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The 2008 East Stoke Salmon Counter Records

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CONTENTS

1. ABSTRACT

Data on the numbers and sizes of salmon ascending the East Stoke Salmon Counter in 2008 are presented and a brief summary of the run and hydrological characteristics for the year given.

2. INTRODUCTION

The data in this report represents the 36th consecutive year of the East Stoke counter's operation recording the upstream movement of Atlantic salmon (*Salmo salar* L.) in the River Frome. It is also the last year where the work will be principally funded by the Natural Environment Research Council (NERC). Reorganisation within the Centre for Ecology and Hydrology (CEH) will result in the Dorset site closing and ending NERC’s involvement with one of the most comprehensive long-term records of salmon movement in England and Wales. However, the Game and Wildlife Conservation Trust have agreed (subject to funding) to take on the responsibility for continuing to run the counter and the associated work on parr and smolt production in the river Frome. The cooperation of CEH and the Freshwater Biological Association (who own the site) in helping this transfer is gratefully acknowledged. Data from the research projects will allow a stock/recruitment model to be produced for the Frome salmon. This will allow identification of the critical mortality phases of the salmon to be ascertained, allow a better estimate of spawning targets required and enable an intelligent management of the stock.

Data are collected by a Scottish Hydro-Electric (formerly North of Scotland Hydro-electric Board (NSHEB)) Mk Xb resistivity counter. The counter is connected to three stainless steel electrodes mounted 450 mm apart on the Environment Agency venturi gauging weir at East Stoke (NGR SY 867868). Data are verified by a combination of trace waveform analysis (see Beaumont *et al*. 1986), video frame-grab and videotape analysis. A more full description of the history of the counter and preliminary long-term results are given in Beaumont *et al.* (2007).

In conjunction with data on salmon movement, information on water temperature, air temperature, rainfall and light levels are also collected at 15 minute intervals. Hydrological (discharge) summaries are derived from Environment Agency data (Copyright © Environment Agency). All data are collated into hourly records.

Salmon run data are presented for the period February to January inclusive. Past data and personal observations indicate that the majority of the upstream movement in January is caused by the continued migration of fish from the previous calendar year migrating to spawn, not fish migrating to spawn in 11 months time.

Numbers used in this report refer to both “gross” and “nett” numbers of fish ascending the counter. Gross number refers to the total number of fish moving up over the weir irrespective of whether they subsequently drop back down over the weir. Nett numbers are the gross upstream number minus the number of downstream counts. The reason for the two figures is that between 1974 and 1984 only coincident downstream counts (counts immediately preceding or following an upstream count) were subtracted from the upstream totals. These coincident counts were considered to be salmon vacillating over the counter and were subtracted from the upstream counts (reducing the total by about 12%): other downstream counts were not recorded. With the development of the computer verification system (Beaumont *et al* 1986) it was discovered that about 40% of all downstream counts were caused by salmon; leading to an overestimate of about 10% in nett upstream counts. Thus, since 1985, all downstream counts have been recorded, these data are individually verified (by waveform analysis and video) and the figure for nett upstream movement determined. This more accurate measure of nett upstream number averages out at ~80% of the gross number and is positively correlated with the gross number (r^2=95%). However, in order for better comparability with data prior to 1985, gross data are still presented.

These data, whilst not being as precise as nett numbers, will still show the trend of salmon numbers and will be within approximately 12% of the pre-1985 data.

During January, February and March the downstream counts are not subtracted from the upstream counts as a high percentage are caused by downstream moving kelts (post-spawning salmon). This year however a considerable number of these kelts exhibited vacillating behaviour over the weir and thus inflated the upstream counts. Therefore, for the period February and March 2008 and January 2009, where coincident downstream and upstream counts occur (within a 5-minute time interval) the up-count has been deleted from the data.

3. ASSOCIATED AND FUTURE WORK

For each of the past four-years, in September, we have tagged approximately 10,000 juvenile salmon (probably about 10-20% of the autumn population) with Passive Integrated Transponder (PIT) tags. These small tags (just 12 mm long x 2 mm wide) enable us to individually identify the fish when they swim past a reader. The data collected in this study will enable us to link the growth rates of the juvenile fish with the time spent at sea before returning and the marine growth rate. Data on freshwater survival, marine survival and life history strategy, from different tributaries will also be obtainable. The passage of the PIT tagged fish out to sea is recorded by equipment mounted on the East Stoke smolt counter and the main river weir (Figure 1). The main river reader also allows the detection of the return of the PIT tagged adult fish. In 2008 we detected 42 PIT tagged salmon and several PIT tagged trout. These records together with the records from the PIT reader on the Louds Mill weir at Dorchester will give us unparallel information about marine survival rates.

We are also continuing to monitor the "autumn" downstream run of parr in the river and working with Cefas in looking at the state of adaptation to salt water of these fish and where they migrate to. Studies to date show that many of these fish reside over winter in the lower river downstream of Wareham. We have recorded the first return of an adult fish that was an autumn migrant (Riley *et al* 2009) and we will continue to examine returns from the adult fish to see if the survival of these early moving fish is better or worse than the fish that migrate in the spring, the "usual" migration time for the smolts.

Figure 1 The main river adult counter and RAPID PIT tag detection system

We have not reared and released any salmon in the Tadnoll Brook & River Cerne this year but have been monitoring the 35,000+ fry we have put in during 2006 and 2007. Both these two Frome tributaries did not have a natural run of fish due to obstacles in the lower reaches. On the Tadnoll a fish pass has now been constructed and on the Cerne our research supported the business case for the fish pass on the weir at Louds Mill (Dorchester) that was built this year. The fish introductions should kick-start the recolonisation of these two streams and PIT tag records have shown an adult return of one of the fry we stocked into the river Cerne.

The large-scale gravel cleaning programme that we in conjunction with the Environment Agency began in 2003 has been continued. Poor survival of the eggs in the spawning gravel has been shown to be a key bottleneck in the recruitment of fish into chalk streams. Data from a joint CEH/Cefas study (Scott and Beaumont 1993) has shown that survival can be increased from 10% to 66% by cleaning the spawning areas. We hope to continue this programme in future years and will be providing training for, and liaising with, fishing groups carrying out the cleaning as well as monitoring the effects on subsequent smolt and salmon production.

Under an agreement with the river Frome salmon net licence holder and the Environment Agency we are also monitoring the salmon net catch from Poole Harbour. All salmon caught are being released and we will be tagging and tracking some to help understand their movement patterns and survival in the lower river. This new area of research for us opens up exciting possibilities of understanding the behaviour of adult fish in the lower river and the influence of temperature and discharge on their passage through the lower river.

4. 2008 DATA REPORT

A large part of the effort in running the East Stoke counter is focussed on verifying the "counts" from the counter. Counts are verified by either video picture (when the water is clear) or the shape of the electrical waveform produced when an object goes across the weir or (more often) both. Video data is combined with electrical waveform data so both can be recorded on videotape. In addition, frame grabs can be taken from the computer screen and stored, thus to some extent making it unnecessary to view the video data (apart from assessing missed fish). Only rarely is raw, unverified data used. An example of the computer verification system's display is shown in Figure 2. A salmon can be seen on the video picture and the electrical trace is shown on the bottom segment of the screen. Text boxes along the bottom of the display record, number of records; number of frame grabs; input signal value; time of day; number of records registered by computer and counter.

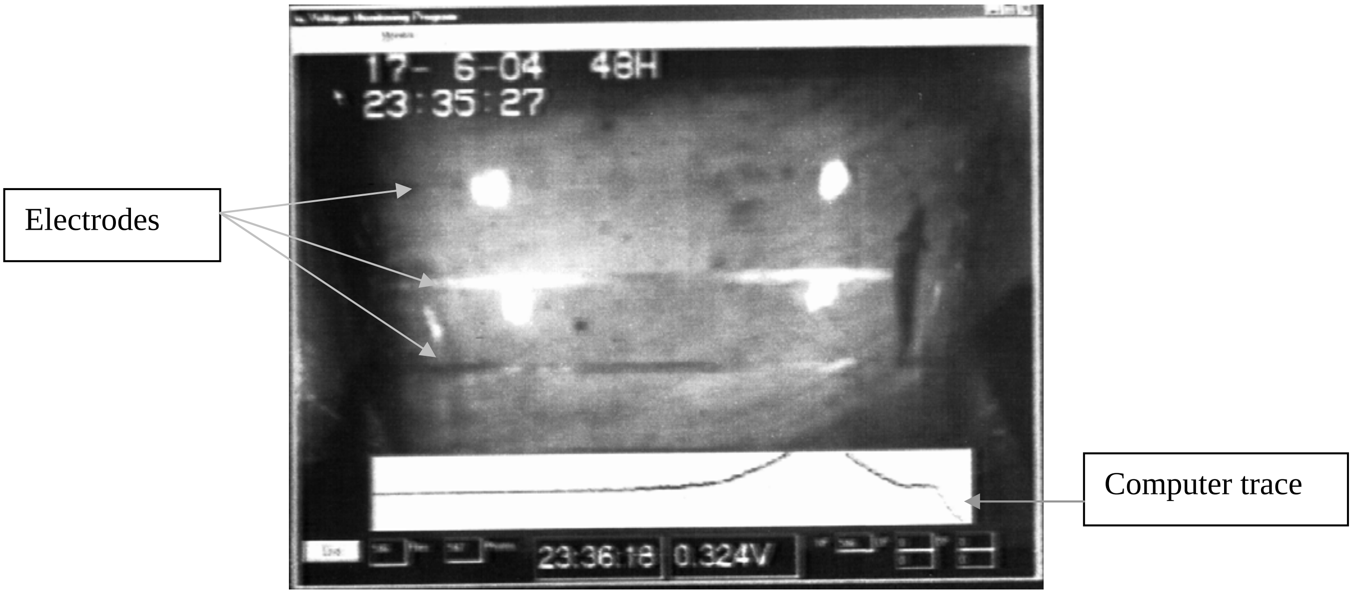

Figure 2 Screen display from the computerised counting and evaluation system. The image shows a 75 cm salmon ascending the weir

As well as verifying the counts the video also shows some intriguing pictures and Figure 3 shows (left picture) a 104 cm salmon and (right picture) four salmon ascending the weir together. We also have footage of a large pike pursuing (unsuccessfully) two salmon up the weir.

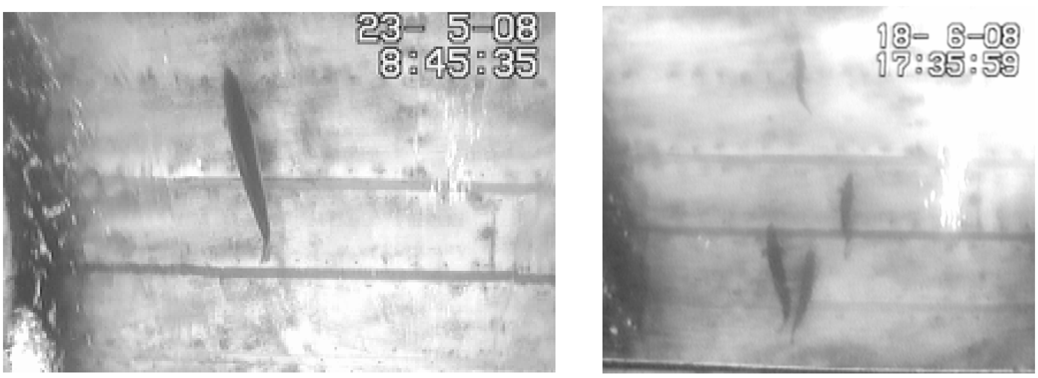

Figure 3 Computer frame grabs from the computerised counting and evaluation system

This year we have also trialled a side-viewing camera in order to try and differentiate between salmon and large sea trout (Figure 4). Results were encouraging in that we obtained some pictures and few of them were sea trout. We will modify the system to improve the coverage of the weir and the view and try again this year.

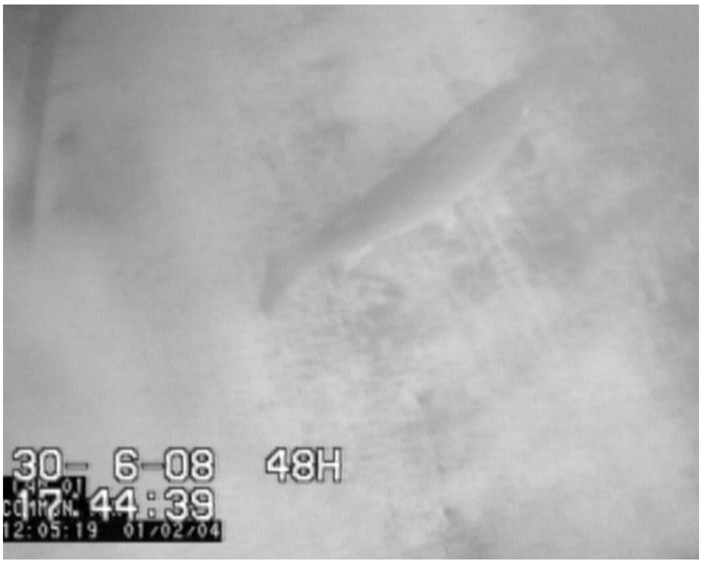

Figure 4 An image from the side-view camera showing a salmon on the weir

Verification of the data entailed identifying the cause of the upstream and downstream counter records plus many thousand (due to the number of false counts recorded) computer waveform traces. For periods when the computer system was not operational accuracy of the counter was assessed by direct examination of the video data. When the computer system was operational accuracy of assessment was carried out by comparing identity assessed from computer traces with identity observed from video records (both tape and video frame grabs). Data from the actual counter could vary widely in accuracy and on a day to day basis could equal 0% if it missed fish. Raw data from the counter is rarely used in an unverified form however and the data for the run is compiled from a combination of counter, computer and video records i.e. all computer trace records and counter records are checked on the video to identify the cause of the record. Raw fish counter data is only used when computer or video data are not available. Provided adequate water clarity, video records are 100% accurate and assessment of accuracy of interpretation of the computer records is made from comparing trace identity with the video records. Where water clarity is poor just computer records are used to verify data. Accuracy of the computer records is usually checked by viewing complete time periods on video (approximately one 24-hour period every month) and comparing the numbers from the computer with the numbers of fish seen. In 2008 average accuracy of waveform interpretation was 80% for upstream records and 81% for downstream. Data are not however corrected for verification error.

We were fortunate this year in having few mechanical and electrical problems in running the counter. Over the year the electronic counter was not operating for only 1 day and there was no waveform verification for 9 days. Due to turbid water there was either no video verification or images were too poor for video viewing for 103 days. There were no days where count information was not possible from either electronic or video data. Figure 5 summarises the operational times and verification diary for the counter in 2008

Figure 6 shows daily counts together with mean daily discharge data. Data from the counter are presented for both gross upstream and gross downstream counts as well as the nett upstream count (see earlier for a full description of how the data are presented). Whilst nett numbers equate to the estimated numbers of salmon ascending the river, gross numbers are included to allow comparison with data obtained prior to 1985 when total downstream numbers were not recorded and verified.

Gross total for the year was 1300
Nett total for the year was 979

Figure 7 shows that the total nett upstream count for the year was the highest since 1998 and considerably above the level of the 5-year average of the very low runs that have been recorded since 1999. Gross run data is also highest since 1998 and also above the 1999-2007 average.

Figure 8 shows the cumulative nett numbers of fish migrating over the weir for each month, the graph also shows the average numbers for 1985-1990 (representing the start of the recording of nett numbers and before the 1991 crash in numbers) the years 1991 to 1998 (when the first sustained drop in numbers occurred) 1999 to 2007 (the second period of very low numbers) and the current year (2008). The figure shows that, until August the run was around that of the average for the 1999-2007 years. In August however numbers running increased to above the average and remained above for the rest of the year. This pattern is very similar to that observed last year.

Figure 9 shows time of day of fish movement over the weir. The avoidance of daylight hours during the summer months can be clearly seen.

A total of 323 upstream migrating fish (33% of the nett run) were measured this year (Figure 10) with the largest fish being 104 cm in May. A considerable amount of approximate length data (~150 fish) is available from where water clarity was poor but this has not been included in the data. Data from fish below 50 cm and fish that are obviously the same fish vacillating over the weir have also been excluded from figure 10 (and the data set).

Figure 11 shows data from the hourly database for each month. As well as gross upstream salmon numbers in an hour, hourly averages (4 x 15 minute readings) of water discharge (East Stoke Millstream (ESMS) discharge is shown separately as dark blue on top of light blue main river (East Stoke flume) discharge – upper boundary of data therefore is total discharge) from Environment Agency data. Air temperature, water temperature and light level are also shown. From mid-July rainfall data (mm/hr) is also shown. Graphs of the hourly data clearly show the clarity of detail available with the hourly time-base.

Figure 12 shows mean monthly discharge data (in cubic metres per second (cumecs)) for 2008 together with mean (1966-2007) 5, 25, 75 and 95 percentile discharge data. This data is collated and calculated from Environment Agency records. The river discharge started the year within the median range (between Q1 and Q3 level), fell below the Q1 in February to March and below the 5%ile in May. Thereafter it steadily rose and went above the 95%ile in August to October before dropping to median levels in November and December. Figure 13 shows the mean annual discharge data for the Frome (together with the 5-year and long-term average for 1966 to 2007).

5. REFERENCES

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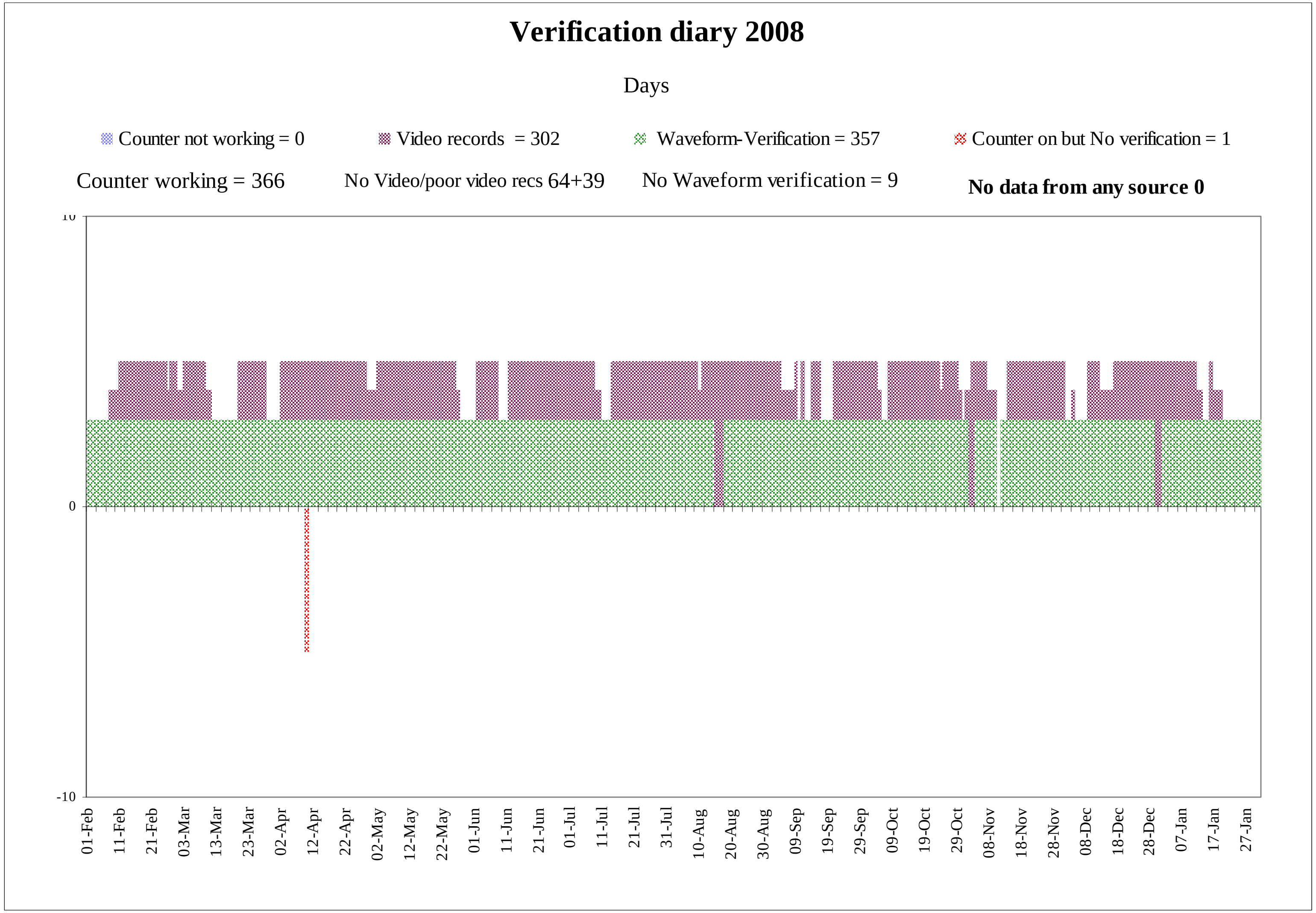


Figure 5 Operational times and verification diary 2008

Month	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Total
Gross U/S	13	41	14	81	83	136	81	36	289	333	138	55	1300
Gross D/S	19	34	2	13	13	26	7	5	54	57	77	54	361
Nett U/S	13	41	12	68	70	110	74	31	235	276	61	55	1046
Nett U/S-CC	3	17										22	979

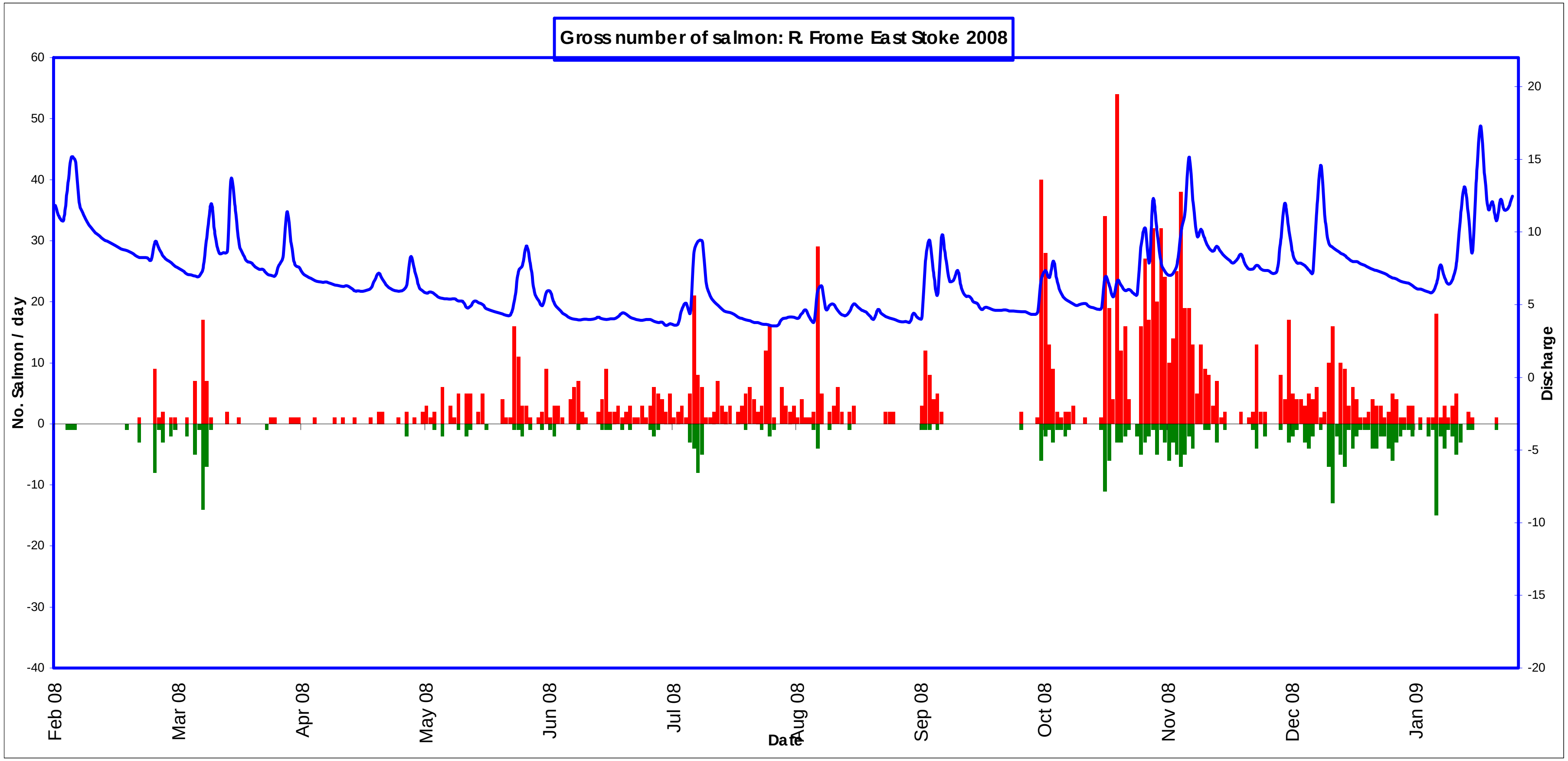
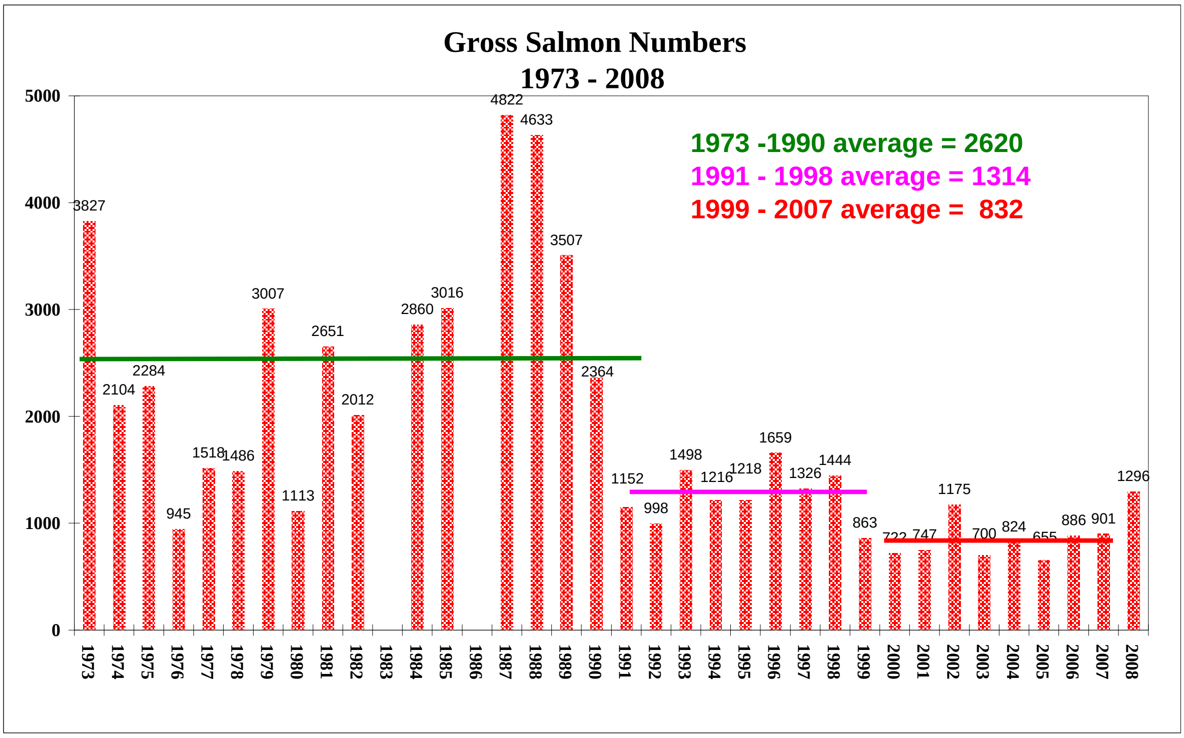


Figure 6 East Stoke Salmon Counter Data 2008



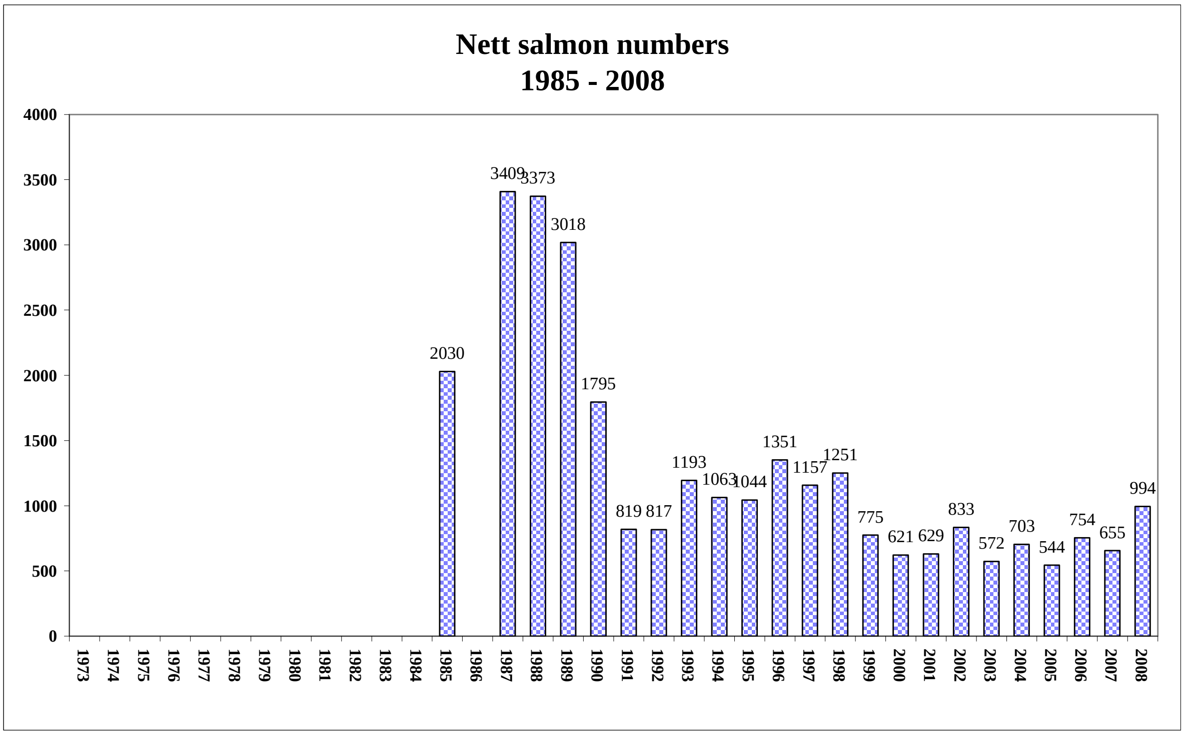
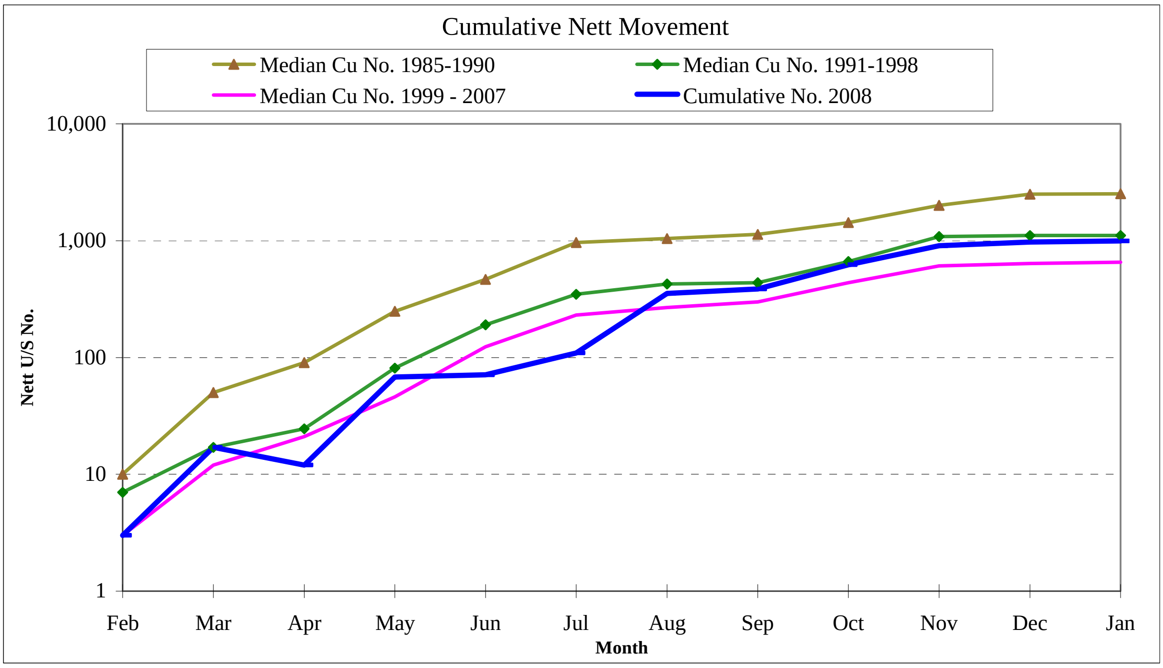


Figure 7: Gross and Nett numbers of salmon ascending the East Stoke weir



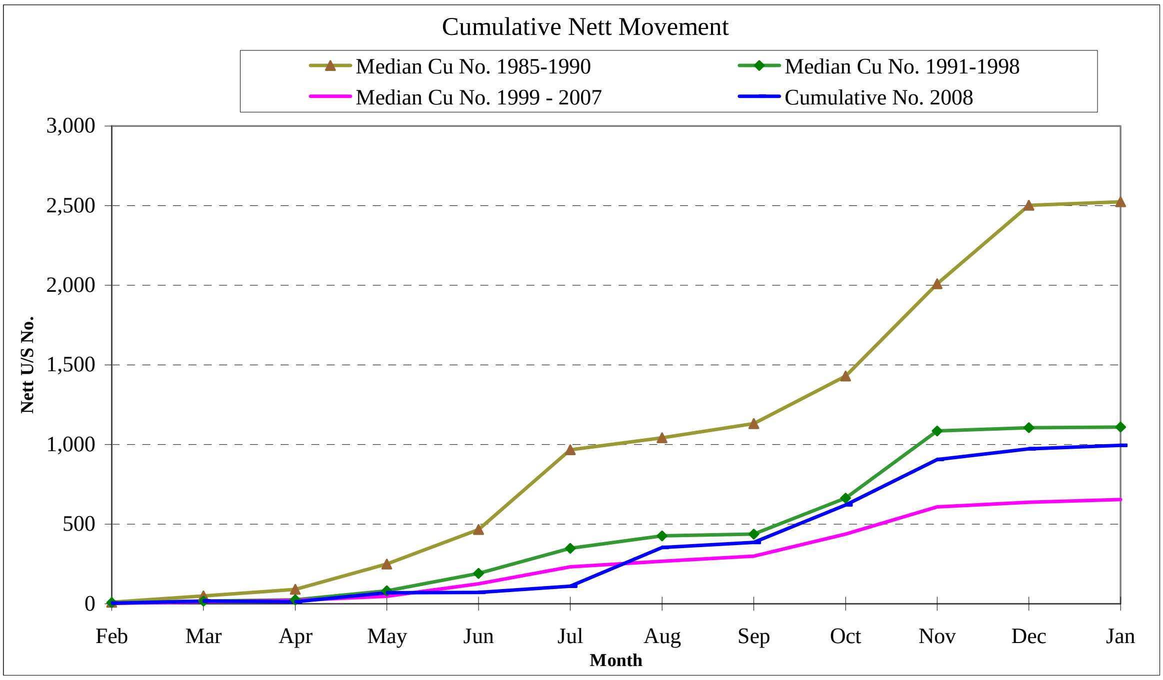


Figure 8: Comparison of Nett 2008 data with previous years. Note: On top graph y-axis (Nett No.) is on a logarithmic scale to better show the early months when low numbers of fish are present.

Figure 9: Time of day of movement (Gross upstream and downstream count data)

Upstream migrating fish >50 cm only

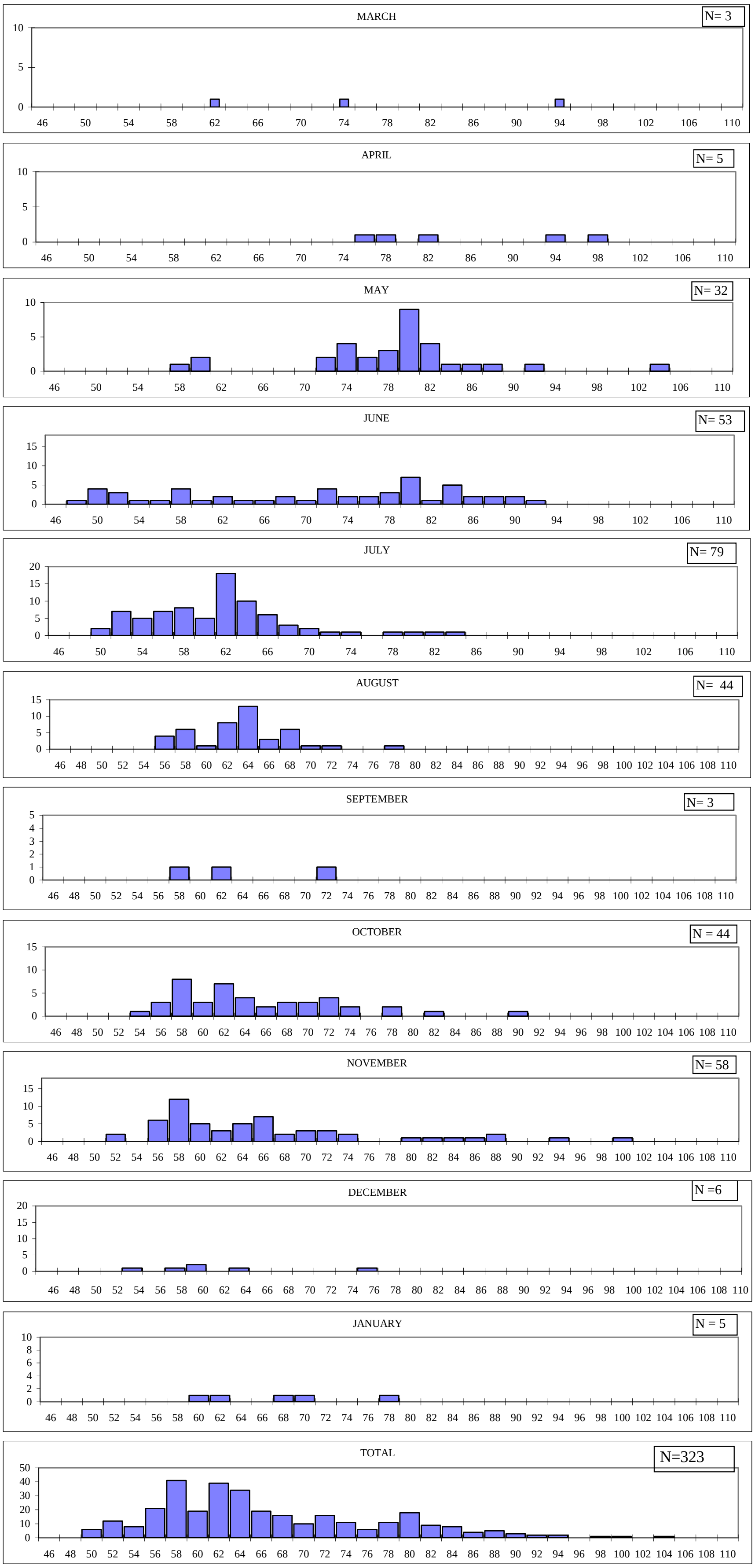
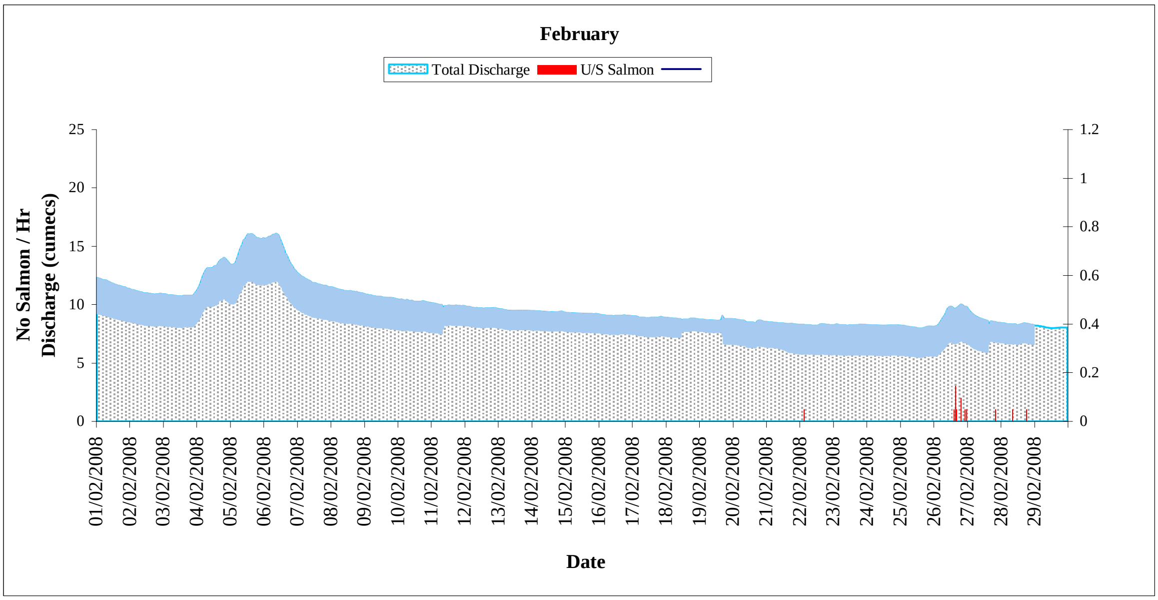
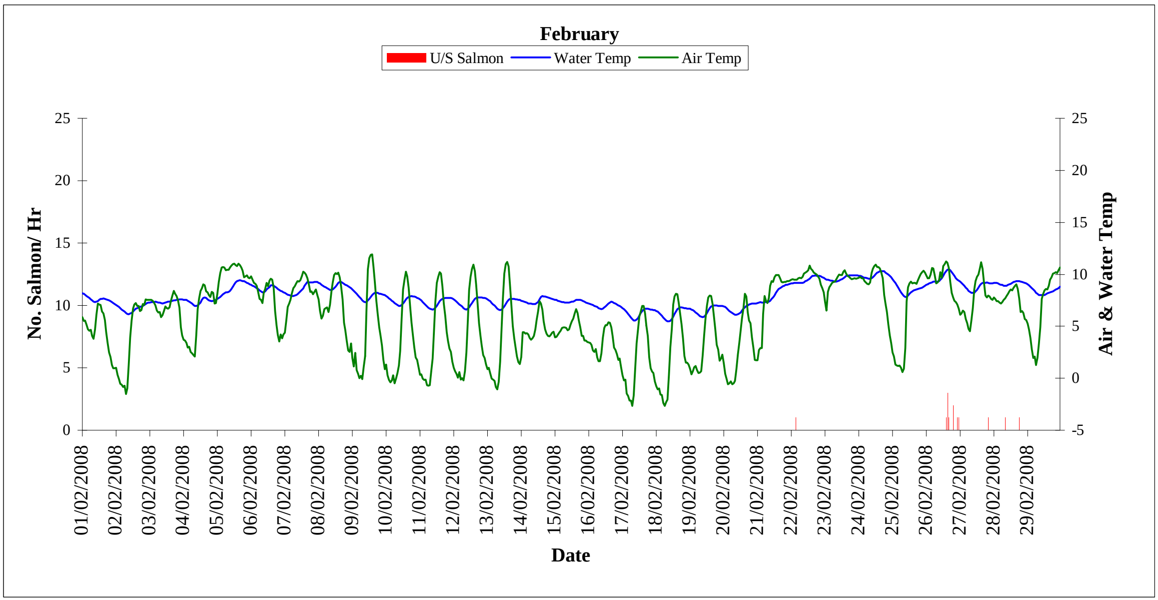


Figure 10: Length of upstream migrating fish each month (Length in cm)





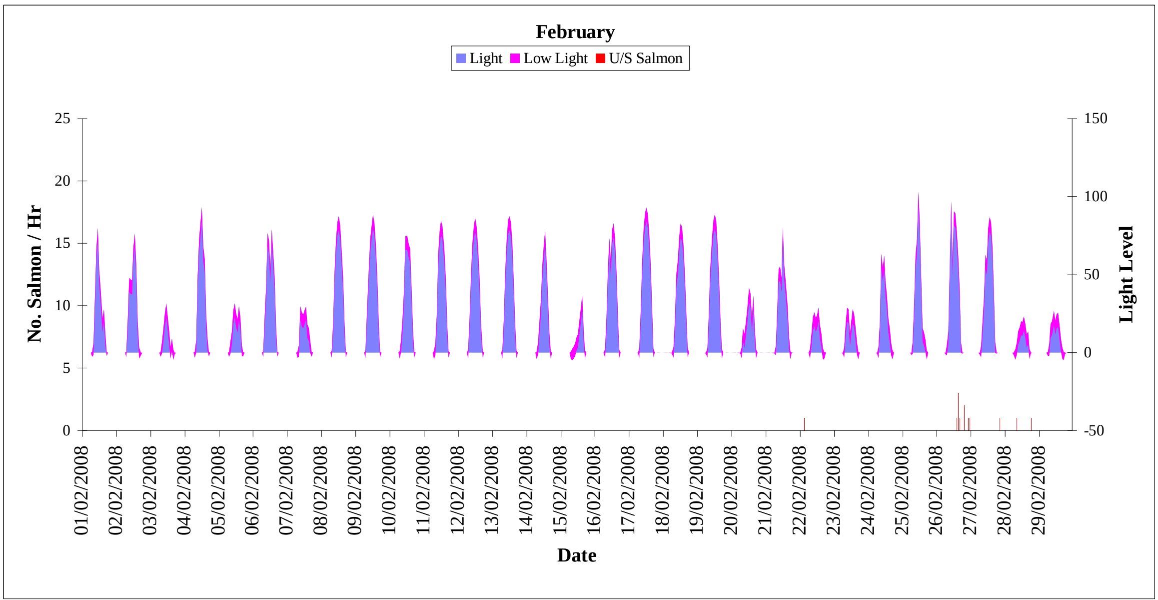
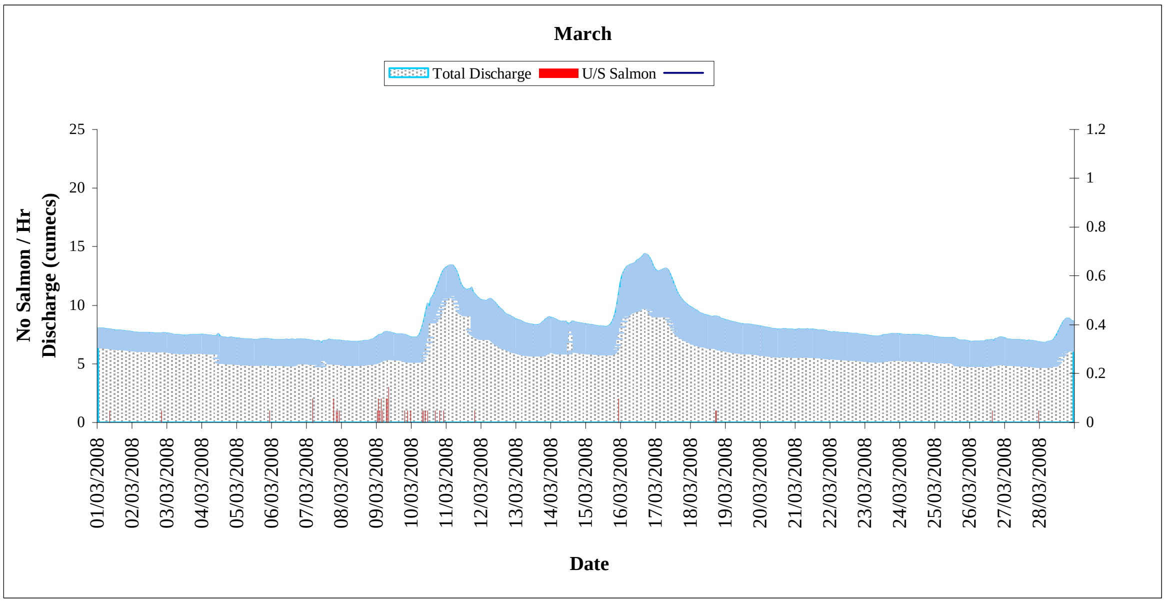
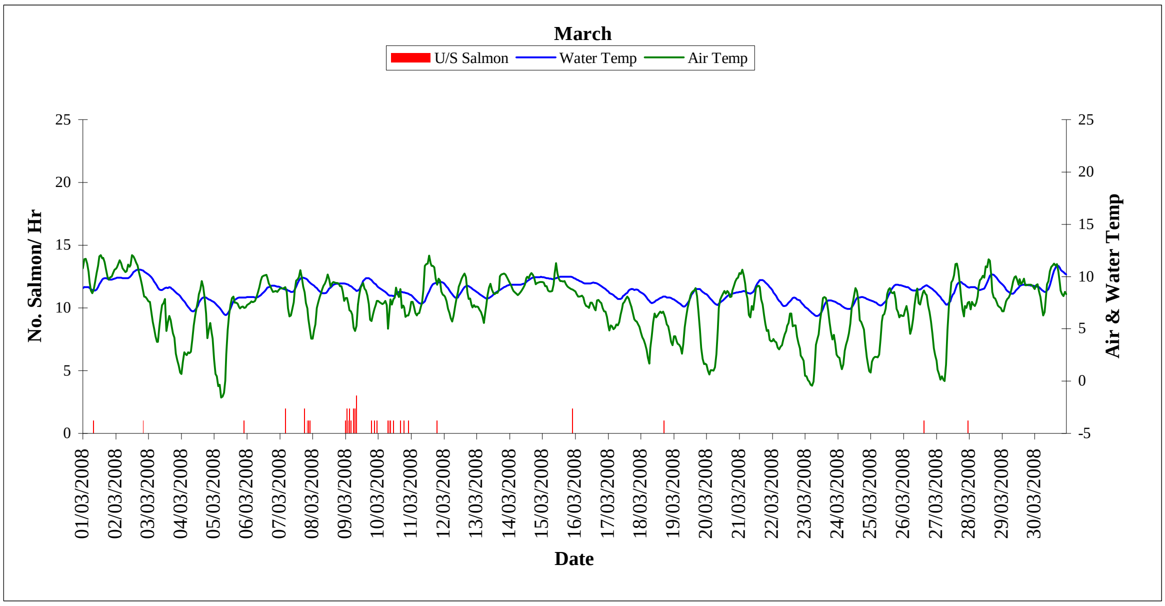
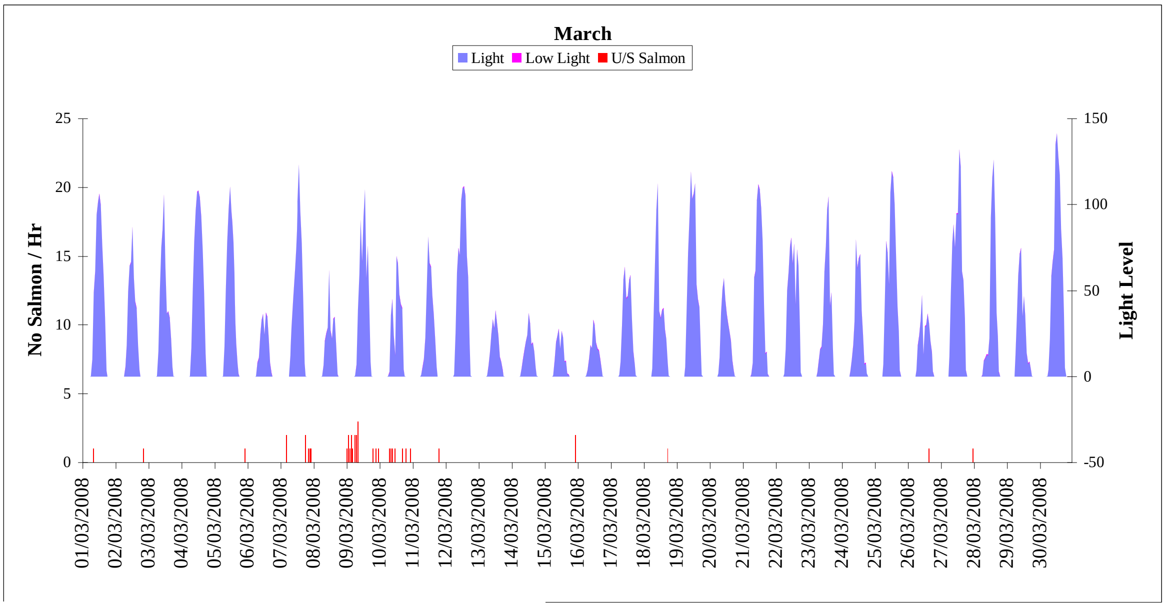


Figure 11: Hourly data







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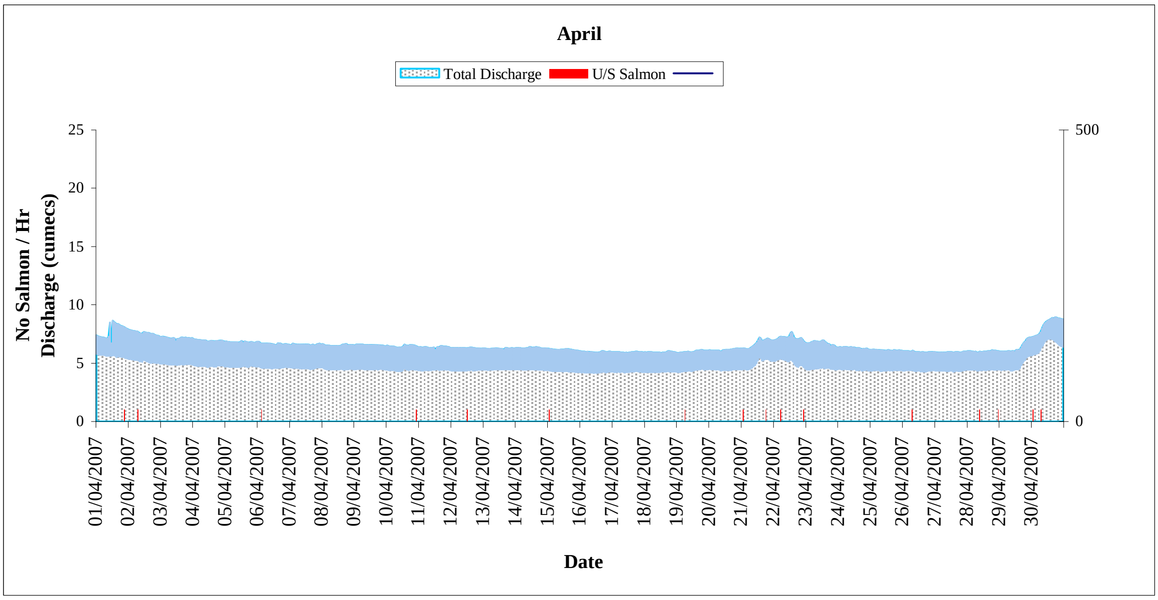

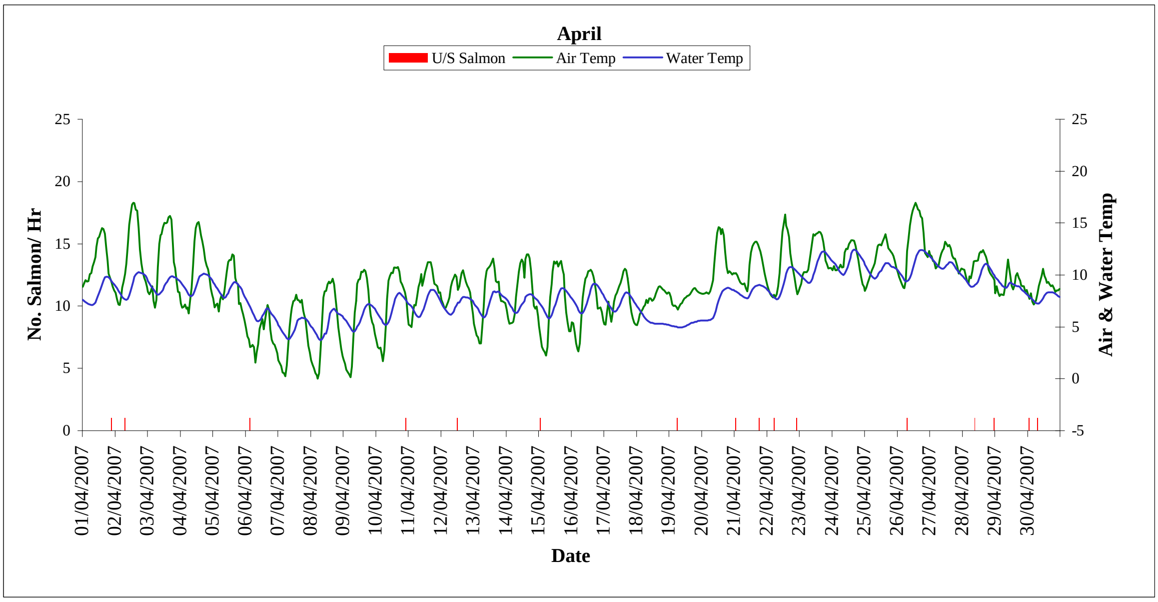

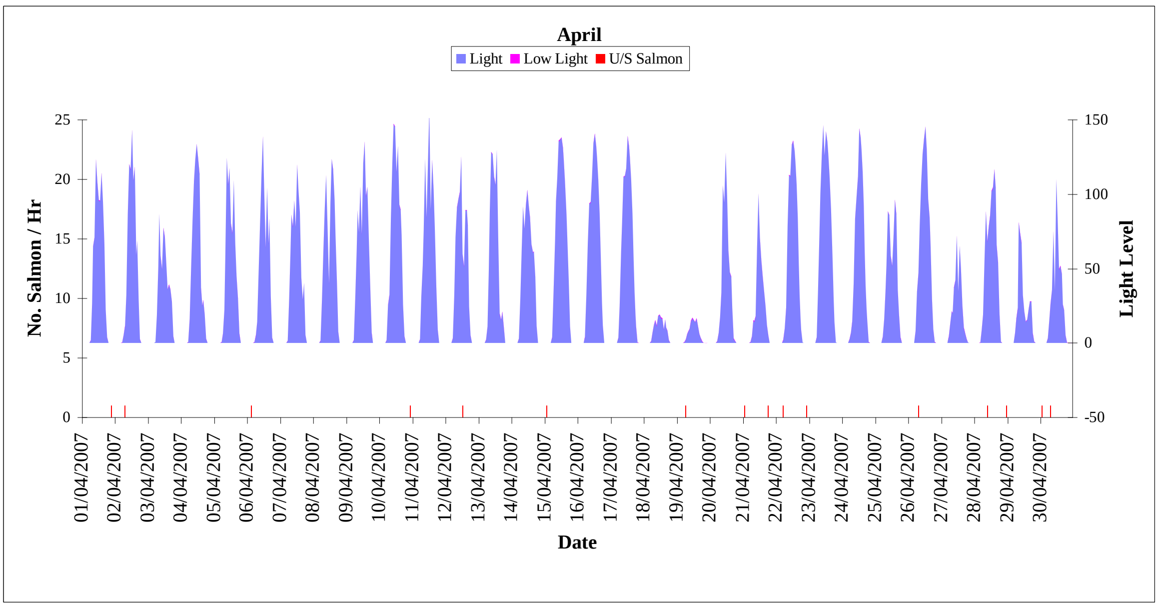

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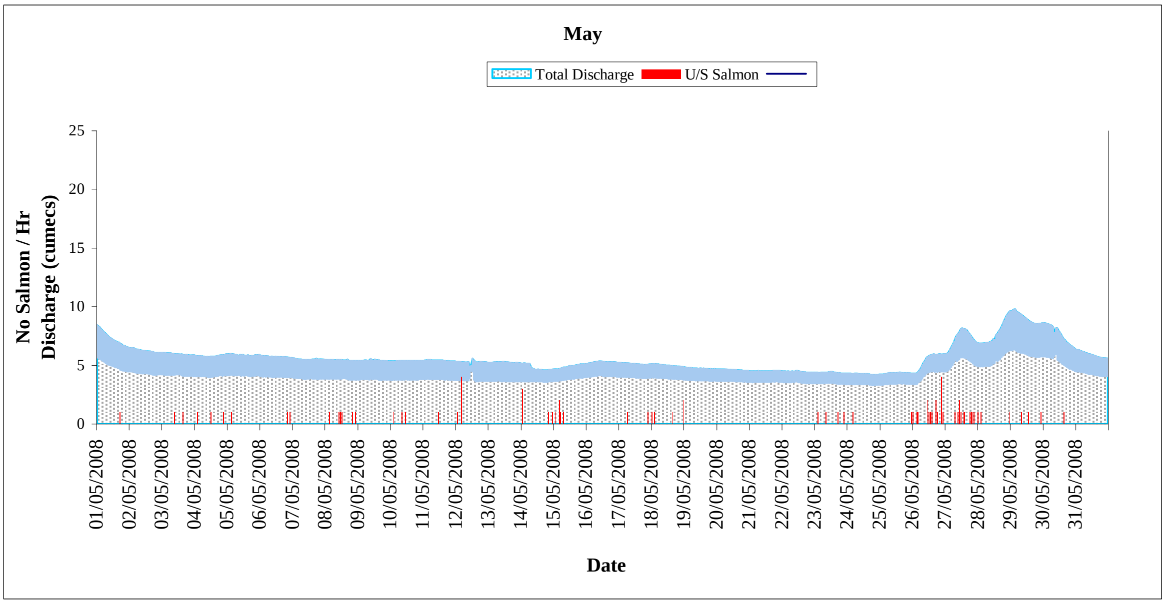

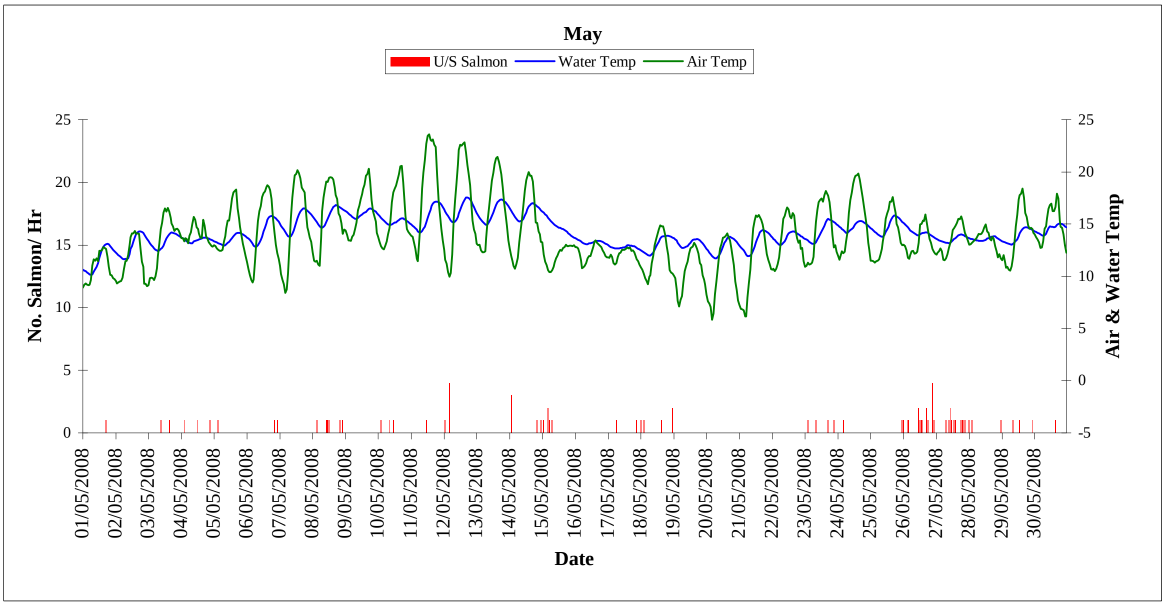

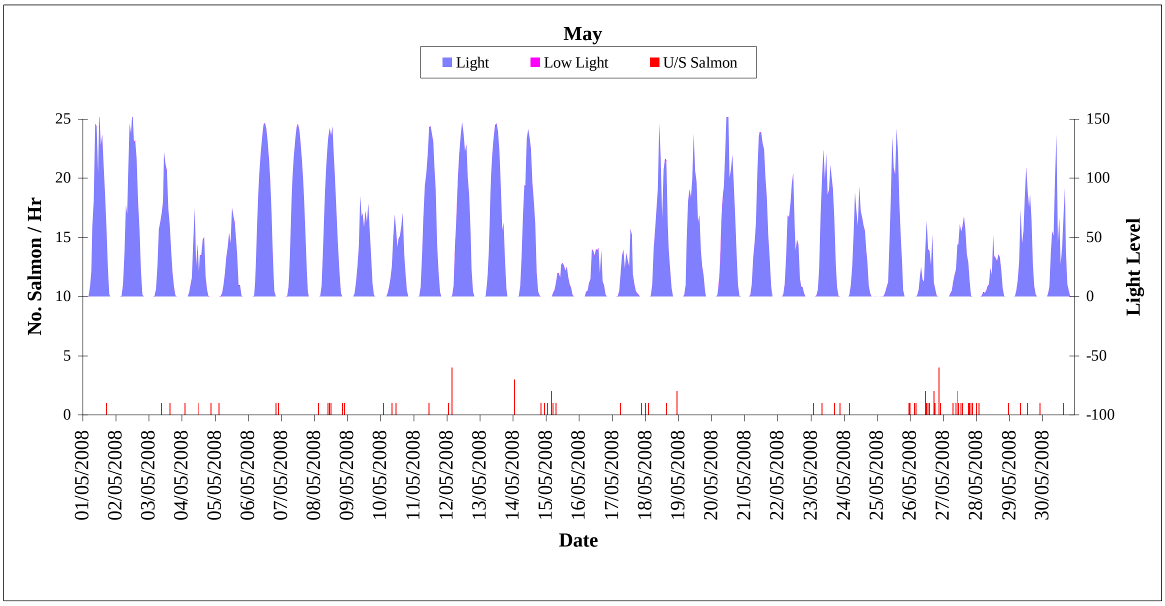

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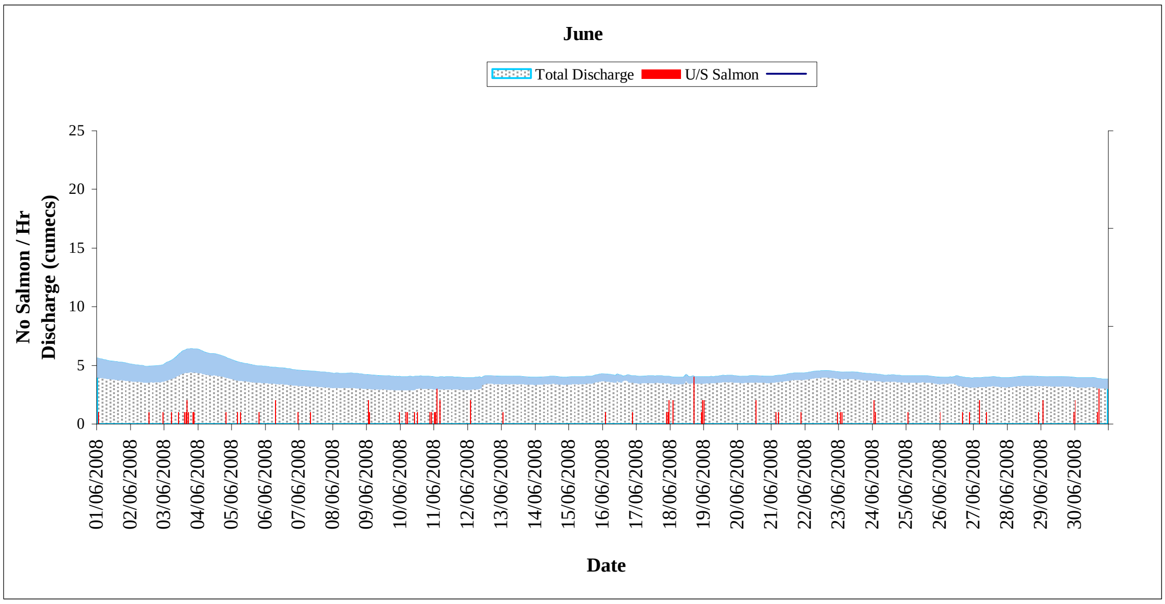

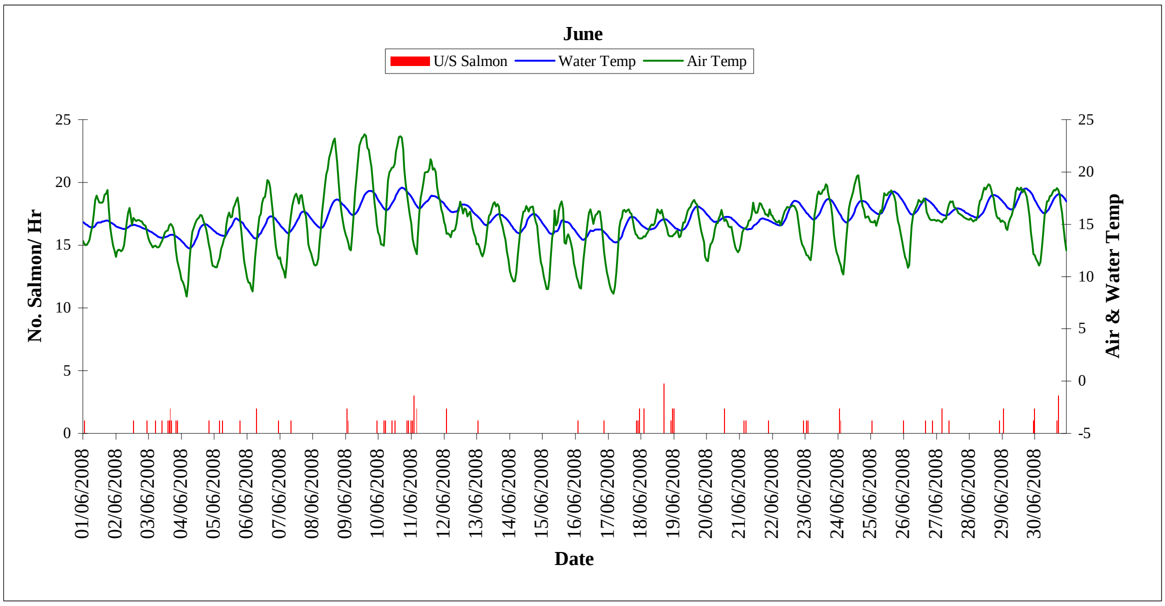

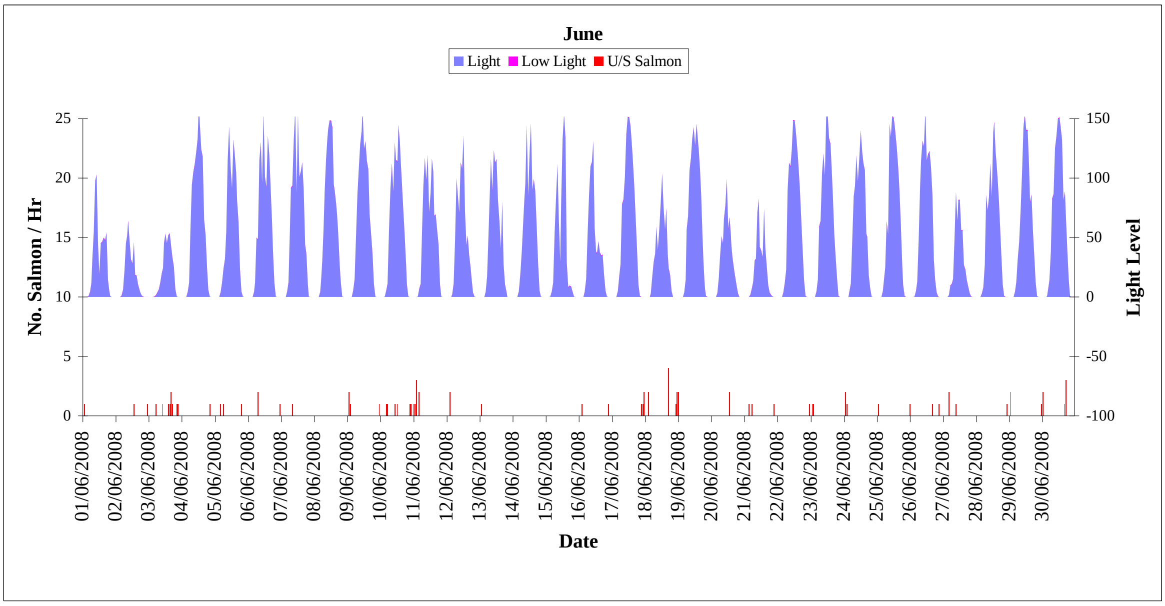

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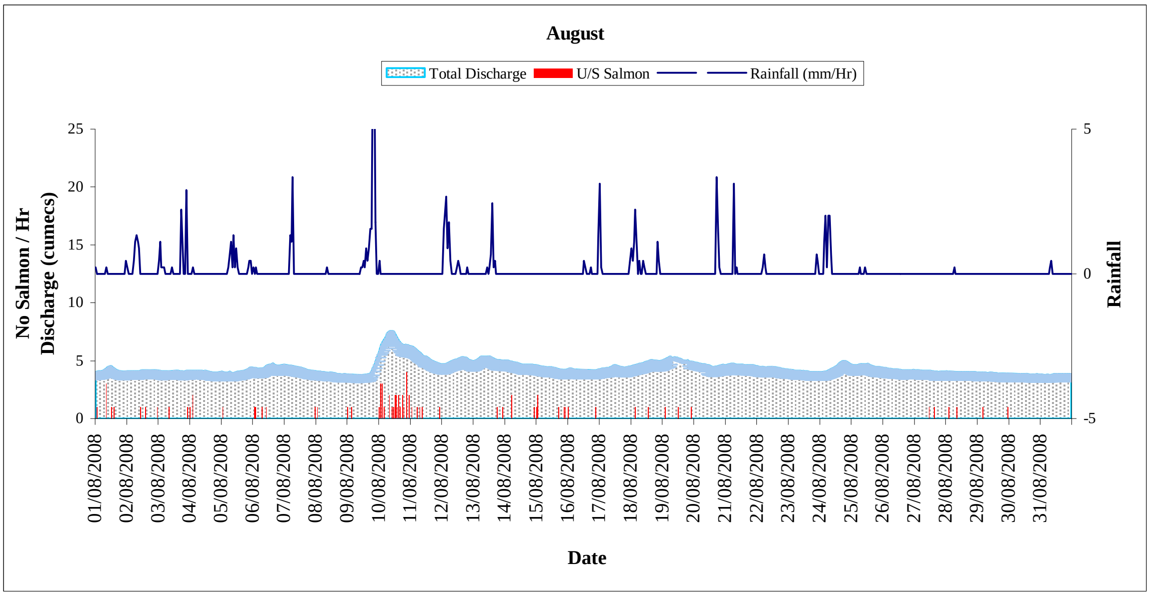

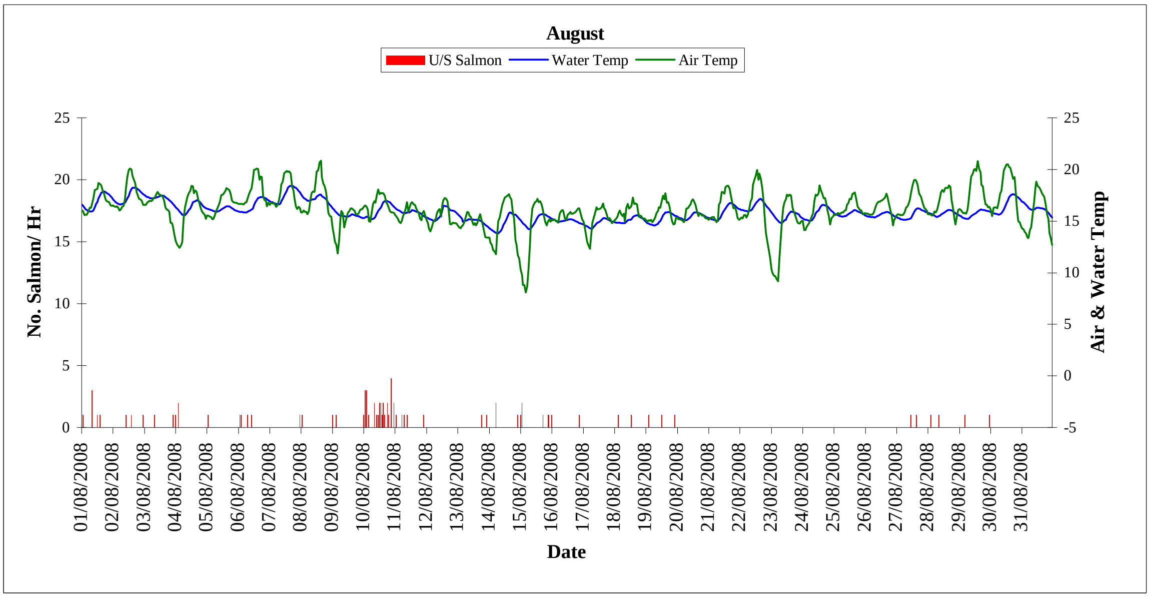

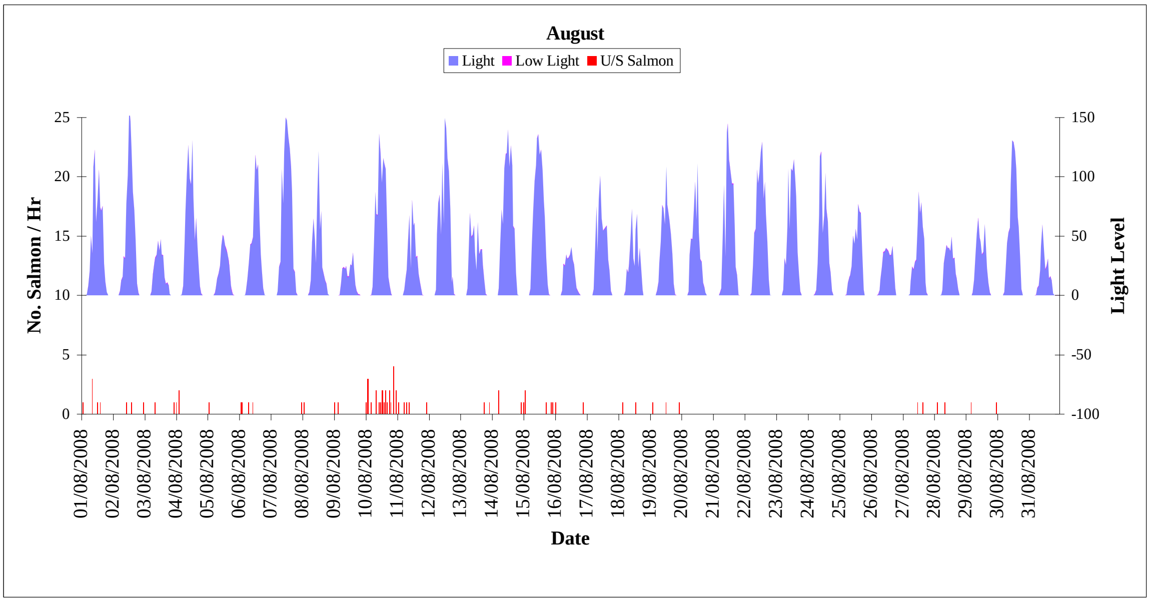

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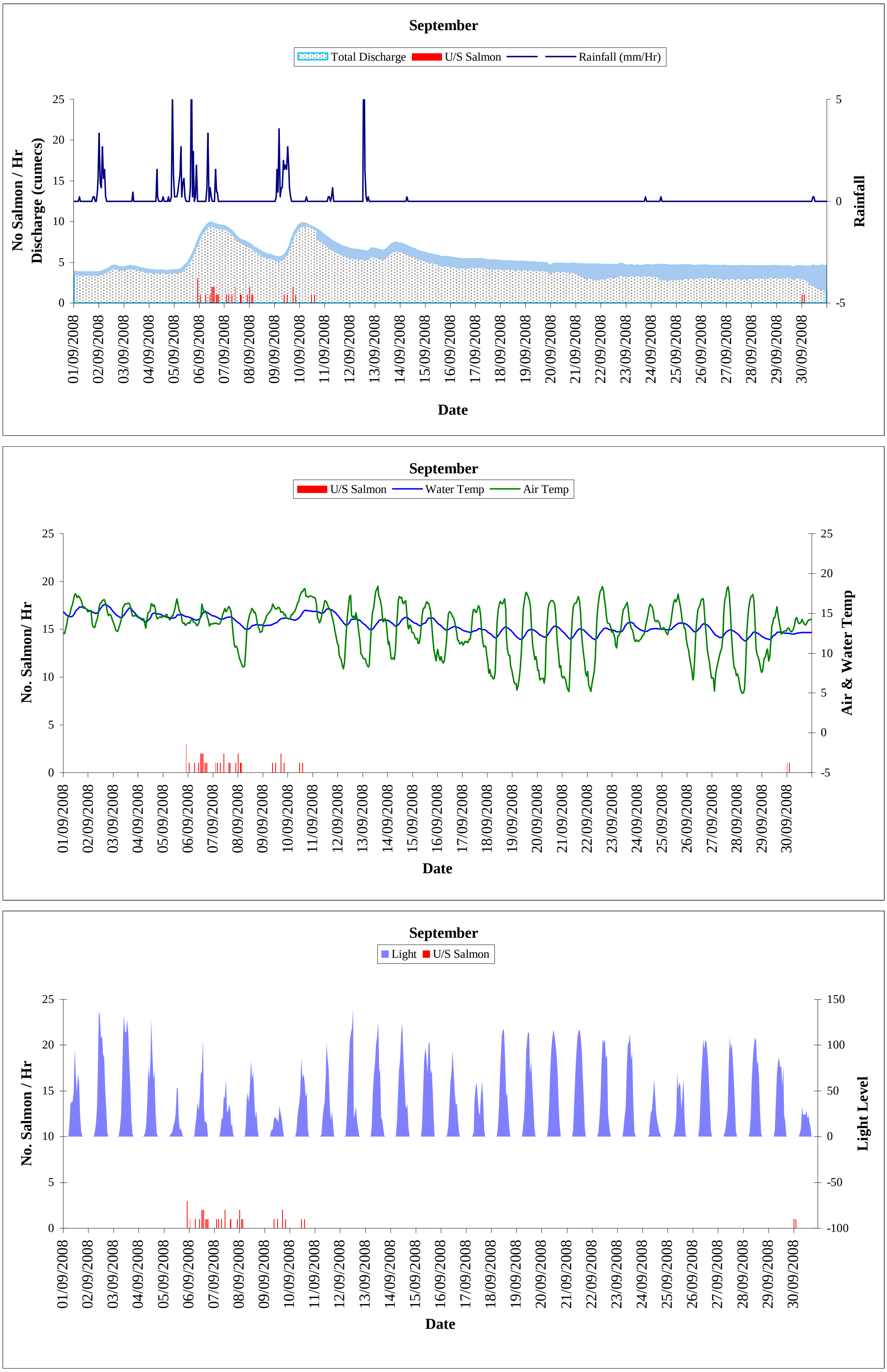

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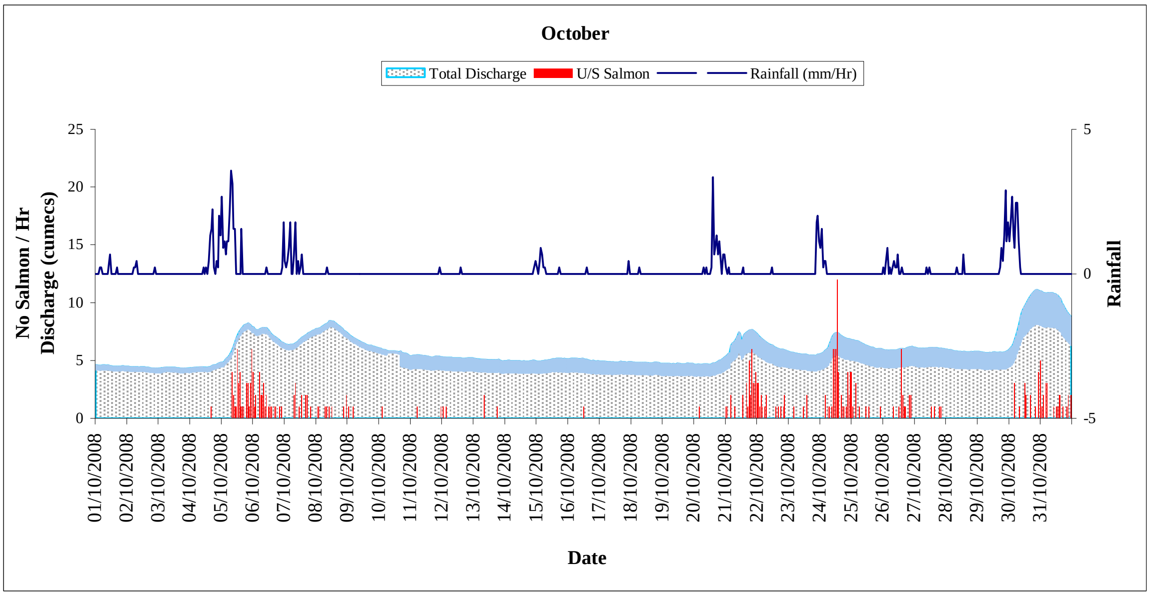

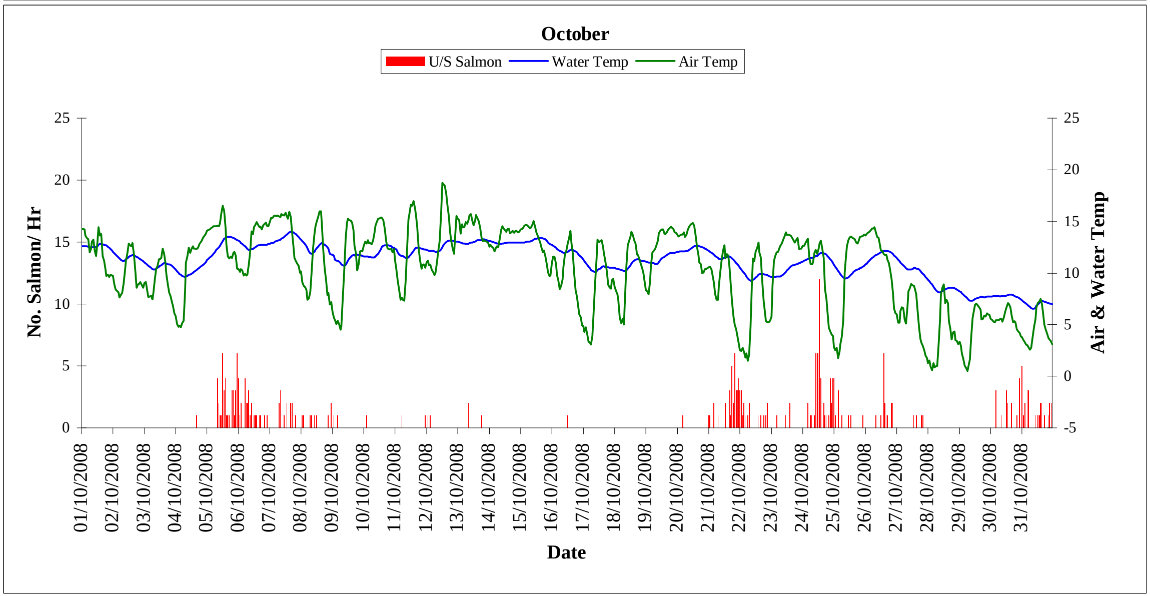

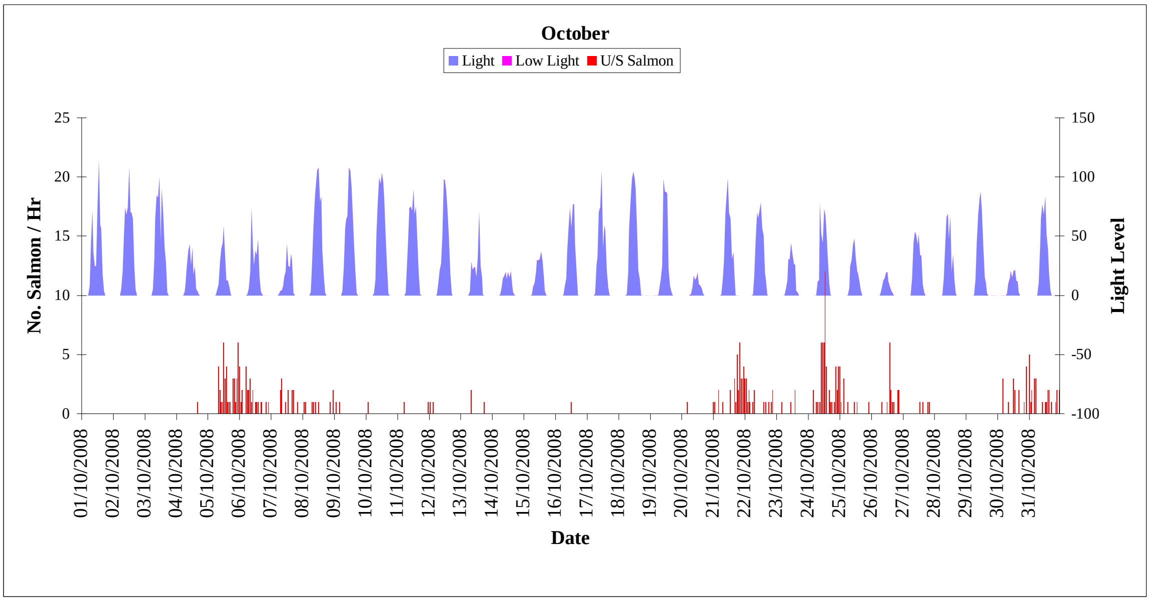

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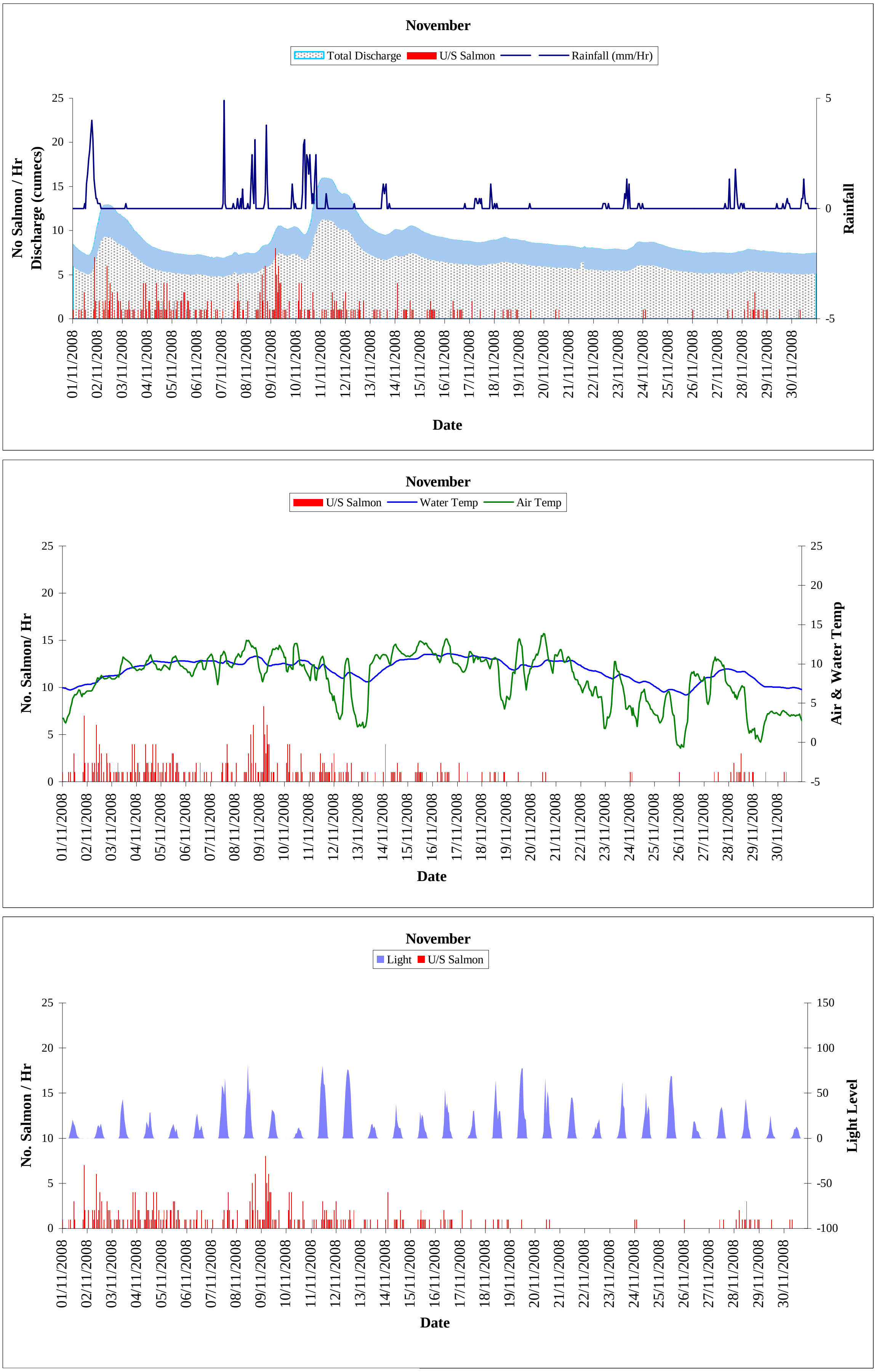

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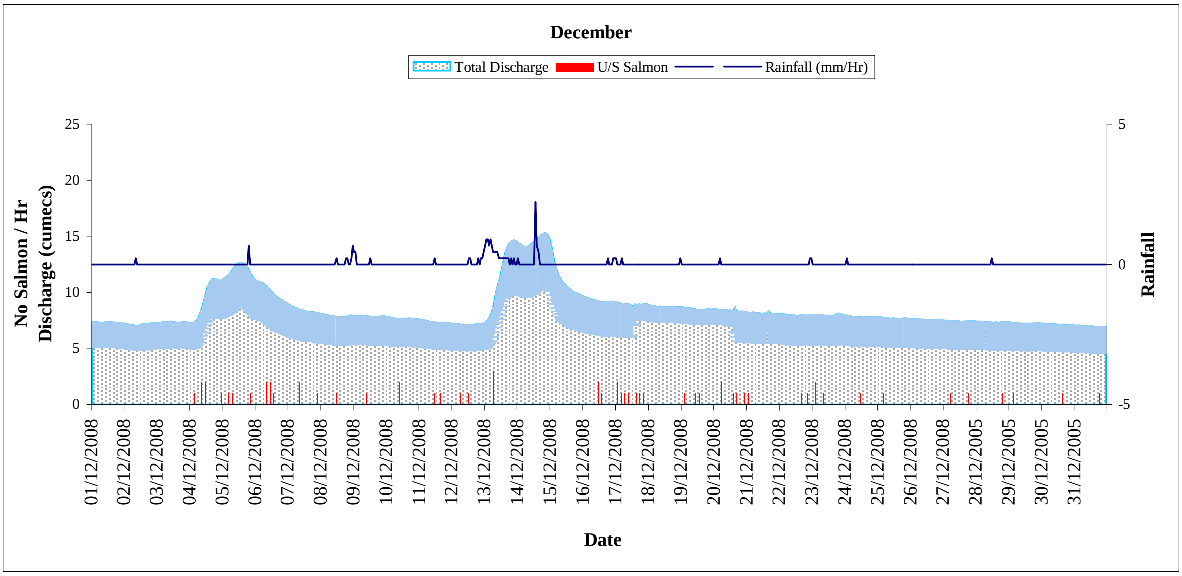

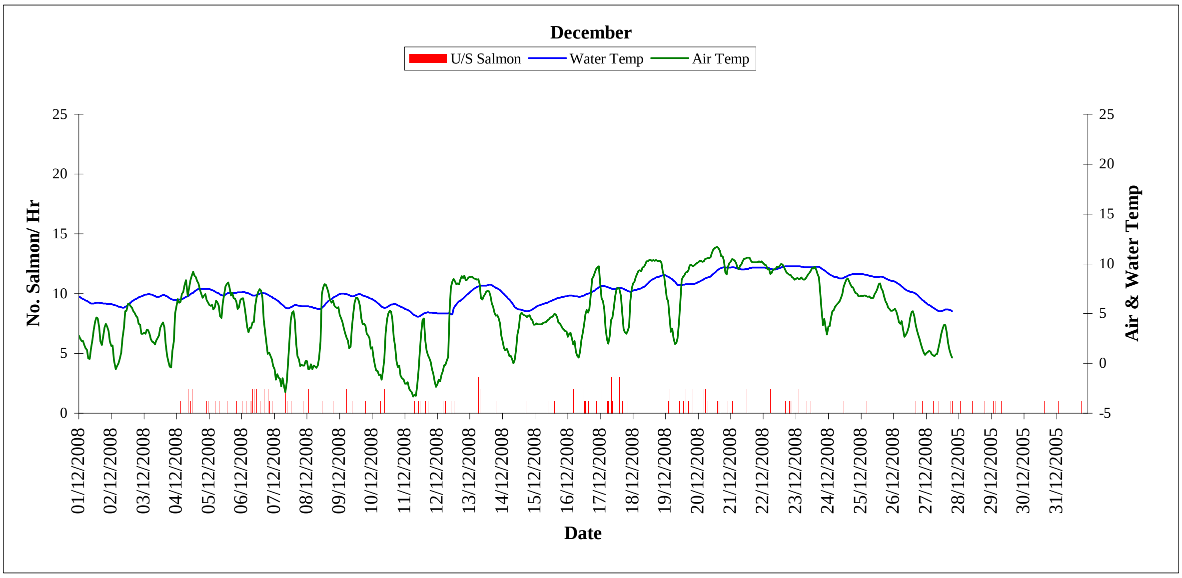

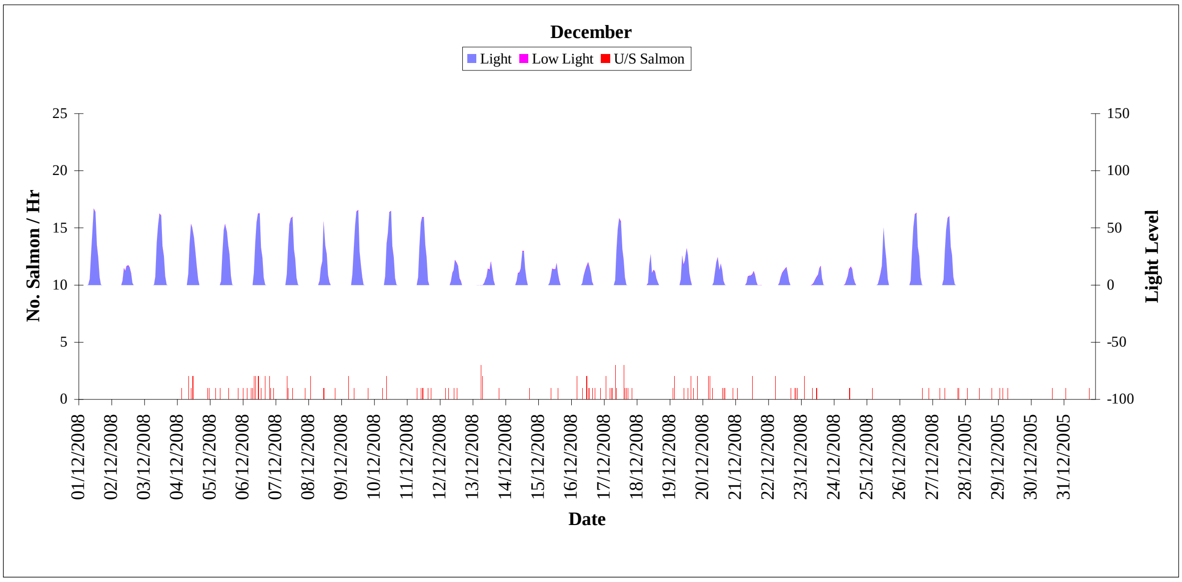

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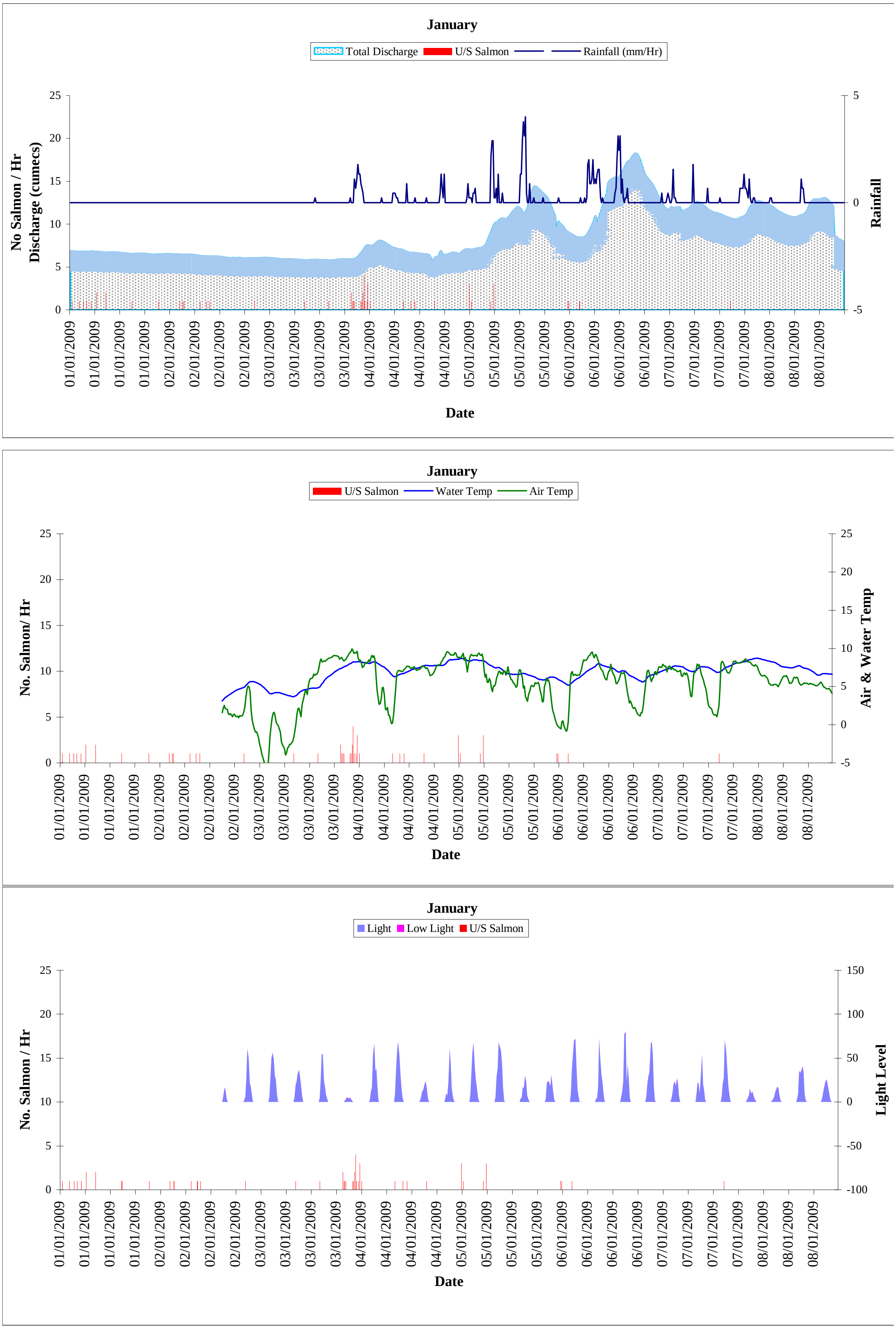

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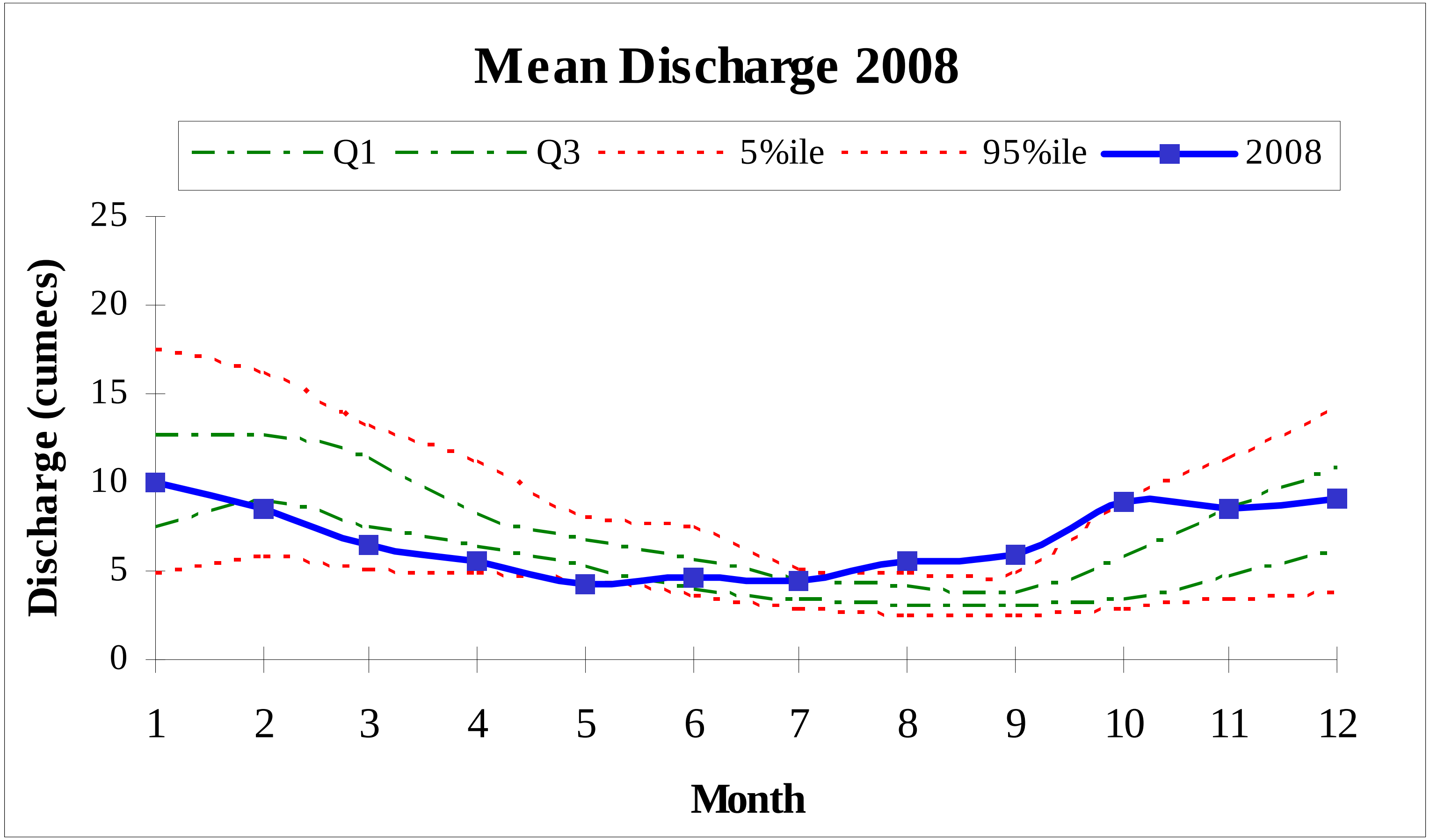

Figure 11: Monthly mean discharge and long-term percentile data (Jan – Dec data)

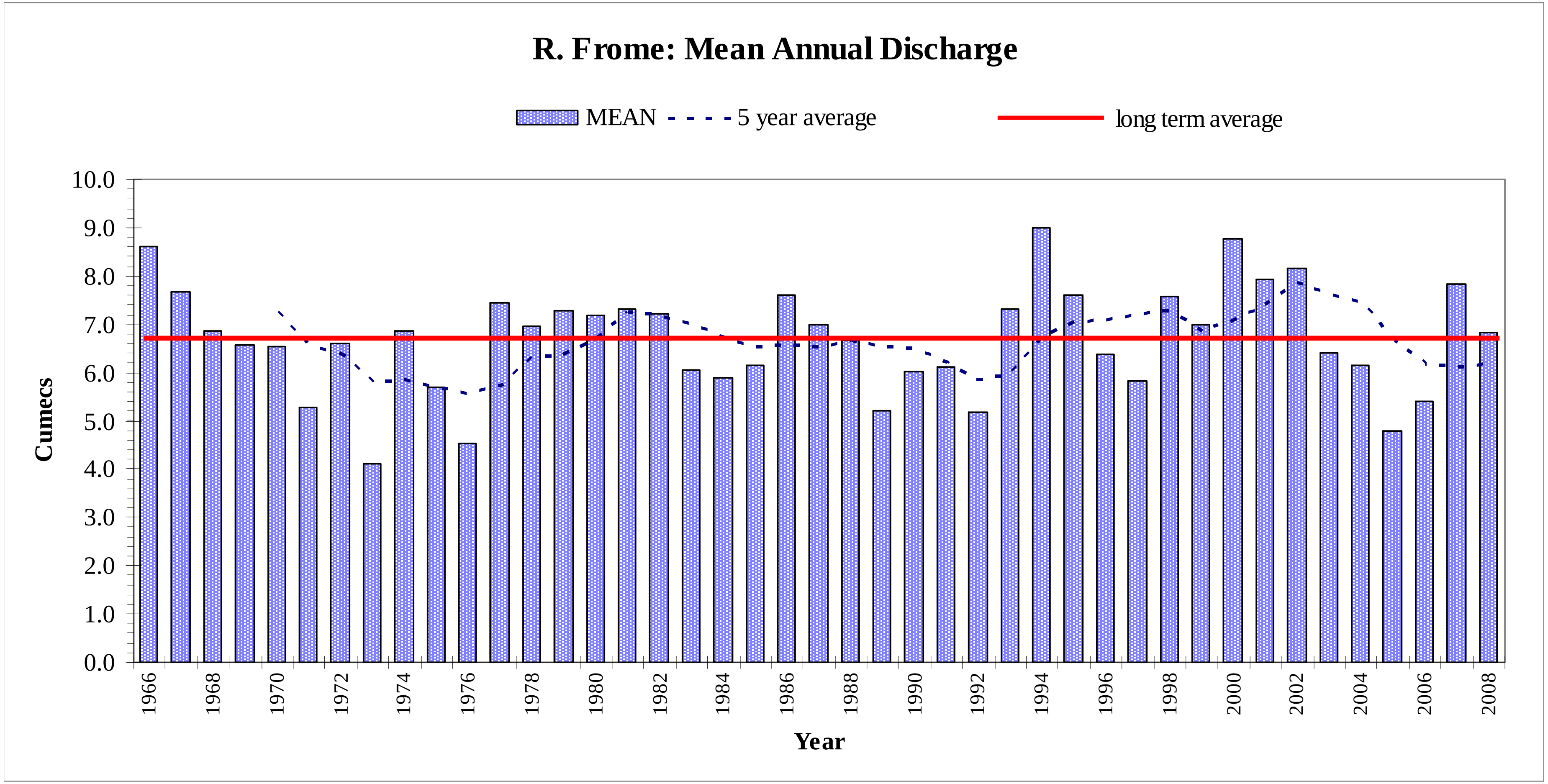

Figure 12: River Frome long-term annual discharge

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