L
4/6/10 pm	/	/	/	/	H	H
4/7/10 am	8.17	118	7.45	93.5	H	H
4/7/10 pm	11.09	133	7.46	91.5	H	H
4/8/10 am	9.68	132	7.17	/	H	H
4/8/10 pm	/	/	/	/	H	H
4/12/10 am	7.32	130	7.42	100.2	H	H
4/12/10 pm	/	/	/	/	H	H
4/13/10 am	6.74	132	7.46	101.3	H	H
4/14/10 am	7.24	137	7.38	102.2	H	H
4/15/10 am	7.05	139	7.63	102.1	H	H
4/17/10 am	/	/	/	/	H	H
4/19/10 am	7.61	138	7.60	102.6	L	H

Notes: Streambed consisted of fine substrate. Substantial amounts of smelt were present both during the day and at night for over a two week time period. Lower half of stream is not conducive to spawning due to silt and sand. Lack of riparian cover, algal bloom, and depth regimes may affect smelt larvae. Eggs were noted to be in thick mats.

## Appendix C: Volunteer Observations

Volunteer data on smelt and smelt egg observations within streams tributary to Lake George, were P= present, L= low, M= Medium/Moderate, and H= high.

Stream Name	Smelt	Smelt Abundance	Eggs	Egg Abundance
Edmunds Brook	P	H	P	H
English Brook	P	H	P	H
Gull Bay Tributary	P	M	-	-
Hague Brook	P	H	P	H
Indian Brook	P	H	P	H
Jenkins Brook	P	M	P	M
Foster Brook	P	H	P	H
Northwest Bay Brook	P	M	P	M
Sabbath Day Point Tributary	P	H	P	H
Smith Brook	P	H	P	H
Spring Hill Tributary	P	-	-	-
Sucker Brook	P	L	-	-
Rogers Rock Tributary	P	H	P	H
West Brook	P	H	P	H

## MISSION

The FUND for Lake George is a not-for-profit, privately funded organization dedicated to the protection of Lake George and its nine surrounding communities. Formed in 1980, the FUND implements a science-based approach to the protection of Lake George water quality and the overall health of the Lake George watershed. The FUND seeks to use lake and watershed monitoring and scientific best practices to continuously benchmark the quality of Lake George. The FUND pursues its mission through grants to fund long-term scientific research on the lake, launching new initiatives, advocacy for new protections, and partnerships with other organizations and local governments. The FUND is the sponsor of the Lake George Waterkeeper, among other programs on Lake George. The FUND for Lake George is managed by a Board of Trustees and maintains an office in Lake George.

The mission of the Lake George Waterkeeper is to defend the natural trust resources of Lake George and its basin for the good of the community and its watershed.

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