ATLANTIC SALMON SMOLT REPORT ON FISH SAMPLING EFFORTS AT MOORE DAM, SPRING 2006

FEBRUARY 2007

FINAL DRAFT

ATLANTIC SALMON SMOLT REPORT ON FISH SAMPLING EFFORTS AT MOORE DAM, SPRING 2006

Prepared for
TRANSCANADA HYDRO NORTHEAST, INC.
4 Park Street
Suite 402
Concord, NH 03301

Prepared by
NORMANDEAU ASSOCIATES, INC.
917 Route 12, #1
Westmoreland, NH 03467

R-20701.000

February 2007

Executive Summary

The Fifteen Mile Falls Project is a three development hydroelectric project on the upper Connecticut River owned by TransCanada Hydro Northeast, Inc. The three developments comprising the Project are Moore, Comerford, and McIndoes. Moore Dam, the upper most development, is located near the town of Littleton in Grafton County, NH and on the Vermont side, in Caledonia County. The FERC approved a third year of study plan to evaluate the timing and season of smolt passage at Moore Dam, prior to filing a fish passage plan, required by the FERC license.

TransCanada constructed an inclined-plane sampler in the skimmer gate at the Moore Dam as the mechanism to conduct the evaluation. The sampler has been monitored seasonally for the passage of stream-reared salmon smolts since 2004. In addition, hatchery-reared smolts have been used to evaluate the effectiveness of the sampler as a downstream route of passage. Results of the third year of study are provided herein. The study included monitoring the timing (diurnal and seasonal), duration, and abundance of the stream-reared Atlantic salmon migratory run at Moore Dam. Additionally, hatchery-reared smolts were used to assess the effectiveness of modifications made at the skimmer gate entrance, consisting of a flow shelf installed in the entrance area to increase flow velocity beyond the face of the dam.

The sampler was monitored from 1 May to 27 June 2006. Collected salmon were identified as hatchery-reared or stream-reared and all live salmon were transported to, and released below the McIndoes Station. Hatchery-reared fish were obtained from the US Fish and Wildlife Service's Pittsford National Fish Hatchery in Pittsford, VT. Fish were tagged at the hatchery, and then transported to Moore Dam where they were held overnight and released the next day in the tailrace of the Dalton Hydro in Gilman, VT. Visual implant elastomer (VIE) tags were put in 805 hatchery-reared smolts that were released in five groups between 9 May and 1 June. A summary of the 2006 results are as follows:

<u>Stream-Reared Smolts</u>

- 2,473 stream-reared smolts were collected between 2 May and 27 June; 89% were collected by 18 June, and 292, the most in one day, were collected on 15 May;
- Catch-per-unit-effort (CPUE) was highest (5.75 smolts/h) during the Night category (between sunset and sunrise), and lowest (1.10 smolts/h) during the Day category. Overall CPUE for stream-reared smolts was 1.88 smolts/h;
- Mortality was 3.7%, down from previous years due primarily to reduced entrainment of debris on the sampler after installation of a trash boom at the entrance to the skimmer gate;
- The full migratory run of stream-reared smolts appears to have been observed; distribution of the run was tri-modal with peaks occurring in the second, forth and seventh sampling week.

<u>Hatchery-Reared Smolts</u>

- 805 hatchery-reared smolts were tagged and released; 377 (47%) were re-captured in the sampler, up from 30% in 2005, and 9% in 2004;
- CPUE for hatchery-reared smolts was 0.26 smolts/h, and was highest (1.27 smolts/h) during the Night category;
- Mortality was 9%, down from previous years due primarily to reduced entrainment of debris on the sampler after installation of a trash boom at the entrance to the skimmer gate.

Based on the results of the last three years of study, the following conclusions can be made:

- The inclined plane sampler was effective at collecting fish that passed over the skimmer gate.
- Opening the sampler by 1 May captures the onset of the smolt emigration past Moore Dam.
- Installation of a debris boom at the entrance of the skimmer gate reduced debris load on the sampler, thereby reducing smolt mortality.
- An increase in the recapture rate of tagged hatchery-reared smolts in 2006 suggests that the flow shelf, installed prior to sampler operation, facilitates passage.
- Collecting total length and weight measurements of stream-reared smolts would provide a condition factor index and offer a context for growth relative to lower basin subpopulations.

Table of Contents

Acronyms, Abbreviations, and Definitions

°C	degree Celsius
cfs	cubic foot per second
CPUE	catch-per-unit-effort
CRASC	Connecticut River Atlantic Salmon Commission
d	day
FERC	Federal Energy Regulatory Commission
FMF	Fifteen Mile Falls
ft	foot
g	gram
gal	gallon
h	hour
hp	horsepower
mg/L	milligram per liter
mi	mile
min	minute
mm	millimeter
MS-222	tricane-methanesulfonate
msl	mean sea level
NH	New Hampshire
NHFGD	New Hampshire Fish and Game Department
RM	river mile
rpm	revolutions per minute
Sample event	Brief period of time when water conveyed from the Moore Dam sampler to the collection tank was shut-off and fish were retrieved from the collection tank for processing.
Sample period	Time between sample events when the sampler was operating.
smolts/h	smolts per hour
TransCanada	TransCanada Hydro Northeast, Inc.
TL	total length
VIE	visual implant elastomer
VT	Vermont
VTDFW	Vermont Department of Fish and Wildlife
USFWS	United States Fish and Wildlife Service
USGenNE	USGen New England, Inc.

List of Tables

List of Figures

1.0 INTRODUCTION

The Fifteen Mile Falls Project (FMF) is a three development hydroelectric project on the upper Connecticut River (Figure 1-1) formerly owned by USGen New England, Inc. (USGenNE) and currently owned by TransCanada Hydro Northeast, Inc. (TransCanada). The Federal Energy Regulatory Commission (FERC) license for the project was transferred to TransCanada on 7 July 2005 (FERC Project No. 2077). The three developments comprising the project are Moore, Comerford, and McIndoes. Moore Dam, the upper most development, is located near the town of Littleton in Grafton County, NH and Caledonia County, VT (Figure 1-2).

The FERC issued a license renewal to USGenNE for continued operation of the project on 8 April 2002. Article 410 of the license required that within 180 days of being notified by the NH Fish and Game Department (NHFGD), the VT Department of Fish and Wildlife (VTDFW), and the U.S. Fish and Wildlife Service (USFWS) that an Atlantic salmon (*Salmo salar*) stocking program had been initiated upstream from the Moore Reservoir and that such passage facilities are needed at the developments, the licensee must file, for FERC approval, a plan for the construction, operation, and maintenance of permanent downstream fish passage facilities at the Moore and Comerford developments. USGenNE received a request from the Connecticut River Atlantic Salmon Restoration Commission (CRASC) on 4 November 2002, to install downstream passage facilities at the two developments. In a letter to FERC dated 18 September 2003, USGenNE indicated there was a lack of sufficient information to adequately provide and construct such facilities and therefore requested a deadline extension for filing a plan in response to the CRASC letter. USGenNE filed a plan on 15 December 2003, which met FERC approval through the Commission Order issued 18 March 2004. In the Order, FERC approved a two-year study plan to evaluate the timing and season of smolt passage before filing a fish passage plan. USGenNE proposed to evaluate and characterize smolt downstream passage by constructing an inclined-plane sampler in the skimmer gate at the Moore Dam. NHDES, as part of its 401 Water Quality Certificate, also approved the extension on the passage plan requirement but only authorized a one-year extension, noting that additional extensions could be sought by USGenNE.

Consultation with agencies resulted in a plan of study for a minimum two-year evaluation, with the second year contingent upon approval from the agencies. The first year of study was conducted in 2004, followed by an approved second year in 2005. Modifications were made to the sampler in the winter and spring 2005-2006, and a third year of study was approved for 2006. As in prior years, the 2006 study monitored the timing (diurnal and seasonal), duration, and abundance of the stream-reared Atlantic salmon smolt migratory run at the Moore development. In addition, hatchery-reared smolts were used to obtain information on the effectiveness of the modifications that had been made to the skimmer gate entrance.

2.0 PROJECT DESCRIPTION

2.1 Moore Development

The Moore Development is located at river mile (RM) 283.5 on the Connecticut River and includes an 11-mi-long reservoir with a surface area of 3,490 acres and 223,722-acre-ft of gross storage at a normal maximum operating level of 809 ft msl. The earthen and concrete gravity dam is 2,920 ft long, 178 ft high, and consists of a 373-ft-long concrete spillway with a 15-ft-wide by 20-ft-high sluice gate, four stanchion bays, three Tainter gate bays and a powerhouse with four Francis type turbine-generator units. The turbines have a combined power rating of 225,600 hp under a design head of 150 ft and a combined rated discharge of 13,300 cfs (FERC 2002). Maximum head and turbine discharge are 158 ft and 18,300 cfs, respectively and runner speed of the turbines is 128 rpm (NEP 1996).

The Moore Development operates as a daily peaking station and passes discharge directly into the Comerford Development reservoir. Elevation changes in Moore Reservoir average approximately 1-ft per day and generally have approached the normal operating level (~el. 804 –

806 ft msl) by mid-May (NEP 1996). The license provides for 320-cfs-year-round minimum flows (NEP 1997).

2.2 Moore Dam Skimmer Gate and Sampler

An inclined-plane sampler was installed at the skimmer gate during early 2004 and monitored for salmon smolt passage during spring 2004 and 2005 (Normandeau Associates, Inc. 2005, 2006). Modifications were made after each passage season to improve the effectiveness and efficiency of the sampler to attract and pass salmon smolts. Modifications made for the 2005 emigration are specified in Normandeau Associates, Inc. (2006); changes made for the 2006 smolt emigration were:

- A 14ft-8in x 25ft wooden flow shelf (Figure 2-1) was submerged approximately five feet below water surface at the entrance of the skimmer gate to extend the flow-net range into the forebay. The flow shelf was installed before the sampler was opened on 1 May.
- A specially designed trash boom was anchored around the skimmer gate entrance to deflect large debris from the sampler (Figures 2-2, and 2-3). The trash boom was installed on 15 May 2006.

A targeted discharge of 500 cfs for downstream passage onto the fish sampler was used throughout the 2006 evaluation. To accomplish this, the skimmer gate was manually adjusted to within approximately one-foot of pond elevation changes.

The inclined plane sampler is 14.5 ft wide and consists of two sections, connected on a pivot (Figure 2-4). The front section, connected to the dam at a horizontal angle, is approximately 9 ft long by 14.5 ft wide; the elevation can be adjusted but the plane surface of this section remains horizontal at all times. The rear section is approximately 21 ft long by 14.5 ft wide and pivots at its junction with the front section. The angle of the rear section to the front section can be adjusted to optimize the amount of dewatering as flow passes over the screen. The surface of both sections was designed to dewater the discharge through the skimmer gate, and was made of 1.25-in by 0.375-in aluminum bars placed parallel to one another to create a gap (Figure 2-5). The gap width was set at 3/16 in for this study, but could be adjusted if necessary. On top of the screen surface was a set of flow guidance structures designed to facilitate even flow and proper velocity across the downstream end of the screen (Figure 2-6).

At the end of the inclined plane is an angled, fabricated metal trough with solid sides that connects to a 12-in-diameter discharge pipe (Figure 2-7). The elbowed discharge pipe is adjustable vertically and conveys water from the trough to the collection tank. The collection tank is an 8-ft by 4-ft-rectangular open-topped metal box, 4 ft deep. Perforations around top portions of the tank, and an adjustable drainage valve at the bottom provided circulating water through the tank and a pre-determined water depth. A 55-gal drum affixed to a monorail system was available to transport fish from the collection tank to a processing area on the headworks of the dam.

3.0 MATERIALS AND METHODS

3.1 Moore Dam Sampler

The sampler was monitored during each day of operation. A sampling event entailed engaging the shut-off valve on the discharge pipe, allowing the collection tank to drain, and dip-netting all fish out of the tank (Figure 3-1). After all fish were removed, the valve was opened to allow flow to the collection tank. Fish were put in 5-gal buckets half filled with water and carried to the processing area located on the headworks of the dam, or transported to the headworks via the monorail system and a 55-gal drum half filled with water (Figure 3-2). Salmon were identified as hatchery-reared (tagged with one of five visual implant elastomer (VIE) colors) (Figure 3-3) or stream-reared, and their physical condition noted in accordance with a coding system developed for the evaluation (Table 3-1). All live salmon were transported below the FMF Project and released in the tailwaters of the McIndoes development. Resident fish removed from the collection tank were identified to species, enumerated, surveyed for obvious injuries, and returned to Moore Reservoir.

During each sampling event, operation conditions such as pond elevation, skimmer gate position, and position of the front and rear sampler sections, were recorded. Sampling period (period of time the sampler was operating between sampling events) was also recorded. Adjustments to the rear sampler section were made by Normandeau personnel when necessary. Adjustments to the skimmer gate, front sampler section, and collection tank platform, were made by TransCanada operators. Fluctuation in the reservoir elevation of approximately 1 ft necessitated a gate adjustment, after which, the front sampler, rear sampler, and collection tank platform were accordingly adjusted.

3.2 Hatchery-Reared Fish Procurement Tagging and Release

Hatchery-reared fish were obtained from the US Fish and Wildlife Service's (USFWS) Pittsford National Fish Hatchery in Pittsford, VT. Smolts were handled as little as possible to minimize stress related to tagging. Smolts were selected for size (>170 mm total length (TL), except for two measuring 118 and 130 mm TL), anesthetized in a 40-mg/L-solution of buffered tricane-methanesulfonate (MS-222), and measured for total length (mm) and weight (g). One of five VIE colors was injected under the transparent tissue framing each eye. Release group was distinguished by color when fish were recaptured in the sampler.

Fish were tagged at the hatchery and transported in 180-gal-aerated tanks, to circular holding tanks on the headworks of the Moore development. After transport, fish were acclimated to within 2°C of ambient water temperature at a rate of approximately 2°C per hour. Water from Moore Reservoir flowed continuously through two 200-gal holding tanks via a submersible pump and garden hoses. Aeration, in addition to continuous flow, was achieved by placing the garden hose discharge above the surface of the water, creating a waterfall effect. Air pumps were available if dissolved oxygen levels fell below 7 ppm. The greatest number of hatchery-reared fish held in a tank at one time was about 100; roughly 2 gal of water per smolt. Tagged smolts were held at the project overnight, and released the following day.

Tagged smolts were transported to Gilman, VT and released just downstream of the Dalton Hydro tailrace (Figure 1-2). The transport truck was backed to a point near the discharge and 8-10 smolts were dipped from the tank, placed in a 5-gal bucket, lowered to the water surface (~10 ft) and released by tipping the bucket.

3.3 Environmental Conditions

Water temperature was monitored near the entrance to the Moore Dam skimmer gate and in the tailrace of Dalton Hydro between 4 May and 27 June, via Onset HOBO Water Temp Pro™ temperature loggers. Loggers were equipped with a protective boot supplied by Onset and suspended from weighted lines. Each station had a redundant logger; loggers were placed approximately 2-ft-below the water surface and recorded temperature every 15 min.

Provisional stream flow data was downloaded from the USGS' national water information web site for gauge number 01131500, Connecticut River near Dalton, NH. This data was used to describe stream flow into the reservoir during the study period.

3.4 Data Collection and Analysis

Temperature data were downloaded at the end of the study and raw data from each logger compiled, checked for gross inaccuracies, and graphed. Operations data, including flow through the skimmer gate, and unit generation and flow, were provided by TransCanada. Percent of flow to the skimmer gate (and onto the sampler) relative to total flow to the units and the skimmer gate was calculated.

The number of stream-reared and hatchery-reared fish removed from the collection tank was tallied for each day. To obtain information on time-of-day of passage, sample periods were divided into three groups: Day, Night, and Day and Night. Day versus Night was based on the timing of sunrise and sunset as documented for Littleton, NH (www.sunrisesunset.com). During the course of the study, sunrise occurred at 05:45 h on 1 May and 05:13 h on 27 June; sunset occurred at 19:49 h on 1 May and 20:33 h on 27 June. When sample periods fell within both night and day hours, they were grouped in the Day and Night category. Catch-per-unit-effort (CPUE) was calculated for each of the three time categories and separately for stream-reared and hatchery-reared smolts. The recapture rate of VIE tagged fish was determined.

4.0 RESULTS

4.1 Sampler Operation

The Moore Dam sampler began operating at 17:00 h on 1 May and was closed at 14:43 h on 27 June 2006. The skimmer gate was closed for short periods of time, ranging from a few minutes to 2h 45min, to reset the gate, clear debris from the sampler, and install the trash boom.

Sampling periods, defined as the period of time the sampler operated between fish removal from the collection tank, ranged from 1h 54min to 21h 35min, and averaged 9h 41min. The sampler collection tank was checked 136 times over the course of the study and fish collected in the tank were processed an average of 2.4 times per day between 1 May and 27 June (ranging from 1 to 5 times per day) (Appendix Table 1). Over 17,570 fish of 25 species were processed, including salmon and one unidentified fish (Table 4-1).

Flow over the skimmer gate and onto the sampler averaged approximately 506 cfs over the period of operation. Flows were categorized into 25-cfs increments and the proportion of time each category occurred was calculated. The flow category with the greatest (23%) percentage of occurrence was 500-524 cfs; the lowest percent occurrence was the 325-349 cfs category (Figure 4-1). The proportion of flow through the skimmer gate, relative to flow through the skimmer gate and turbine discharge combined, ranged from 2.86 to 100% (mean = 33.74 %, SD = 38.47). High proportional flows through the skimmer gate occurred when there was little or no turbine discharge, and low proportional flows to the skimmer gate occurred when turbine discharge was high. Proportional discharge to the skimmer gate was most frequently 0 – 15% of flows (61% combined) and 100% (22%, Figure 4-2A). The distribution of hourly averaged proportional flow to the skimmer gate represents three distinct periods of variable proportion through the skimmer gate, and two distinct periods when the proportion of flow to the skimmer gate was quite low (Figure 4-2B). The daily average proportional flow through the skimmer gate demonstrated these periods with less than 10% of the flow through the skimmer gate, concurrent with high inflow and subsequently high discharge periods (Figure 4-2C). Spill through Tainter gate #2 occurred for 26 hours from 10:00h on 11 June through 12:00h on 12 June. This flow ranged from 338-3,143 cfs and averaged 1,402 cfs.

Proportional flow to the skimmer gate relative to flow through the skimmer gate and turbine discharge combined, averaged hourly over the period of operation ranged from 7.1 – 15.3%. Proportion of flow to the skimmer gate was generally higher during night hours when flow to the turbines was low (Figure 4-3). The hourly proportion of the total flow, defined as skimmer gate flow plus turbine flow, from the skimmer gate was assigned a diel phase; from May 1 through June 27, observations from 0600 – 1900 h, inclusive were classified as daytime, and from 2000 – 0500 h, inclusive were classified as nighttime. A one-way analysis of variance (ANOVA) was applied to test the hypothesis that proportional flow was higher during nighttime compared to daytime hours. The mean proportion of flow during nighttime (mean = 47.50 %, N= 574, SD = 43.35) was significantly higher (P>F <0.0001) than during the daytime (mean = 23.47 %, N =

799, SD = 30.86), though a low R^2 value (0.10) indicated that little of the variability in the proportional flow data was explained by diel phase.

Water level in the Moore Reservoir is raised through the spring, causing trees and leaves from the shore line, and detritus stirred up from the sediment to be transported by water and wind currents to the skimmer gate entrance. In 2005 this debris load contributed to relatively high smolt mortality due to entrainment and impingement of debris on the sampler. Sixty-seven percent of the smolt mortality recorded, occurred when debris was especially high (29 May – 1 June 2005). On 15 May 2006 a trash boom was installed at the skimmer gate entrance to deflect debris away from the sampler. Debris loading was considerably reduced after the trash boom was installed. Debris load on the sampler and in the collection tank was documented at least daily using an index range of 1 to 4, as defined in the table below. The debris level code averaged 2.6 before trash boom installation and 1.6 after. The reduction in load suggested by the index was verified by the amount of debris observed on the boom (see Figure 2-3 for example).

Debris Level Codes Recorded for the Moore Dam Fish Sampler	
1	No debris
2	Light debris (no problem)
3	Moderate debris (must be cleaned but does not affect operation of the sampler
4	Heavy debris (affects operation of the sampler)

4.1.1 Stream-Reared Salmon Smolt Collection

Stream-reared Atlantic salmon smolts were collected on 54 of 57 days and in 109 of the 136 sampling events. The greatest number of stream-reared smolts collected in one day was 292 on 15 May. The distribution of the smolt migration over time was tri-modal with peaks occurring in the second, forth and seventh sampling week (Figure 4-4). Daily average CPUE of stream-reared smolts varied greatly over the season, but trended with proportional discharge to the skimmer gate (Figure 4-2C)

For analysis of CPUE, sample periods were divided into three categories based on the time of sunset and sunrise in Littleton, NH (www.sunrisesunset.com). The three categories were Day (sunrise to sunset), Night (sunset to sunrise) and Day and Night (when sample periods fell within both Day and Night categories). Effort was calculated as the number of hours the sampler was operated within each category. Of the 1,316 hours sampled, 46% fell in the Day category and 4% in the Night category. CPUE for stream-reared smolts was highest in the Night category at 5.76 smolts/h. Day and Night CPUE for stream-reared smolts was 2.33 and Day CPUE for stream-reared smolts was 1.10 (Table 4-2). CPUE for hatchery-reared smolts was greatest during the Day and Night category (0.40, Figure 4-6).

Of the 2,473 stream-reared smolts collected, 95.3% (n=2,360) had no observable injuries, 0.8% (N=19) had some form of injury (ranging from descaling to laceration), 0.1% were moribund (N=2), and 3.7% (N=92) died (Table 4-3). Examination of fish for injuries and other handling, such as netting out of the collection box, contributed to descaling of specimens but was not quantified. Therefore, the injury rate due to the sampler may be overestimated.

Length data collected from dead stream-reared smolts in 2005 (n=94) and 2006 (n=95) show two distinct frequency distributions within the sample years, suggesting two age classes of fish. Analysis of scale samples collected from the 2006 mortalities (n=77) indicate the prominent distribution represents Age-2 smolts and the smaller, Age-3 smolts (Figure 4-5).

4.2 VIE Tagged Hatchery-Reared Salmon Smolts

Nine-hundred-seven Atlantic salmon smolts were obtained from the Pittsford National Hatchery, 855 were injected with a VIE tag and 805 of those were released at Gilman. Tagged smolts ranged in length from 118 to 335 mm TL; mean length was 235.5 mm TL, and the sample mode was 230 mm TL. The weight of a subset of the tagged smolts (N=886) ranged from 58 to 310 g; mean weight was 120.5 g, and the sample mode was 100 g.

While five VIE tag colors were used six releases were made. The blue VIE tagged fish were tagged and released two days apart because transportation from the hatchery was not available for the complement of the release group.

The number of fish in release groups ranged from 78 to 202, and releases occurred between 9 May and 1 June. All fish were released 11 miles upstream of Moore Dam in Gilman, VT at water temperatures ranging from 8.0 to 19.1^{o}C (Table 4-4). Of 805 smolts released, 377 (47%) were collected in the sampler by 27 June. Percent recapture by release group ranged from 36.4% (Pink) to 57.9% (Orange) with the highest occurring in the 23 May release group.

The CPUE for hatchery-reared fish was 0.29 smolts/h, compared to 1.88 smolts/h for stream-reared fish (Table 4-2, Figure 4-6). The highest CPUE (0.4 smolts/h) occurred during the Day and Night time-category. CPUE for hatchery-reared salmon during the Day time-category was 0.19; no hatchery-reared smolts were collected during the Night time category.

The condition of hatchery fish recaptured in the sampler was generally similar to that for stream-reared salmon (Table 4-3). Ninety-eight percent (N=368) exhibited no injuries, 1.3% (N=5) had other injuries, one was moribund, and 0.8% (N=3) died prior to release. The handling of fish pre-release and during recapture procedures may have affected injury rates, especially descaling.

4.2.1 Tag Retention

Fifty of the tagged smolts were held on site at the Moore development to determine the short-term retention rate of the VIE tag in smolts. These fish were tagged as described for study fish and examined 8, 16, and 27 days after tagging. Tag retention was 99% on day 8, 98% on day 16 and 95% on day 27; however, no fish lost both tags. Fish were released below the McIndoes development after examination on day 27 (22 June).

4.3 Environmental Parameters

Average daily water temperature did not vary more than 0.1^{o}C between the fish release point at Gilman and the skimmer gate opening in the Moore reservoir during the study period. Temperature ranged from 8.2 to 21.2^{o}C during this time (Figure 4-7). The minimum temperature was recorded on 24 May in the middle of a four-day period when average daily water temperature dropped to below 10^{o}C. Inflow to Moore Reservoir ranged from 1,900 to 15,700 cfs between 1 May and 27 June (Figure 4-8). Average daily discharge from the Moore Development mirrored inflow, ranging from 1,245 to 15,854 cfs. A spill event occurred on 11-12 June.

4.4 Resident Species

Approximately 14,730 resident fish, representing 24 species and one unidentified fish were collected in the sampler (Table 4-1). The majority (>11,000) were common (*Notropis cornutus*) or golden (*Notemigonus crysoleucas*) shiners; their numbers were frequently estimated because of high density occurrences. Four other species contributed to the majority of the resident fish collection: rock bass (*Ambloplities rupestris*), silvery minnow (*Hybognathus nuchalis*), yellow perch (*Perca flavescens*), and smallmouth bass (*Micropterus dolomieu*).

5.0 DISCUSSION

5.1 Stream-Reared Salmon Smolts

The purpose of this study was to obtain information on the timing and abundance of the stream-reared smolt migration past the Moore Dam. As in 2005, the full migratory run was observed this year. The run began in early May and exhibited a tri-modal distribution before substantially decreasing by 27 June, when the sampler was closed for the season. By 19 June, 90% of the run had passed. Based on two years of study, it appears that opening the sampler by 1 May captures the onset of emigration.

Timing of the smolt run was apparently influenced by both water temperature and flow. Mills (1989) suggests that salmon emigration starts in earnest once the temperature remains above 10^{o}C. A drop in the number of smolts collected after 15 May was concurrent with a drop in water temperature from 15^{o}C on 12 May to just below 10^{o}C on 22 May, creating the first mode in passage distribution (Figure 4-4). Short term changes in temperature and flow have been correlated with increased downstream migration (Jonsson et al. 1991); such changes may account for the second and third peaks, but no significant correlation was found with regression analysis. CPUE for stream-reared smolts was highest at night when the proportion of flow through the sampler, compared with total flow, was also high.

The significant spike in the number of smolts passed on 15 May, and the immediate drop in numbers is difficult to interpret. All smolts were in the morning collection after the sampler had been running from 17:55 on 14 May to 3:05 on 15 May. The sampler was closed from 11:30 to 14:00 on 15 May while the trash boom was installed. The precipitous change in water temperature, before dropping below 10^{o}C, may have had a positive influence on emigration followed by a negative influence as it fell below 10^{o}C. Whether installation of the trash boom was influential or coincidental to the drop in smolt passage numbers after 15 May is not deducible through this study design. Though the trash boom was partially submerged, its 2-ft penetration below the water surface was unlikely to inhibit emigration of salmon smolts which tend to swim within 10-ft of the surface.

Age-2 smolts were the dominate age classes passing the sampler in 2005 and 2006, with Age-3 making up the difference in 2006. The length frequency distribution for 2005 suggests that a third, larger length class may have contributed to the collection that year (Figure 4-5). Scale samples collected in 2005 were sent to NHDEP for analysis and the data were not available at the time of this submittal. Not all members of a sibling population mature in the same year and it is not surprising to find flexibility in the timing of maturation both within and between populations of Atlantic salmon smolts (Thorpe 1987).

5.2 Hatchery-Reared Salmon Smolts

Recapture rates of VIE tagged, hatchery-reared smolts were higher this year (36-58%) than in the previous two years, when recapture of fish released at the Gilman site ranged from 3-11% (2005) and 3-30% (2004) (Normandeau Associates 2004, 2005). The mean rate of recapture was higher in 2006 than for either previous study; inversely, the coefficient of variation was lower (Figure 5-1). It is possible that the increased rate of recapture resulted from greater effectiveness of the sampler due to modifications, specifically the flow shelf installation. Physical variables, particularly flow and temperature likely affected recapture rate, as well as stress induced by handling, which may have been reduced over time due to experience. Assuming rates of migration to the dam were similar among years, however, the reduced coefficient of variation in 2006 suggests a more consistent ability of smolts to locate and use the skimmer gate under the observed physical conditions.

5.3 Mortality

Percent mortality for stream-reared and hatchery-reared smolts collected in the sampler was lowest in 2006. Combined mortality was 3% in 2006, compared to 12% in 2005 and 5% in 2004. Installation of the debris boom appeared to be the primary reason for the reduced mortality. The boom prevented entrainment of large debris and much of the smaller debris on the sampler and in the collection tank. Large debris on the sampler can change the surface flow pattern and obstruct passage to the collection tank. Small debris in the collection tank can clog the collection tank causing overflow. Through experience, handling has become more efficient and the may have contributed to the reduction in mortality. Though the sampler was checked for fish less frequently in 2006, the collections were made later at night and earlier in the morning this year compared to previous years, reducing the time fish remained in the collection tank.

5.4 Conclusions

Based on the results of the last three years of study, the following conclusions can be made:

- The inclined plane sampler is effective at collecting fish that pass over the skimmer gate, providing a non-turbine emigration route past the project for salmon that are stocked above the Moore Reservoir. Stocking above Gilman, VT was initiated in 1998 (personal communication D. Emerson, NHFGD).
- Opening the sampler by 1 May captures the onset of the smolt emigration past Moore Dam.
- Debris load on the sampler and in the collection tank increases mortality rate but survival appears to be improved by installation of a debris boom, and conducting sampling events at night and early morning.
- An increase in the recapture rate of tagged hatchery-reared smolts in 2006 suggests that the flow shelf, installed prior to sampler operation, facilitates passage.
- Collecting total-length and weight measurements of stream-reared smolts would provide a condition factor index and offer a context for growth relative to lower basin subpopulations.

6.0 LITERATURE CITED

Federal Energy Regulatory Commission (FERC). 2002. Final environmental assessment for hydropower license. Fifteen Mile Falls Hydroelectric Project, FERC Project No. 2077-016, New Hampshire and Vermont.

Jonsson, B., Jonsson, N., and Hansen, L.P. 1991. Differences in life history and migratory behavior between wild and hatchery-reared Atlantic salmon in nature. Aquaculture, 98: 69-78.

Mills, D. 1989. Ecology and Management of Atlantic Salmon. Chapman and Hall, New York.

NEP. 1997. Fifteen Mile Falls (Project L.P. #2077) Settlement Agreement (dated 6 August 1997).

NEP. 1996. Fifteen Mile Falls (Project L.P. #2077) Initial Consultation Document, Vol. 1. Prepared by Louis Berger Associates for New England Power Co.

Normandeau Associates Inc. 2000. Atlantic salmon smolt migration through the Moore and Comerford Reservoirs, spring 2000. Report prepared for PG&E Generation, Lebanon, NH.

Normandeau Associates Inc. 2005. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2004. Report prepared for USGen New England, Inc., Concord, NH.

Normandeau Associates Inc. 2006. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2005. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Thorpe, J. E. 1987. Smolting verses residency: developmental conflict in salmonids. American Fisheries Symposium 1:237-244.

TABLES

Table 3-1. Codes used to document condition of salmon smolts collected in the Moore sampler, spring 2006.

Code Number	Condition
1	No observed injuries or descalation
2	Minor descalation (<10%)
3	Moderate descalation (10-25%)
4	Major descalation (>25%)
5	Eye injury
6	Contusion on body
7	Lacerations or other open wounds likely caused by sampler
8	Moribund
9	Dead

Table 4-1. Fish species and number collected in the Moore Dam fish sampler between 1 May and 27 June 2006.

Common Name	Scientific Name	Number Collected	Percent of Total
White sucker	*Catostomus commersoni*	0	0.00
Bluegill	*Lepomis macrochirus*	0	0.00
Tessellated darter	*Etheostoma olmstedi*	0	0.00
Blacknose dace	*Rhinichthys atratulus*	1	0.03
Sucker family	*Catostomidae*	1	0.03
Unidentified		1	0.03
Brown bullhead	*Ictalurus nebulosus*	2	0.06
Longnose dace	*Rhinichthys cataractae*	3	0.09
Black crappie	*Pomoxis nigromaculatus*	3	0.09
Brook trout	*Salvelinus fontinalis*	6	0.17
Northern pike	*Esox lucius*	6	0.17
Rainbow smelt	*Osmerus mordax*	8	0.23
Redbreast sunfish	*Lepomis auritus*	10	0.28
Largemouth bass	*Micropterus salmoides*	12	0.34
Fallfish	*Semotilus corporalis*	16	0.45
Pumpkinseed	*Lepomis gibbosus*	29	0.82
Rainbow trout	*Oncorhynchus mykiss*	35	0.99
Brown trout	*Salmon trutta*	74	2.10
Golden shiner	*Notemigonus crysoleucas*	81	2.30
Smallmouth bass	*Micropterus dolomieui*	367	10.41
Yellow perch	*Perca flavescens*	578	16.40
Silvery minnow	*Hybognathus nuchalis*	1,143	32.43
Rockbass	*Ambloplites rupestris*	1,153	32.72
Common shiner	*Notropis cornutus*	>1,200	
Spottail shiner	*Notropis hudsonius*	>10,000	

Table 4-2. Catch-per-unit-effort (smolts/h) for the three time-categories sampled at the Moore sampler. CPUE is the number of smolts collected divided by the number of hours sampled for each time-category.

Time Category	Effort (h)	Number of Salmon Collected			CPUE (smolts/h)		
		Stream-Reared	Hatchery	Total	Stream-Reared	Hatchery	Total
Day	612.68	674	117	791	1.10	0.19	1.29
Night	47.55	274	0	274	5.76	0.00	5.76
Day and Night	655.63	1525	260	1785	2.33	0.40	2.72
Total	*1315.86*	*2473*	*377*	*2850*	*1.88*	*0.29*	*2.17*

Table 4-3. Physical condition of salmon smolts collected in the Moore sampler, spring 2006. For the last four conditions listed, fish were noted to have either that condition only, or that condition and one or more of the previous conditions.

	Stream-Reared		Hatchery	
Condition	**Number**	**Percent**	**Number**	**Percent**
No injuries	2,360	95.43	368	97.61
Descaling	1	0.04	2	0.53
Eye injury	0	0.00	0	0.00
Contusions, and …	16	0.65	3	0.80
Lacerations, and …	2	0.08	0	0.00
Moribund, and …	2	0.08	1	0.27
Dead, and …	92	3.72	3	0.80

Table 4-4. Release and recapture information for hatchery-reared salmon smolts released in the Dalton Hydro tailrace, Gilman, VT, for the Moore study, spring 2006.

Tag Date	VIE Tag Color	Number Tagged	Date Released	No. Released	Temperature at Release (oC)	No. Collected in Sampler	Percent Recapture	Days at Large (Range)	Days at Large (Mean)
8-May-06	Pink	200	9-May-06	198	13.0	72	36.4	2 - 46	18
15-May-06	Green	151	16-May-06	131	12.0	56	42.7	3 - 36	20
22-May-06	Orange	202	23-May-06	202	8.0	117	57.9	3 - 33	20
26-May-06	Blue	102	27-May-06	93	11.0	102	52.0	3 - 30	29
28-May-06	Blue	103	29-May-06	103	13.5				
31-May-06	Red	99	1-Jun-06	78	19.0	30	38.5	6 - 25	16

FIGURES

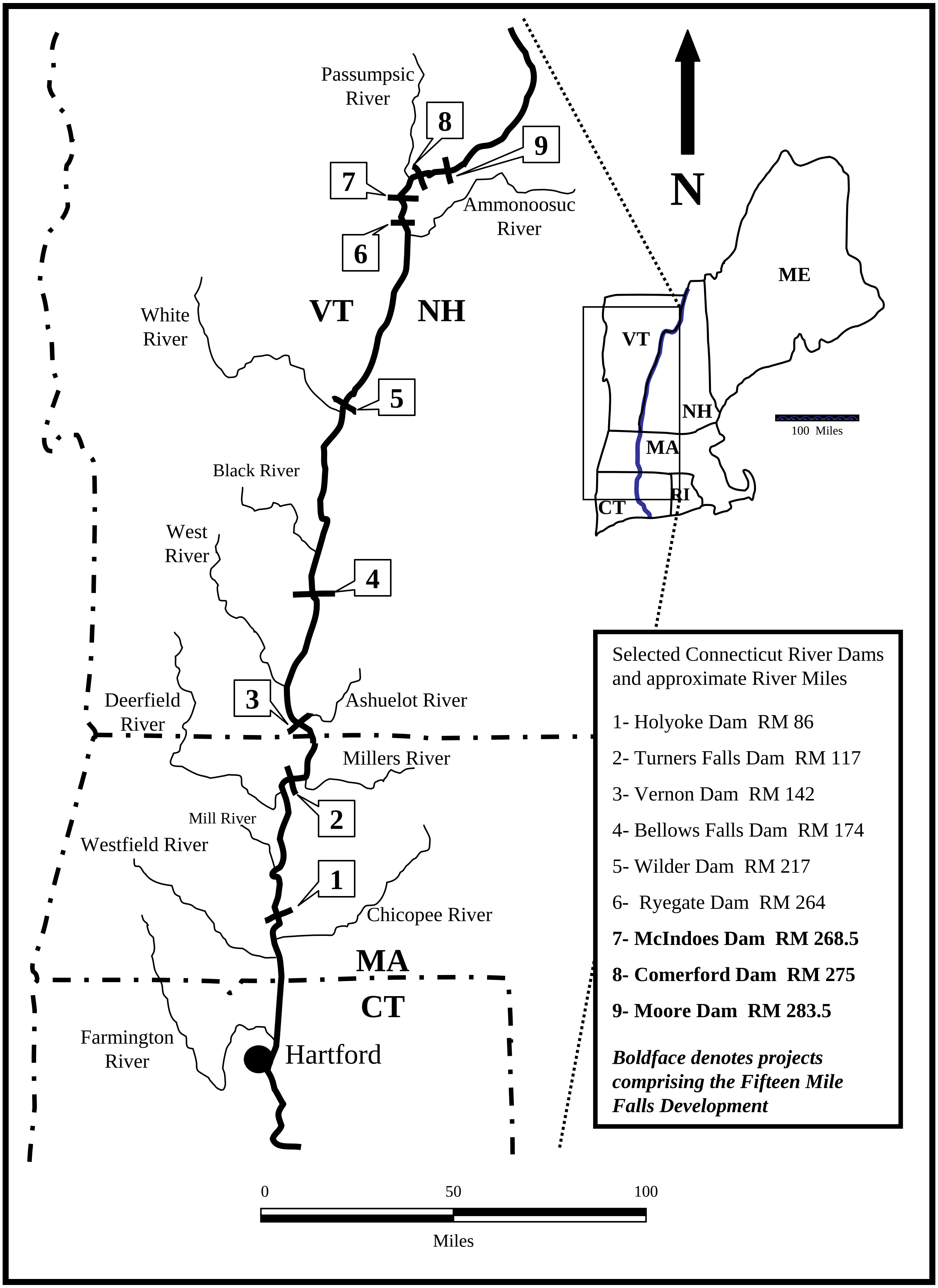


Figure 1-1. Location of the Fifteen Mile Falls Project on the Connecticut River.

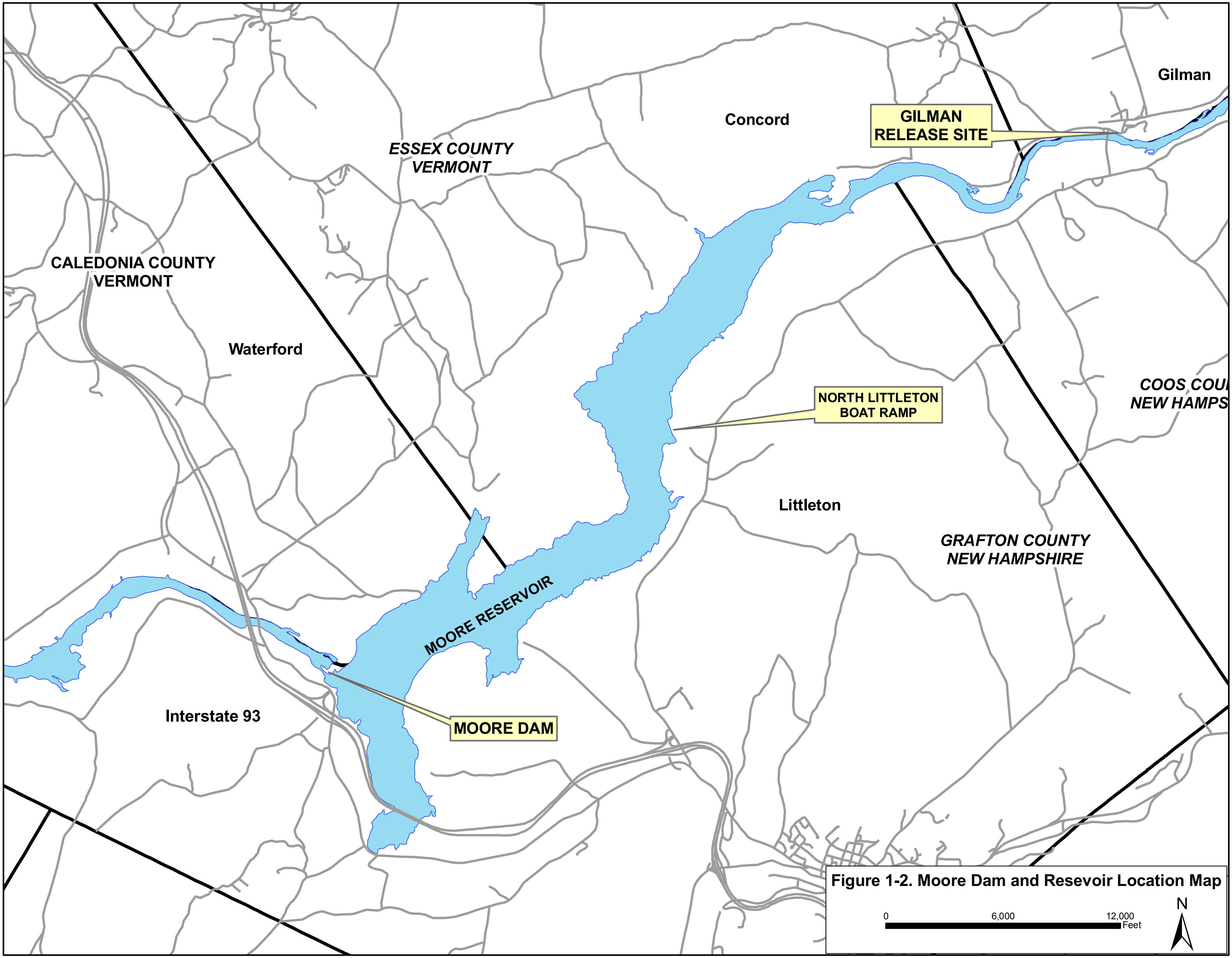


Figure 1-2. Moore Dam and Resevoir Location Map

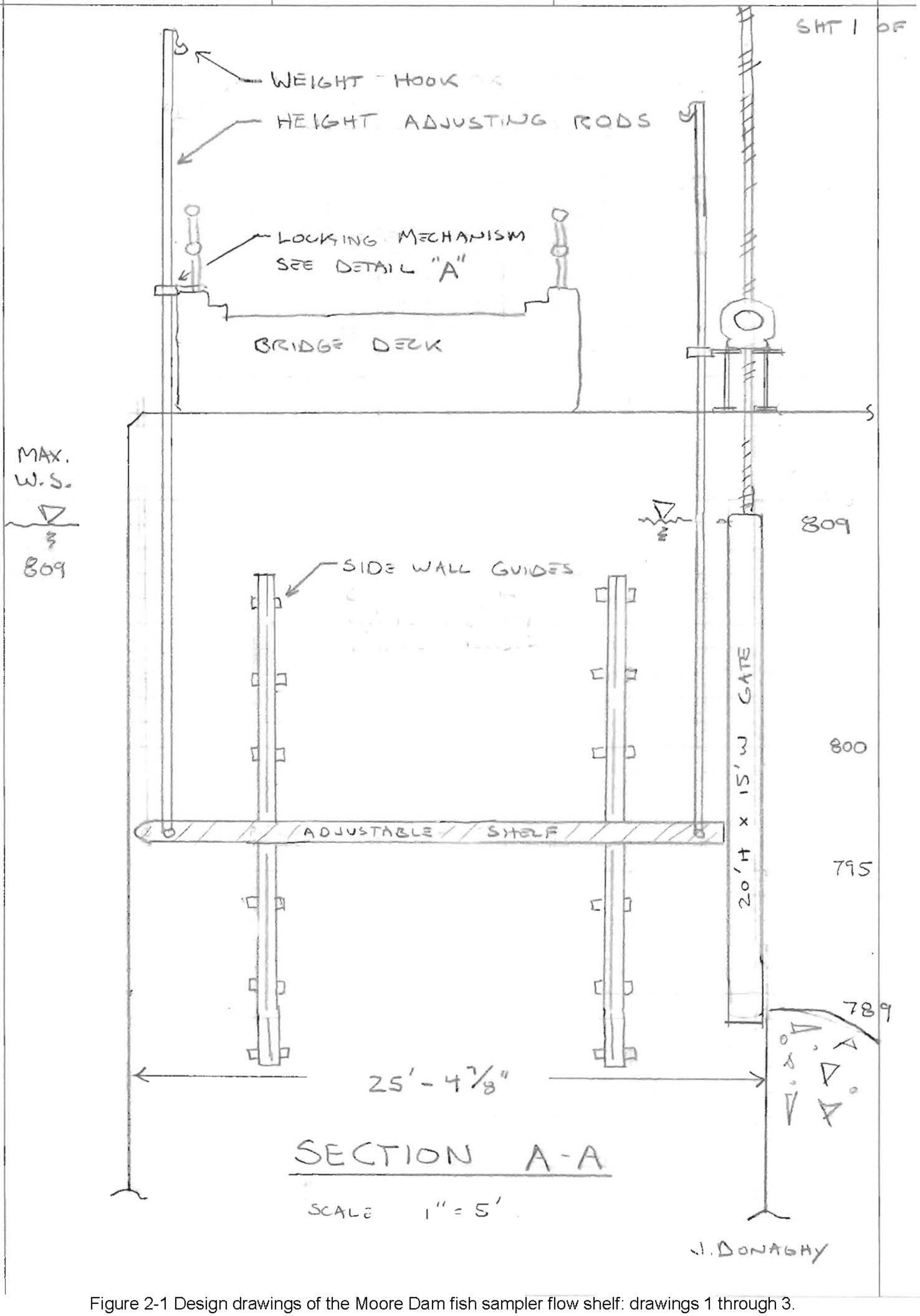
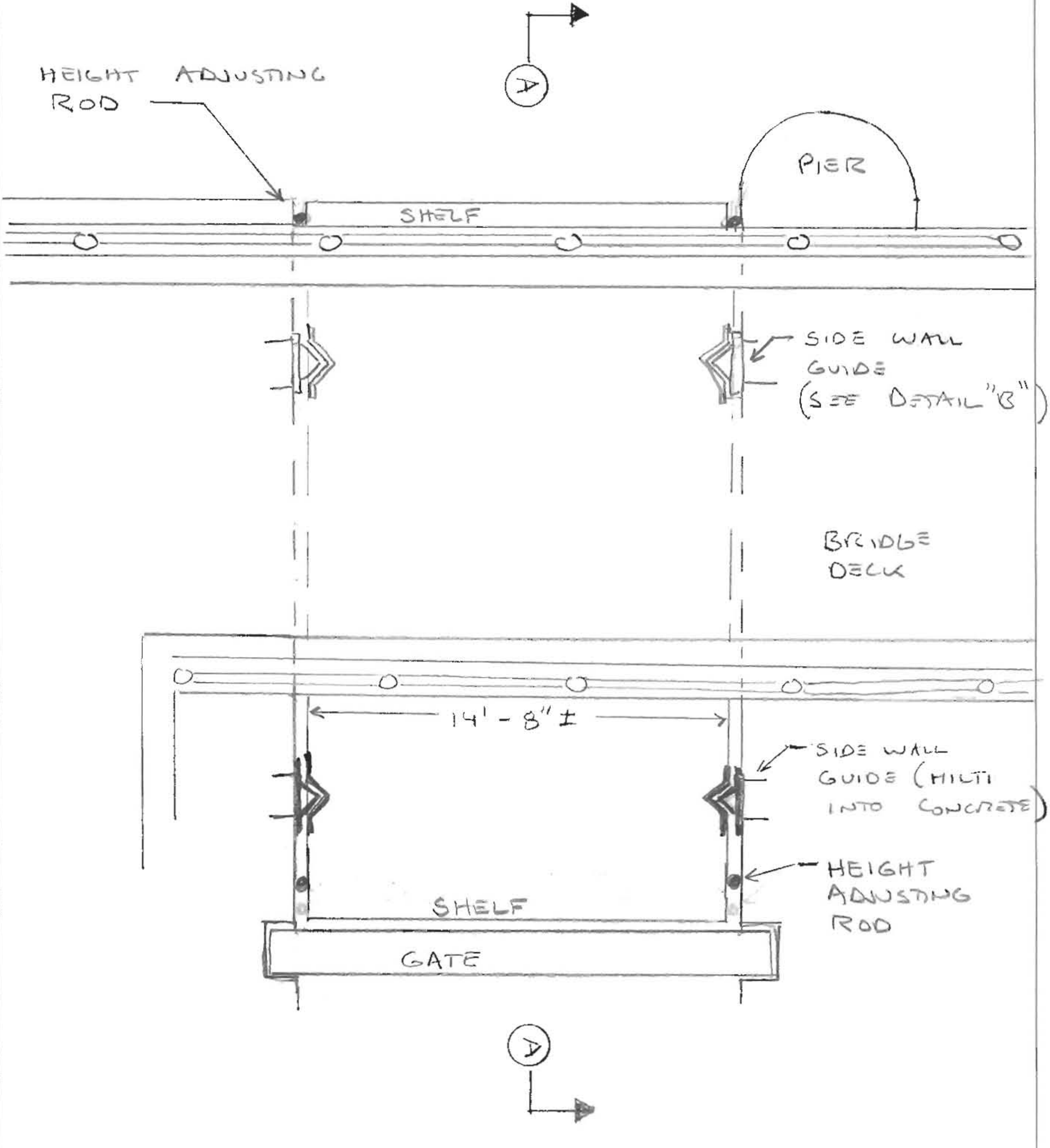


Figure 2-1 Design drawings of the Moore Dam fish sampler flow shelf: drawings 1 through 3.



PLAN

SCALE 1" = 5'

J. DONAGHY

Figure 2-3. Moore Dam trash boom installed at the entrance to the skimmer gate, spring 2006.

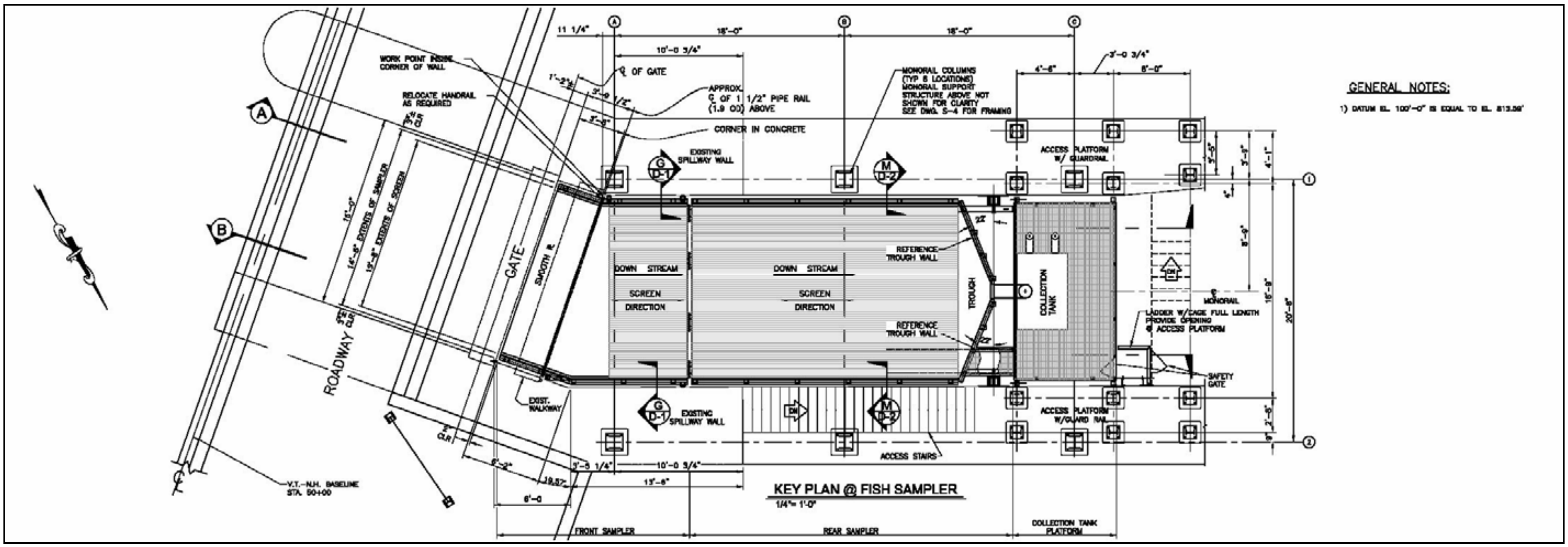


Figure 2-4. Key plan of TransCanada's Moore Development inclined plane sampler. The plan does not show flow reflectors installed after the sampler was erected. Plan drawing prepared by Kleinschmidt.

Figure 2-5. Dewatering surface of the fish sampler at Moore Dam.

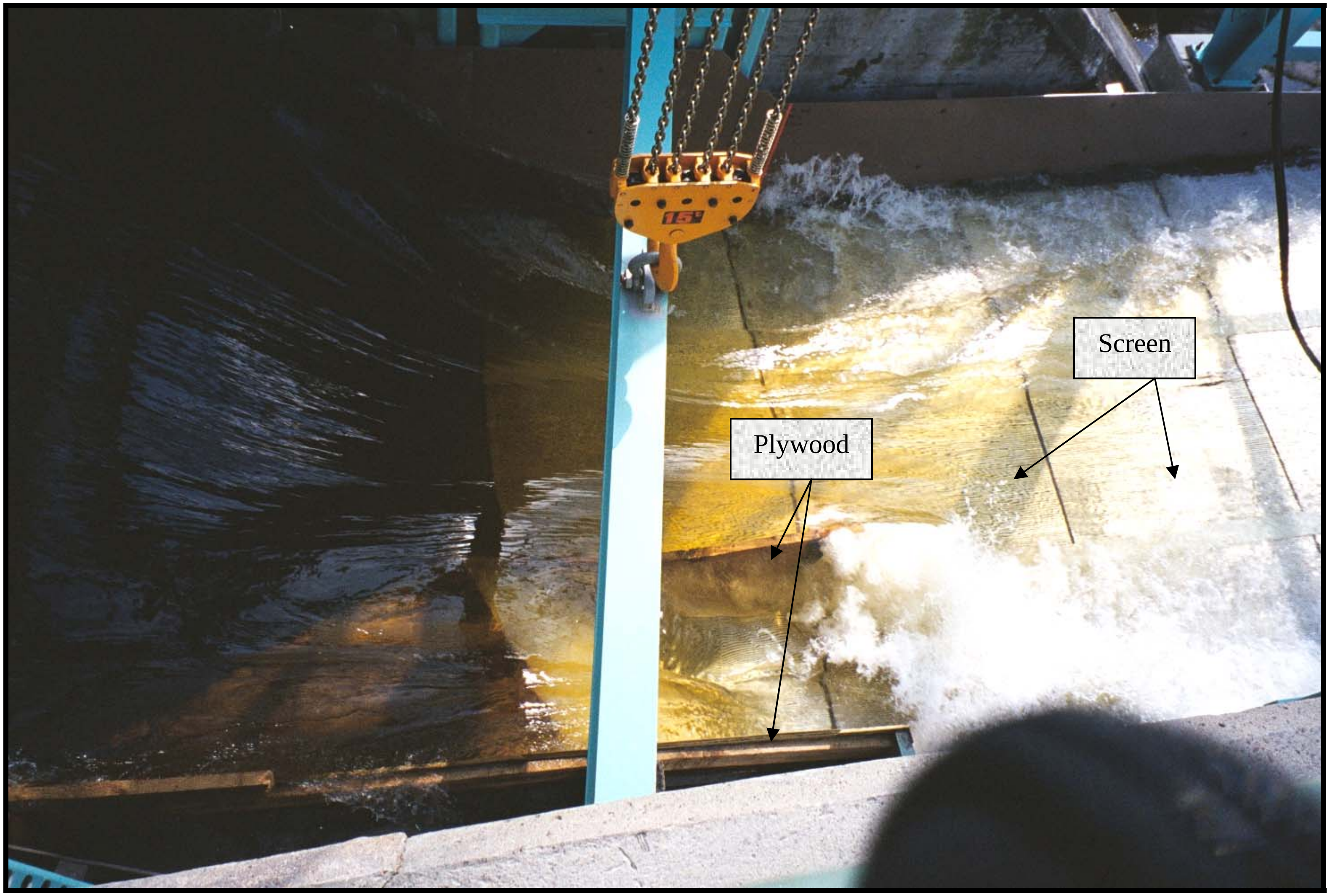


Figure 2-6. Moore Development, inclined plane sampler showing plywood flow adjusters.

Figure 2-7. Distal end of the Moore Dam fish sampler in fishing mode, showing the elbowed discharge pipe and collection tank.

Figure 3-1. Fish collection tank and discharge pipe. The distal end of the sampler is raised to curtail flow to the collection tank while the sample is collected.

Figure 3-2. Transporting fish from the sampler collection tank to the transport tank via the monorail system, spring 2006.

Figure 3-3. A hatchery-reared smolt with a post-orbital pink VIE tag. This fish died in the holding tank before release.

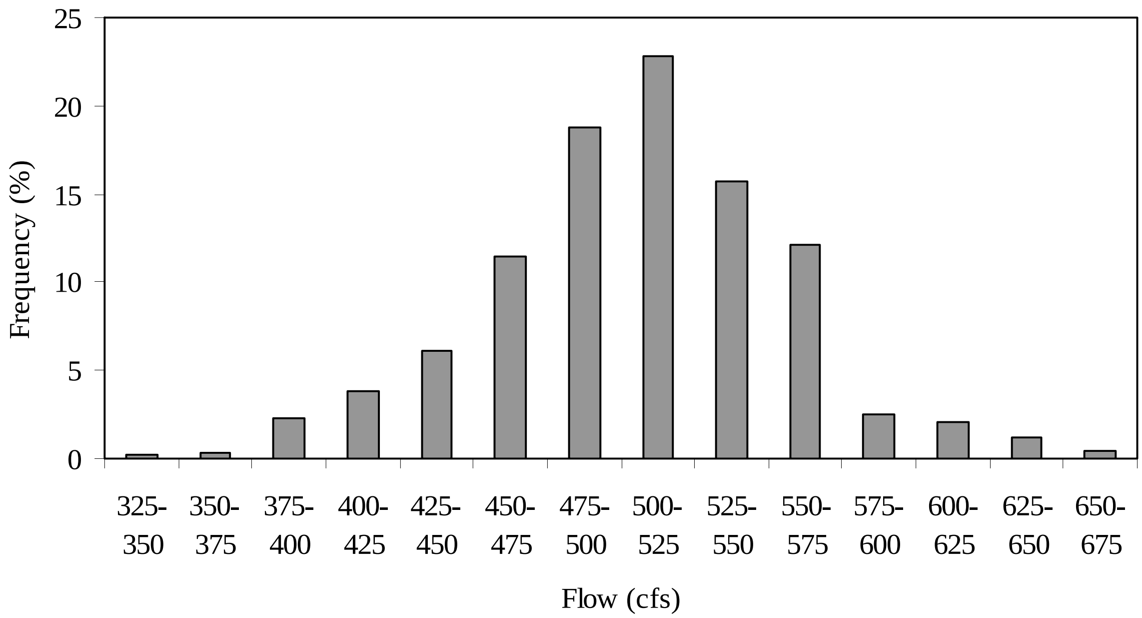


Figure 4-1. Frequency distribution of flow over the Moore Dam skimmer gate, 05/01/2006 1800h - 06/27/06 1400 h.

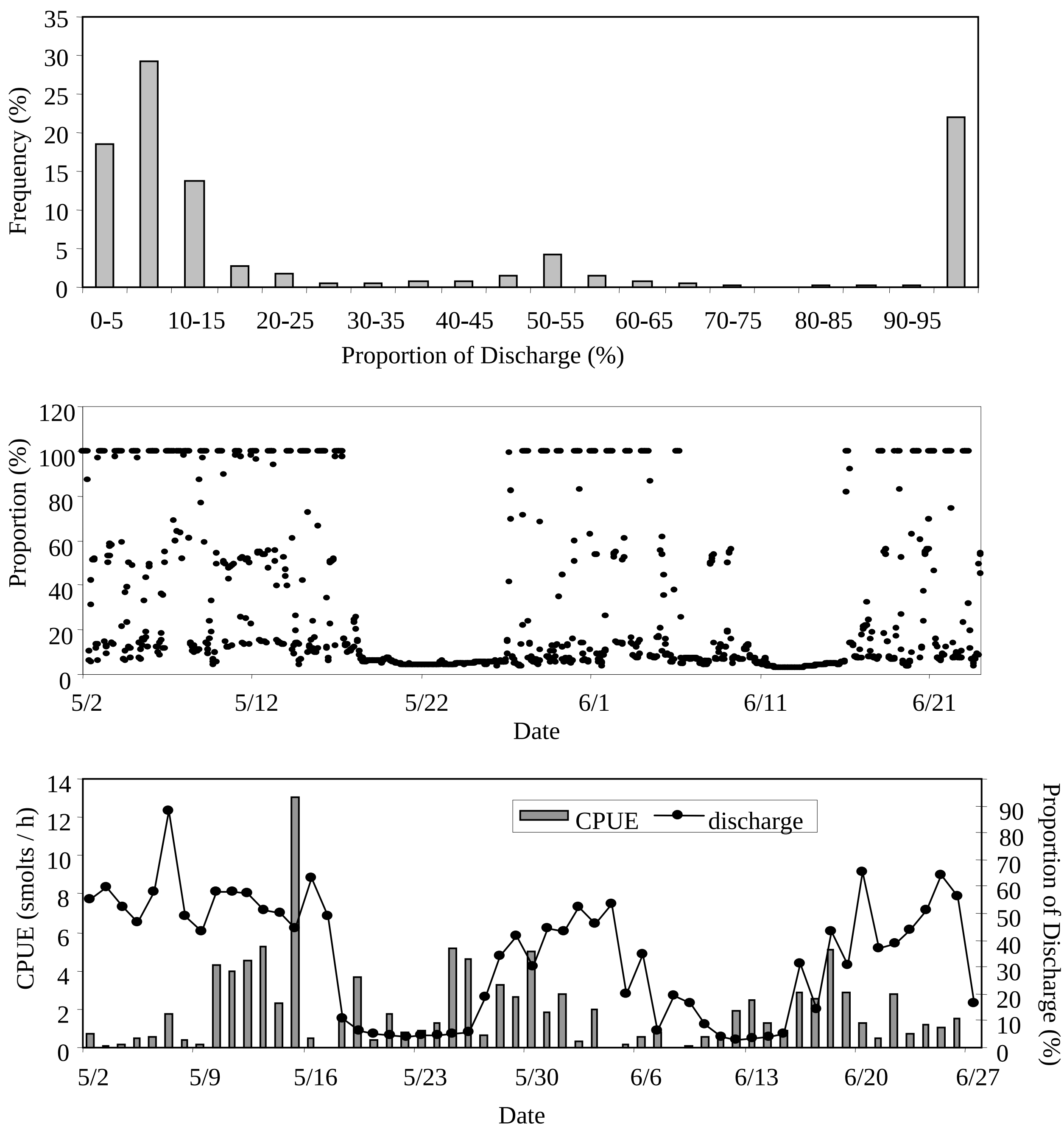


Figure 4-2. A. Frequency distribution of proportion of discharge (turbine flow + skimmer gate flow) to the skimmer gate; B. Hourly average proportion of discharge to the skimmer gate; C. Daily average proportion of discharge to the skimmer gate and daily average catch-per-unit-effort (CPUE = smolts captured per hour fished) by date.

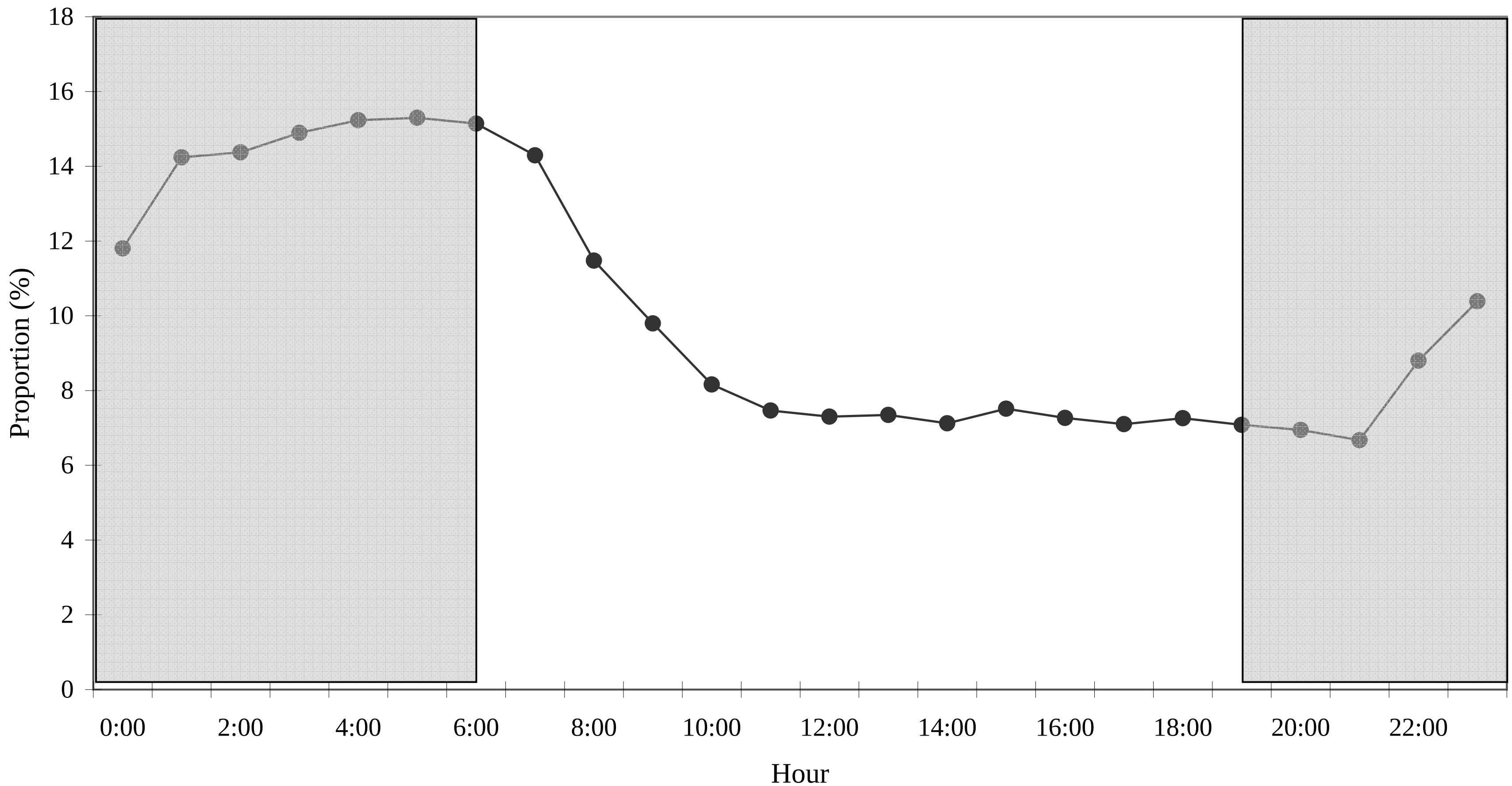


Figure 4-3. Proportion of flow to the skimmer gate sampler relative to total Project flow (i.e., flow through the skimmer gate plus turbine discharge), averaged hourly over the period of sampler operation, 2006. Shaded areas are approximately the hours after sunset during the study period.

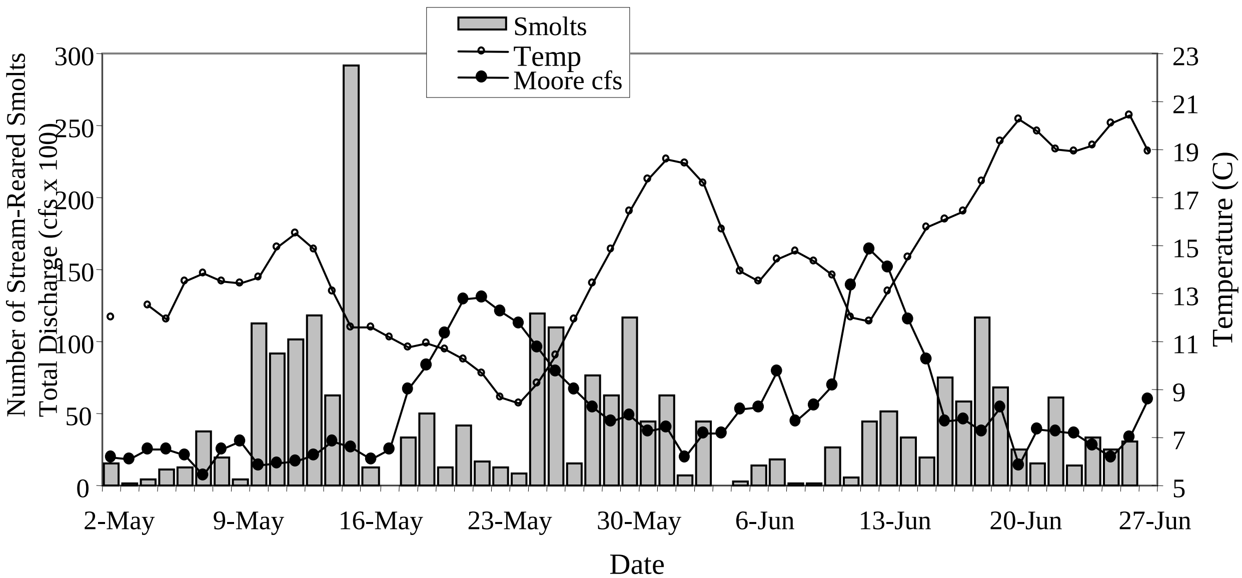


Figure 4-4. Daily average water temperature and discharge (cfs x 100), and sum of stream- reared smolts collected at Moore Dam, spring 2006.

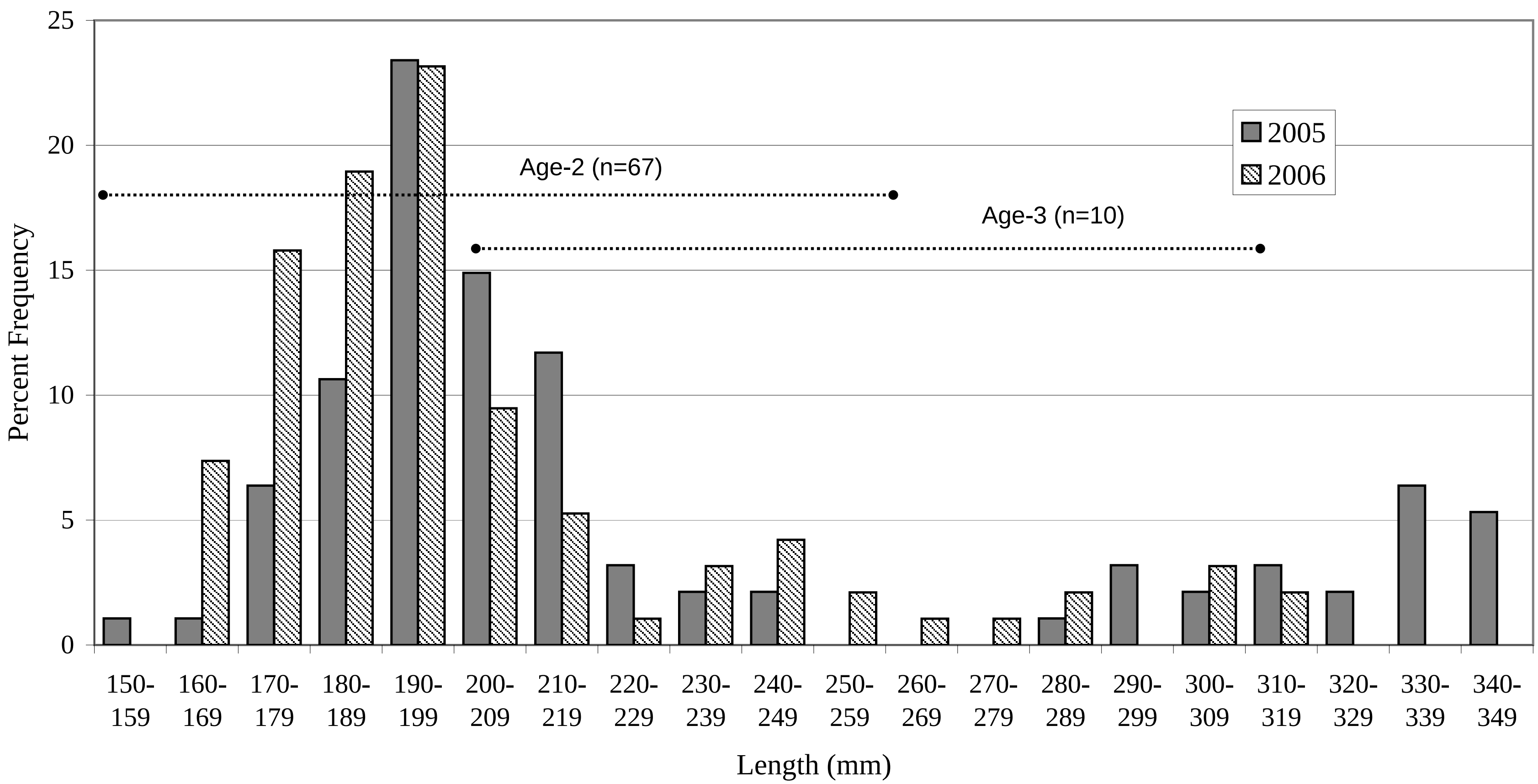


Figure 4-5. Length frequency distribution (%) of deceased Atlantic salmon smolts collected from the Moore Dam sampler in 2005 (n=94) and 2006 (n=95). Age at length was determined by age analysis of scales collected from a sub-set (n=77) of the 2006 sample.

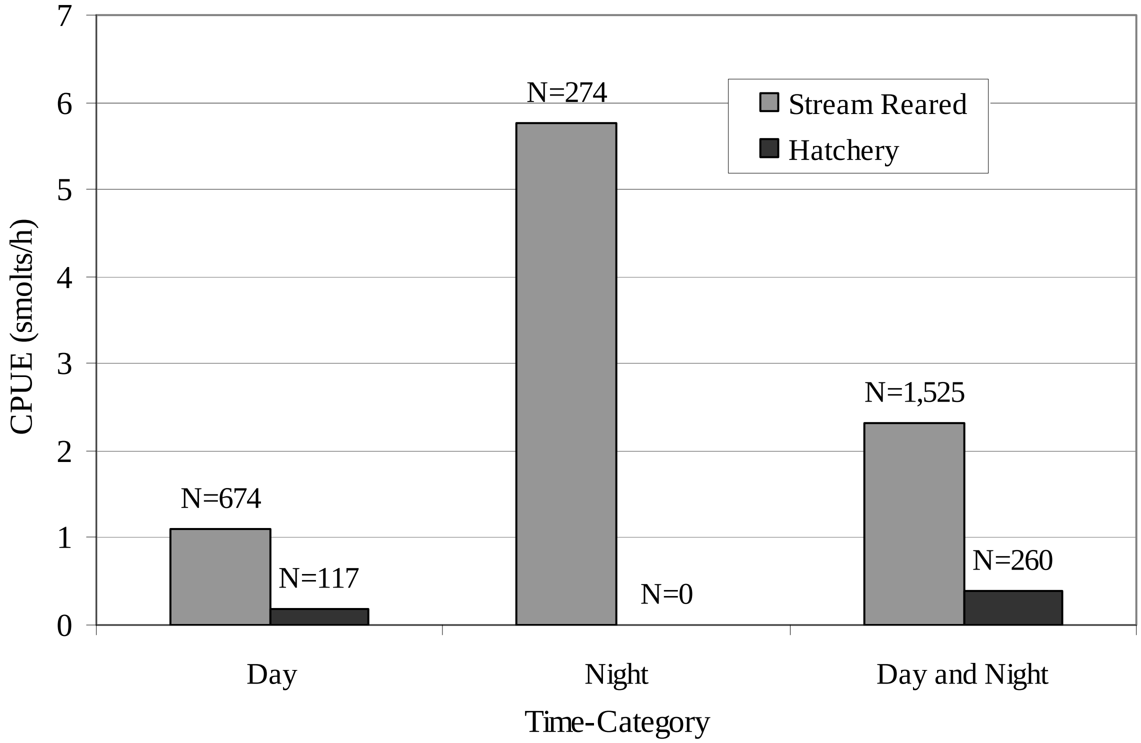


Figure 4-6. Catch-per-unit-effort for stream-reared and hatchery-reared smolts collected during three time-categories. N indicates the number of smolts collected in each time category.

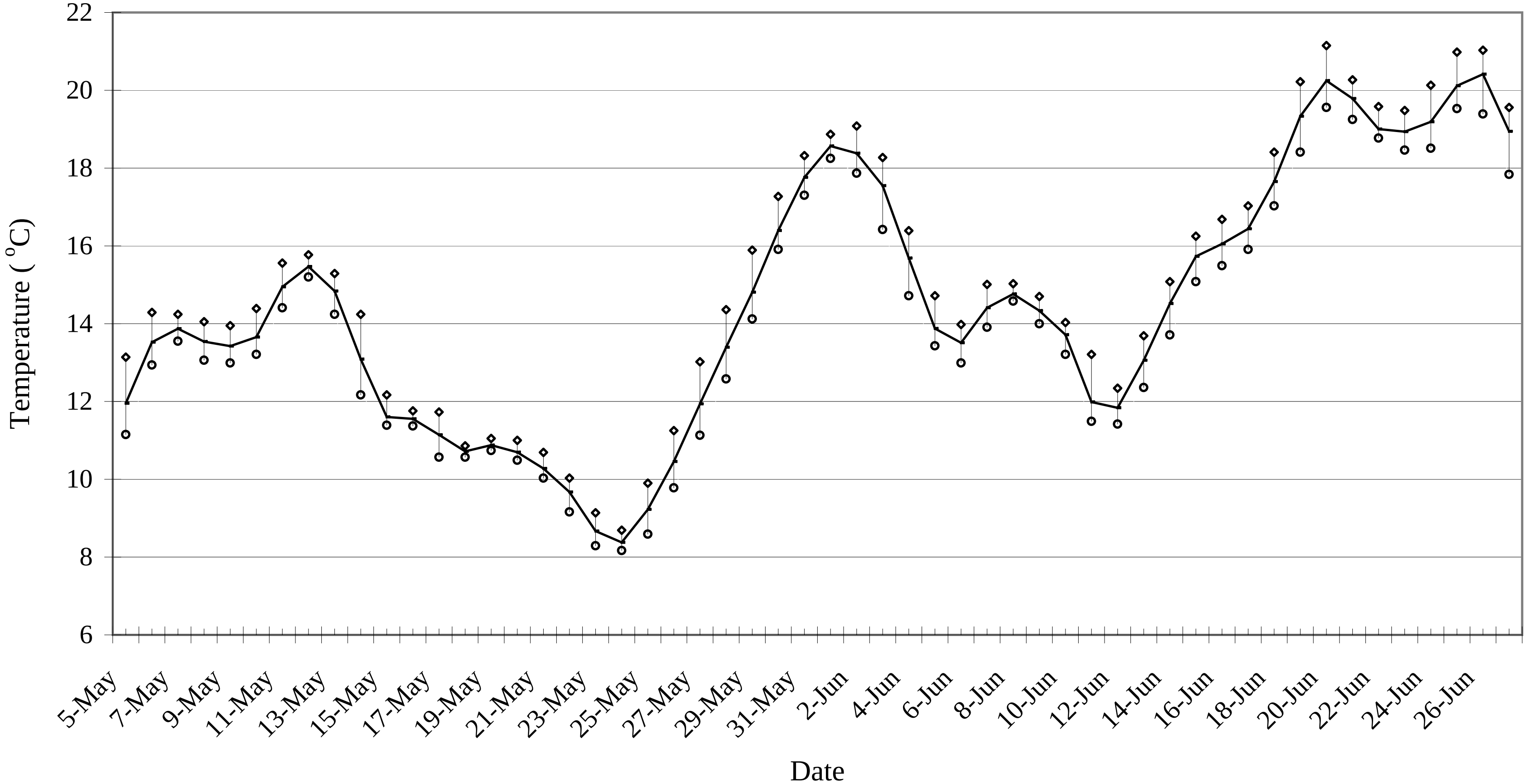


Figure 4-7. Minimum, mean, and maximum daily water temperature in the Moore Reservoir at the Moore Dam skimmer gate entrance.

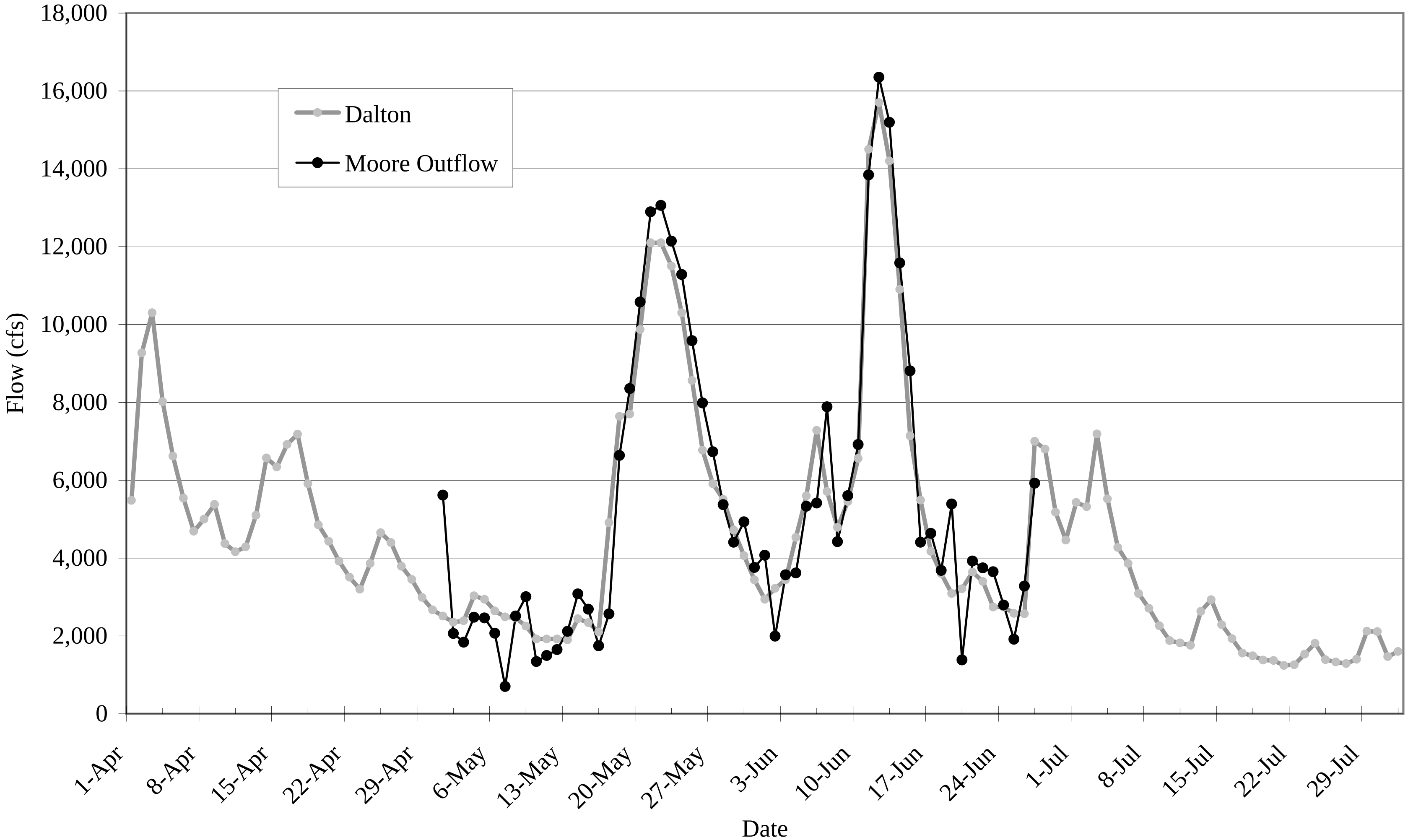


Figure 4-8. Inflow (cfs) to the Moore Reservoir recorded at USGS Gauge 01131500 located at the Dalton Hydro, and outflow from the Moore Hydro project, recorded by TransCanada, spring 2006.

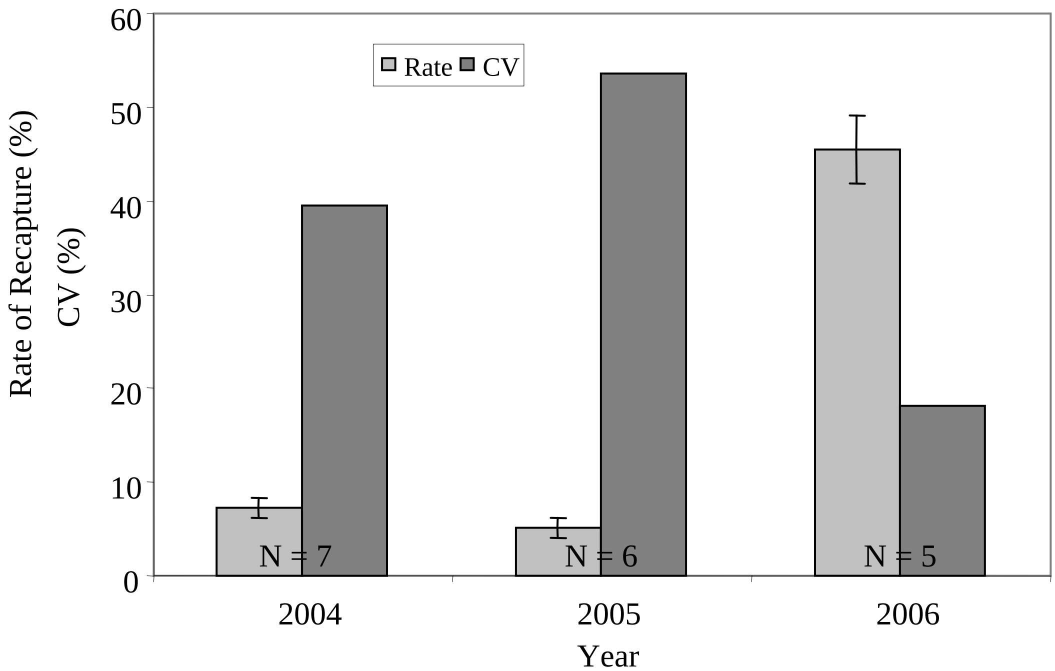


Figure 5-1. Hatchery-reared smolt collections, disregarding two groups released in the Moore Dam forebay in 2004: Mean (+ / - 1 SE) recapture rates of tagged smolts and coefficient of variation of annual recapture rates. N indicates number of release groups.

APPENDIX

Appendix Table 1. Number of stream-reared and hatchery-reared Atlantic salmon smolts collected in the Moore Dam sampler during each of 136 sampling periods, spring 2006. Data is sorted by set-date and set-time.

Sampling Period	Set Date	Set Time	End Date	End Time	Effort (h:min)	Stream Reared	Hatchery	Total	Cumulative Total
Day and Evening	05/01/06	17:00	05/02/06	13:00	20:00	15	0	15	15
Day and Evening	05/02/06	14:30	05/03/06	7:15	16:45	2	0	2	17
Day	05/03/06	8:25	5/3/2006	16:20	7:55	0	0	0	17
Day and Evening	05/03/06	17:20	05/04/06	9:00	15:40	3	0	3	20
Day and Evening	05/04/06	18:30	5/4/2006	21:38	3:08	0	0	0	20
Day	05/04/06	9:35	05/04/06	17:47	8:12	1	0	1	21
Evening	05/04/06	22:02	05/05/06	5:25	7:23	10	0	10	31
Day	05/05/06	5:38	5/5/2006	9:50	4:12	0	0	0	31
Day	05/05/06	10:02	5/5/2006	17:35	7:33	0	0	0	31
Day and Evening	05/05/06	17:50	05/05/06	21:33	3:43	1	0	1	32
Evening	05/05/06	21:39	05/06/06	5:22	7:43	11	0	11	43
Day	05/06/06	5:37	5/6/2006	9:47	4:10	0	0	0	43
Day and Evening	05/06/06	17:35	5/6/2006	21:45	4:10	0	0	0	43
Day	05/06/06	9:58	05/06/06	17:35	7:37	2	0	2	45
Evening	05/06/06	21:54	05/07/06	5:22	7:28	19	0	19	64
Day	05/07/06	9:54	5/7/2006	18:30	8:36	0	0	0	64
Day	05/07/06	5:37	05/07/06	9:54	4:17	1	0	1	65
Day	05/07/06	10:03	05/07/06	18:30	8:27	30	0	30	95
Day and Evening	05/07/06	20:08	05/08/06	5:35	9:27	5	0	5	100
Day	05/08/06	10:45	05/08/06	18:30	7:45	2	0	2	102
Day and Evening	05/08/06	19:06	05/09/06	5:35	10:29	3	0	3	105
Day	05/09/06	5:55	05/09/06	18:30	12:35	1	0	1	106
Day and Evening	05/09/06	18:40	05/10/06	5:50	11:10	111	0	111	217
Day	05/10/06	6:40	5/10/2006	16:35	9:55	0	0	0	217
Day and Evening	05/10/06	16:50	05/10/06	21:51	5:01	2	0	2	219
Day and Evening	05/10/06	22:01	05/11/06	6:25	8:24	37	0	37	256
Day	05/11/06	6:45	05/11/06	16:50	10:05	28	1	29	285
Day and Evening	05/11/06	17:27	05/11/06	21:44	4:17	26	0	26	311
Evening	05/11/06	22:15	05/12/06	5:30	7:15	91	0	91	402
Day	05/12/06	6:10	05/12/06	8:33	2:23	1	0	1	403
Day	05/12/06	8:47	05/12/06	16:40	7:53	1	0	1	404
Day and Evening	05/12/06	17:00	05/12/06	21:54	4:54	9	0	9	413
Evening	05/12/06	22:10	05/13/06	5:39	7:29	114	0	114	527
Day	05/13/06	6:35	05/13/06	8:55	2:20	1	0	1	528
Day	05/13/06	9:08	05/13/06	16:35	7:27	1	0	1	529
Day and Evening	05/13/06	16:55	05/13/06	22:00	5:05	2	0	2	531
Evening	05/13/06	22:20	05/14/06	3:15	4:55	29	0	29	560
Day and Evening	05/14/06	3:40	05/14/06	5:45	2:05	10	0	10	570
Day	05/14/06	6:10	05/14/06	9:30	3:20	2	0	2	572
Day	05/14/06	9:45	05/14/06	17:37	7:52	1	0	1	573
Day and Evening	05/14/06	17:55	05/15/06	3:05	9:10	282	0	282	855
Day	05/15/06	8:00	5/15/2006	17:33	9:33	0	0	0	855
Day and Evening	05/15/06	4:12	05/15/06	7:48	3:36	10	0	10	865
Day and Evening	05/15/06	17:45	05/16/06	3:15	9:30	13	0	13	878
Day and Evening	05/16/06	3:30	5/16/2006	6:20	2:50	0	0	0	878
Day	05/16/06	6:30	5/16/2006	12:30	6:00	0	0	0	878
Day	05/16/06	12:35	5/16/2006	17:00	4:25	0	0	0	878

Appendix Table 1. Continued

Sampling Period	Set Date	Set Time	End Date	End Time	Effort (h:min)	Stream Reared	Hatchery	Total	Cumulative Total
Day and Evening	05/16/06	17:00	5/16/2006	21:25	4:25	0	0	0	878
Evening	05/16/06	21:45	5/17/2006	3:05	5:20	0	0	0	878
Day and Evening	05/17/06	3:17	5/17/2006	5:50	2:33	0	0	0	878
Day	05/17/06	5:56	5/17/2006	13:14	7:18	0	0	0	878
Day	05/17/06	13:17	5/17/2006	19:50	6:33	0	0	0	878
Day and Evening	05/17/06	19:53	05/18/06	3:05	7:12	19	0	19	897
Day	05/18/06	7:00	5/18/2006	9:30	2:30	0	0	0	897
Day and Evening	05/18/06	3:30	05/18/06	6:40	3:10	13	0	13	910
Day	05/18/06	9:50	05/18/06	20:20	10:30	2	0	2	912
Day and Evening	05/18/06	20:35	05/19/06	6:10	9:35	50	7	57	969
Day	05/19/06	7:15	5/19/2006	11:25	4:10	0	0	0	969
Day and Evening	05/19/06	11:25	05/20/06	5:40	18:15	9	0	9	978
Day	05/20/06	6:09	05/20/06	20:22	14:13	4	0	4	982
Day and Evening	05/20/06	20:40	05/21/06	6:45	10:05	42	3	45	1027
Day and Evening	05/21/06	7:08	5/21/2006	21:22	14:14	0	0	0	1027
Day and Evening	05/21/06	21:30	05/22/06	6:11	8:41	10	1	11	1038
Day	05/22/06	6:28	05/22/06	17:07	10:39	6	1	7	1045
Day and Evening	05/22/06	17:20	05/23/06	6:00	12:40	11	0	11	1056
Day	05/23/06	6:11	05/23/06	8:05	1:54	2	0	2	1058
Day and Evening	05/23/06	20:20	05/24/06	5:55	9:35	21	1	22	1080
Day	05/24/06	6:15	05/24/06	20:00	13:45	8	0	8	1088
Day and Evening	05/24/06	20:20	05/25/06	6:03	9:43	77	0	77	1165
Day	05/25/06	6:28	05/25/06	19:51	13:23	42	0	42	1207
Day and Evening	05/25/06	19:58	05/26/06	6:08	10:10	38	1	39	1246
Day	05/26/06	6:30	05/26/06	20:00	13:30	72	3	75	1321
Day and Evening	05/26/06	20:15	05/27/06	6:01	9:46	10	1	11	1332
Day	05/27/06	6:12	05/27/06	20:00	13:48	5	0	5	1337
Day and Evening	05/27/06	20:10	05/28/06	6:08	9:58	26	6	32	1369
Day	05/28/06	6:25	05/28/06	19:52	13:27	51	1	52	1421
Day and Evening	05/28/06	20:03	05/29/06	6:15	10:12	33	8	41	1462
Day	05/29/06	6:32	05/29/06	20:07	13:35	30	5	35	1497
Day and Evening	05/29/06	20:28	05/30/06	6:05	9:37	96	23	119	1616
Day	05/30/06	6:30	05/30/06	19:55	13:25	20	5	25	1641
Day and Evening	05/30/06	20:00	05/31/06	6:20	10:20	40	11	51	1692
Day	05/31/06	6:50	05/31/06	20:40	13:50	5	0	5	1697
Day and Evening	05/31/06	20:50	06/01/06	6:00	9:10	60	5	65	1762
Day	06/01/06	6:40	06/01/06	20:01	13:21	3	0	3	1765
Day and Evening	06/01/06	20:08	06/02/06	6:35	10:27	2	1	3	1768
Day	06/02/06	6:48	06/02/06	20:23	13:35	5	1	6	1774
Day and Evening	06/02/06	20:33	06/03/06	6:00	9:27	34	13	47	1821
Day and Evening	06/03/06	20:15	6/4/2006	6:25	10:10	0	0	0	1821
Day	06/03/06	6:31	06/03/06	20:08	13:37	11	4	15	1836
Day	06/04/06	7:15	6/4/2006	20:15	13:00	0	0	0	1836
Day and Evening	06/04/06	20:25	06/05/06	6:33	10:08	2	2	4	1840
Day	06/05/06	6:44	06/05/06	19:15	12:31	1	1	2	1842
Day and Evening	06/05/06	19:25	06/06/06	6:15	10:50	7	1	8	1850
Day	06/06/06	6:35	06/06/06	20:35	14:00	7	0	7	1857
Day and Evening	06/06/06	20:45	06/07/06	6:30	9:45	18	29	47	1904
Day	06/07/06	6:50	6/7/2006	19:20	12:30	0	0	0	1904
Day and Evening	06/07/06	17:35	6/8/2006	7:25	13:50	0	0	0	1904

Appendix Table 1. Continued

Sampling Period	Set Date	Set Time	End Date	End Time	Effort (h:min)	Stream Reared	Hatchery	Total	Cumulative Total
Day and Evening	06/07/06	19:35	06/08/06	7:25	11:50	0	2	2	1906
Day	06/08/06	7:35	06/08/06	19:05	11:30	1	1	2	1908
Day and Evening	06/08/06	19:12	06/09/06	7:26	12:14	1	0	1	1909
Day	06/09/06	7:38	06/09/06	18:45	11:07	0	1	1	1910
Day and Evening	06/09/06	18:50	06/10/06	7:15	12:25	7	2	9	1919
Day	06/10/06	7:37	06/10/06	19:05	11:28	6	1	7	1926
Day and Evening	06/10/06	19:11	06/11/06	7:16	12:05	13	1	14	1940
Day	06/11/06	7:30	06/11/06	19:15	11:45	5	0	5	1945
Day and Evening	06/11/06	19:20	06/12/06	7:15	11:55	17	4	21	1966
Day	06/12/06	7:25	06/12/06	19:00	11:35	27	6	33	1999
Day and Evening	06/12/06	19:35	06/13/06	7:42	11:49	22	6	28	2027
Day	06/13/06	7:50	06/13/06	16:30	8:40	29	14	43	2070
Day and Evening	06/13/06	16:58	06/14/06	7:30	14:32	15	14	29	2099
Day	06/14/06	7:47	06/14/06	19:20	11:33	19	3	22	2121
Day and Evening	06/14/06	19:30	06/15/06	7:10	11:40	9	4	13	2134
Day	06/15/06	7:35	06/15/06	16:45	9:10	10	2	12	2146
Day and Evening	06/15/06	16:55	06/16/06	7:15	14:20	13	3	16	2162
Day	06/16/06	7:32	06/16/06	19:08	11:36	62	16	78	2240
Day and Evening	06/16/06	19:45	06/17/06	7:10	11:25	23	7	30	2270
Day	06/17/06	7:33	06/17/06	19:10	11:37	36	12	48	2318
Day and Evening	06/17/06	19:40	06/18/06	7:15	11:35	50	27	77	2395
Day	06/18/06	7:41	06/18/06	19:14	11:33	67	24	91	2486
Day and Evening	06/18/06	19:40	06/19/06	7:27	11:47	47	10	57	2543
Day	06/19/06	7:53	06/19/06	19:36	11:43	21	5	26	2569
Day and Evening	06/19/06	19:50	06/20/06	7:20	11:30	23	12	35	2604
Day	06/20/06	7:41	06/20/06	15:30	7:49	2	2	4	2608
Day and Evening	06/20/06	15:55	06/21/06	7:18	15:23	2	0	2	2610
Day and Evening	06/21/06	7:30	06/21/06	21:50	14:20	13	6	19	2629
Day and Evening	06/21/06	22:01	06/22/06	7:26	9:25	60	34	94	2723
Day	06/22/06	7:52	06/22/06	20:40	12:48	1	2	3	2726
Day and Evening	06/22/06	20:50	06/23/06	8:15	11:25	12	7	19	2745
Day	06/23/06	8:30	06/23/06	15:56	7:26	2	0	2	2747
Day and Evening	06/23/06	16:04	06/24/06	7:10	15:06	12	0	12	2759
Day	06/24/06	7:23	06/24/06	19:07	11:44	21	1	22	2781
Day and Evening	06/24/06	19:17	06/25/06	7:14	11:57	12	1	13	2794
Day	06/25/06	7:50	06/25/06	20:10	12:20	13	1	14	2808
Day and Evening	06/25/06	20:27	06/26/06	7:10	10:43	25	7	32	2840
Day and Evening	06/26/06	17:50	6/27/2006	8:40	14:50	0	0	0	2840
Day	06/26/06	7:30	06/26/06	17:40	10:10	6	4	10	2850
Day	06/27/06	9:12	6/27/2006	14:43	5:31	0	0	0	2850