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The 2006 East Stoke Salmon Counter Records

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CONTENTS

1. ABSTRACT

Data on the numbers and sizes of salmon ascending the CEH East Stoke Salmon Counter in 2006 are presented and a brief summary of the run and hydrological characteristics given.

2. INTRODUCTION

The data in this report represents the 34th consecutive year of the East Stoke counter's operation recording the upstream movement of Atlantic salmon (*Salmo salar* L.) in the River Frome. As such it represents the most comprehensive record of salmon movement in England and Wales. Data from the adult salmon counter, together with the data on smolt migration now being obtained, 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.

In conjunction with data on salmon movement, information on water temperature, air temperature, water height and light levels (including a measure of the brightness of the night) 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 having indicated that the upstream movement numbers in January are 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 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 in the mid 80s (Beaumont *et al* 1986) it was discovered that about 40% of all downstream counts were caused by salmon; thus leading to an overestimate of about 10% in nett upstream counts. Thus, since 1984 the coincident downstream counts have not been routinely subtracted from the counter totals and all downstream counts have been recorded. These data are now 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 1984, gross data are still presented. These data, whilst not being as precise as nett numbers, will still show accurately the trend of salmon numbers and will be within approximately 12% of the pre-1984 data.

3. ASSOCIATED AND FUTURE WORK

For the past four-years we have been tagging juvenile salmon in the Frome catchment with PIT tags. These small tags (just 12 mm long x 2 mm wide) enable us to individually identify the fish using 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 tags are detected by equipment mounted on the East Stoke smolt counter and the main river weir (Figure 1), recording the passage of the PIT tagged fish out to sea. The main river reader also allows the detection of the return of the adult PIT tagged fish. For the past two years we have tagged over 10,000 juvenile salmon (probably about 10-20% of the autumn population) and this year should see the return of the adults from the 2005 tagging exercise giving significantly more information. We are continuing to monitor the "autumn" run of parr in the river and working with Cefas at looking at the state of adaptation to salt water of these fish and where they migrate to. We will also be examining 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 RAPID PIT tag detection system

The data from the PIT tagging is also being used in a collaborative project with Cefas to investigate whether Rotary Screw Traps (RST) cause increased marine mortality of smolts. These devices are used on some rivers to monitor smolt numbers and it is important that no adverse impacts are caused as a result of their use.

We are also continuing the project to reinstate salmon into the Tadnoll Brook (a tributary of the Frome). Salmon in the tributary appear to have died out as a result of a combination of low discharge years and problems with passage to the spawning areas of the tributary. This year we again captured some adult broodstock from the main river, stripped them and have been incubating the eggs in the Tadnoll Brook (in streamside incubators Figure 2). When big enough these fish will also be PIT tagged, thus enabling us to monitor and assess the success of the reinstatement. The help of Watergates Fish Farm is gratefully acknowledged as is the kind permission of the river owners for access to the river for capturing the adult brood fish. The Environment Agency has also completed installing the fish pass into the Tadnoll to help passage upstream past some hatches.

In addition, as part of a project looking at interactions between related salmon parr, salmon have also been released into the river Cerne (another tributary that at present does not support salmon).

Figure 2 Streamside incubator boxes with salmon eggs ready to be added

The large-scale gravel cleaning programme that we 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 combined 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. For the second year running we have just completed a survey of the distribution of the redds in the river and will be assessing these locations with regard to the cleaned areas.

4. 2006 DATA REPORT

The computer verification system at East Stoke continues to provide real benefits with regard to verifying the data from the counter. 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). An example of the computer verification system's display is shown in Figure 3a and figure 3b shows a selection of frame grabs from the computer. 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.

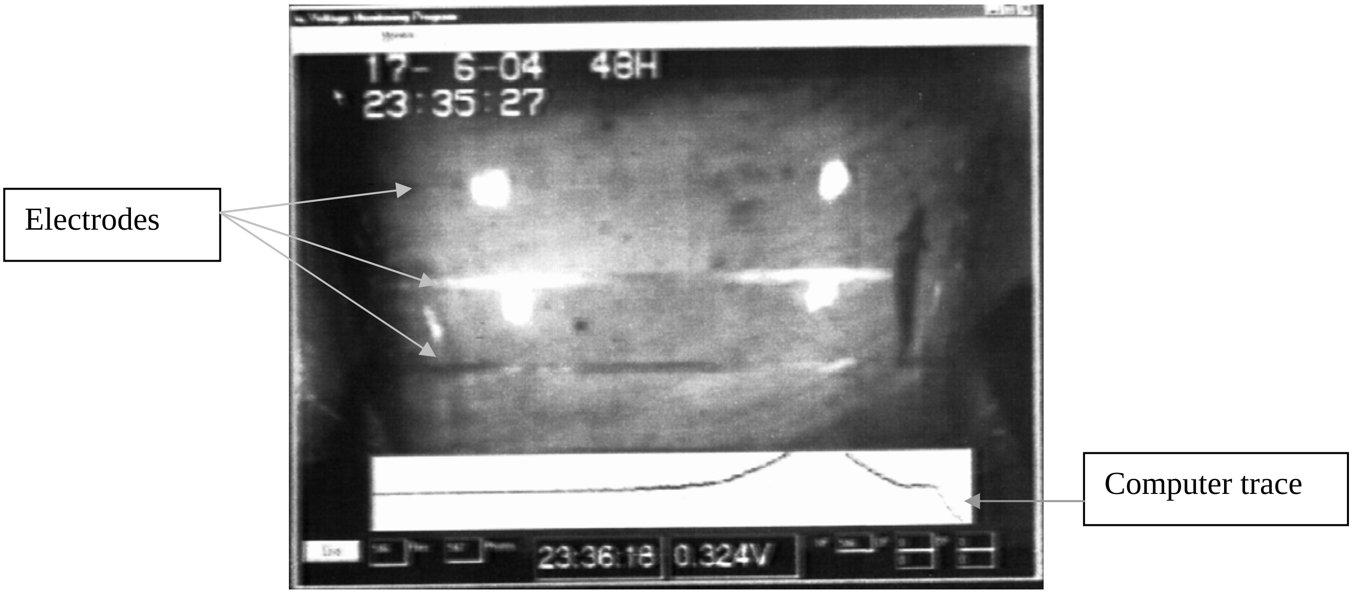


Figure 3a Screen display from the computerised counting and evaluation system. The image shows a 75 cm salmon ascending the weir

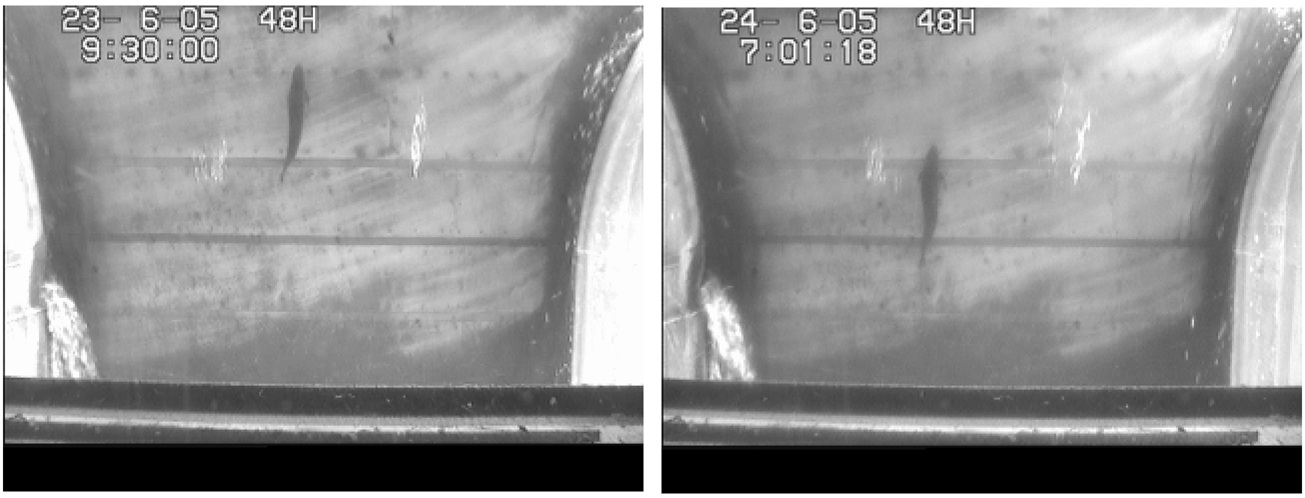


Figure 3b Computer frame grabs from the computerised counting and evaluation system

Verification of the data entailed verifying 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. In 2006 a total of 241 days had usable video data and for 125 days video verification was not available (due to turbid water etc). Accuracy of the computer records was 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. Overall an accuracy of 73% in upstream and 89% in downstream counts was found. Data presented are not however corrected for verification error.

This year again there was a very high number of fish vacillating (going up and down) over the weir in March and April. These fish were identified as kelts by the thinness of the fish on the video and frame grab records. In order to prevent bias by including these fish they have been edited from the data set either on the basis of the video identification or on the close timing of up and down counts (coincident counts).

Figure 4 shows verified 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. It should be noted that whilst downstream counts are not subtracted from January, February or March data (as a large proportion of these are likely to be kelts dropping back downstream) this year for the March data coincident downstream counts have been subtracted for the reasons noted earlier regarding the kelts vacillating over the weir. 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 886
Nett total for the year was 750

Figure 5 shows that the total nett upstream count for the year was high in comparison with the very low runs that have been recorded since 1999 but still low compared with the 1991-1998 and earlier run numbers. Gross run data is the second highest since 1999. Figure 6 shows the 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 2005 (the second period of very low numbers) and the current year (2006). The figure shows that, with the exception of October, the run over the year was

above the 1999 to 2005 average for all months and considerably exceeded this value for November.
Figure 7 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 372 fish were measured this year (Figure 8) with the largest fish being 100 cm. Data from fish below 50 cm have been excluded from figure 8 (and the data set).

Figure 9 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 (Millstream (ESMS) discharge shown separately as dark blue on top of light blue main river discharge – upper boundary of data therefore is total discharge) from Environment Agency data. Air temperature, water temperature and light level are also shown. Data from the low light meter are missing this year due to equipment failure. This high sensitivity light meter data is designed to show bright nights to see if night-time illumination level affects the run pattern. The equipment will be repaired as soon as possible. Graphs of the hourly data clearly show the clarity of detail available with the hourly time-base.

Figure 10 shows mean monthly discharge data (in cubic metres per second (cumecs)) for 2006 together with mean (1966-20054) 5, 25, 75 and 95 percentile discharge data. This data is collated and calculated from Environment Agency records. The river discharge remained below the lower quartile (25%) until April when then rose to between the interquartile until July when it again dropped. In September discharge was very close to the 5%ile value however the river depth was maintained by weed growth which backed up the water. Between October to December the river steadily rose and in December the discharge exceeded the upper quartile of the long-term discharge value. Figure 11 shows the mean annual discharge data for the Frome (together with the 5-year and long-term average for 1966 to 2005) and shows that although total discharge was higher than last year it was still the 5th lowest figure on record.

5. REFERENCES

Beaumont W R C, Mills C A and Williams G (1986) The use of a microcomputer as an aid to identifying objects passing through a resistivity fish counter. *Aqua. Fish. Mgmt* **17**, 213-226.

Scott A and Beaumont W R C (1994) Improving the survival rates of Atlantic salmon (*Salmo salar* L.) embryos in a chalk stream. *Institute of Fisheries Management Annual Study Course, 1993, Cardiff.*

MONTH													
Month	*Feb-06*	*Mar-06*	*Apr-06*	*May-06*	*Jun-06*	*Jul-06*	*Aug-06*	*Sep-06*	*Oct-06*	*Nov-06*	*Dec-06*	*Jan-07*	**Total**
Gross U/S	**13**	**15**	**9**	**47**	**98**	**129**	**30**	**4**	**161**	**355**	**18**	**7**	**886**
Gross D/S	**6**	**15**	**2**	**11**	**11**	**15**	**10**	**1**	**23**	**53**	**10**	**2**	**159**
Nett U/S	**13**	**15**	**7**	**36**	**87**	**114**	**20**	**3**	**138**	**302**	**8**	**7**	**750**

= many u/s kelts. Coincident counts removed

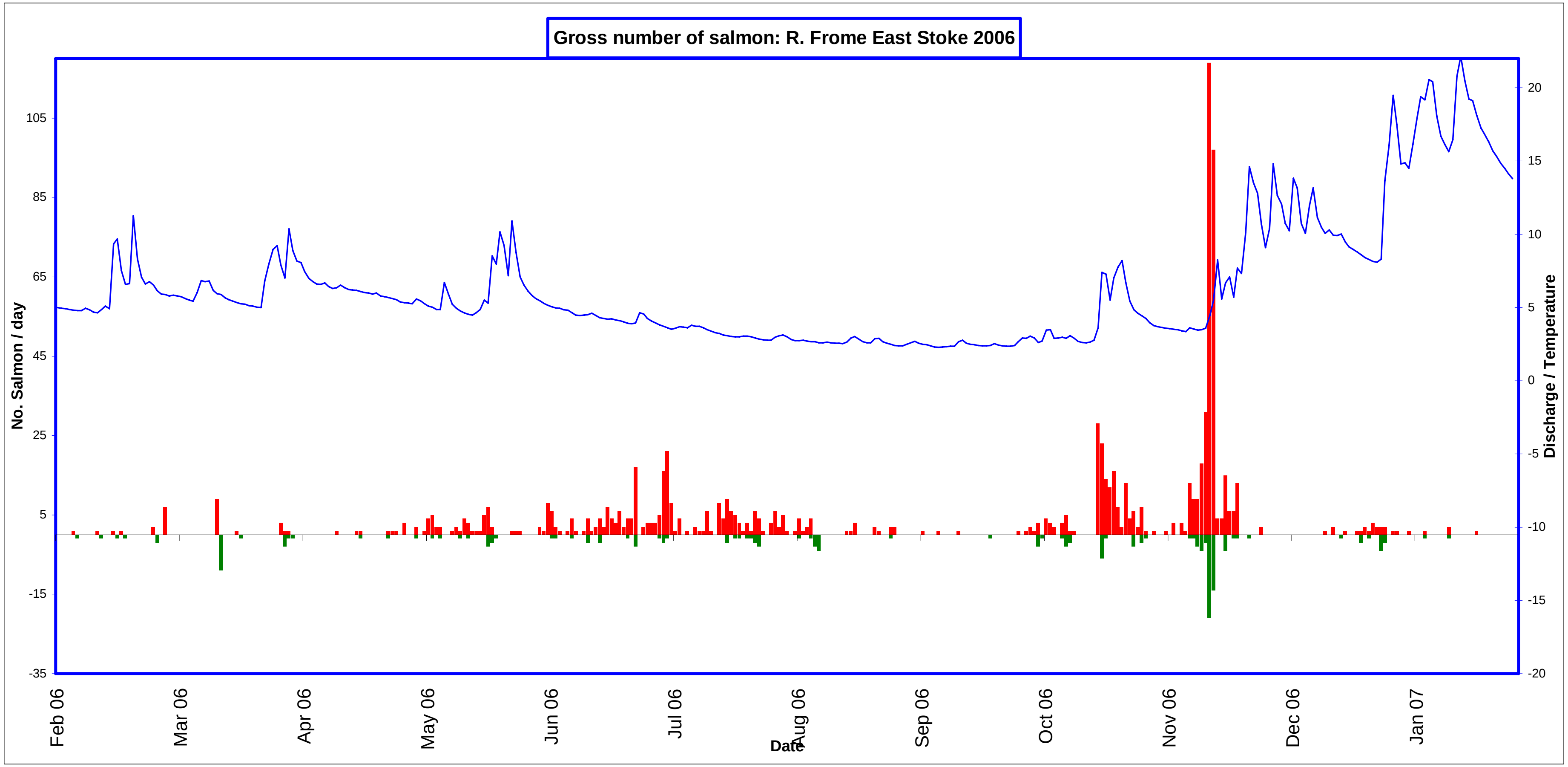
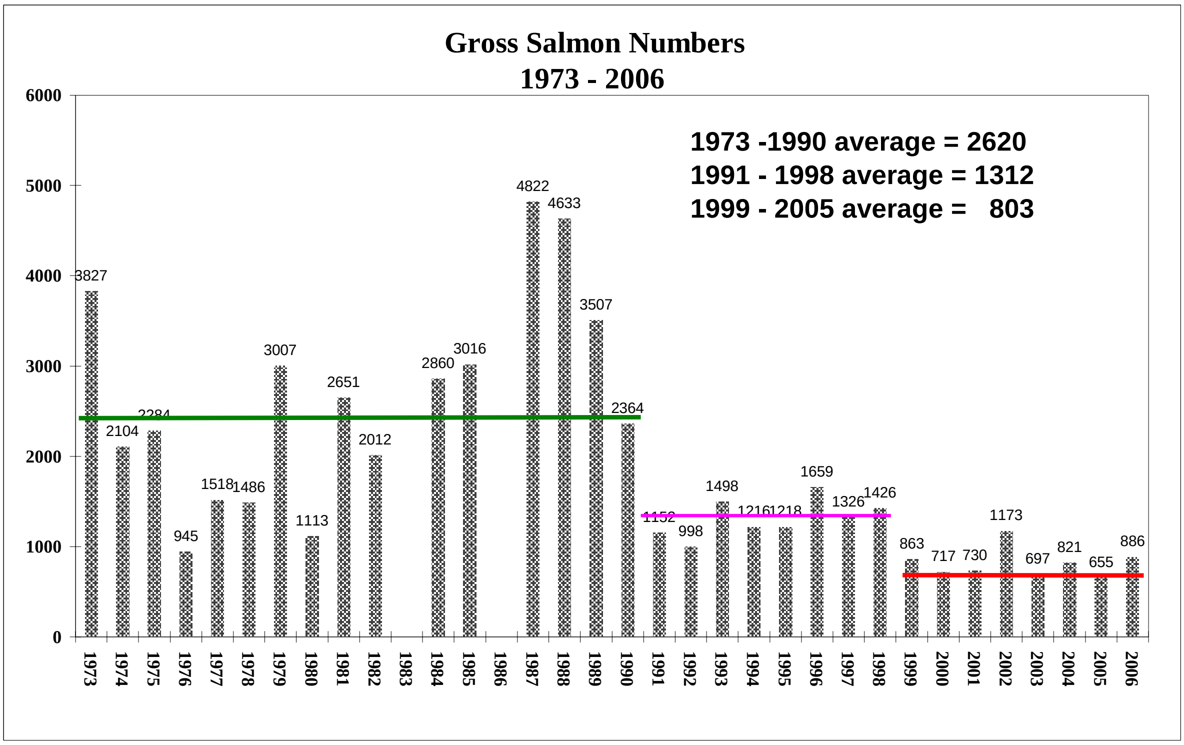


Figure 4 Centre for Ecology and Hydrology: East Stoke Salmon Counter Data 2006



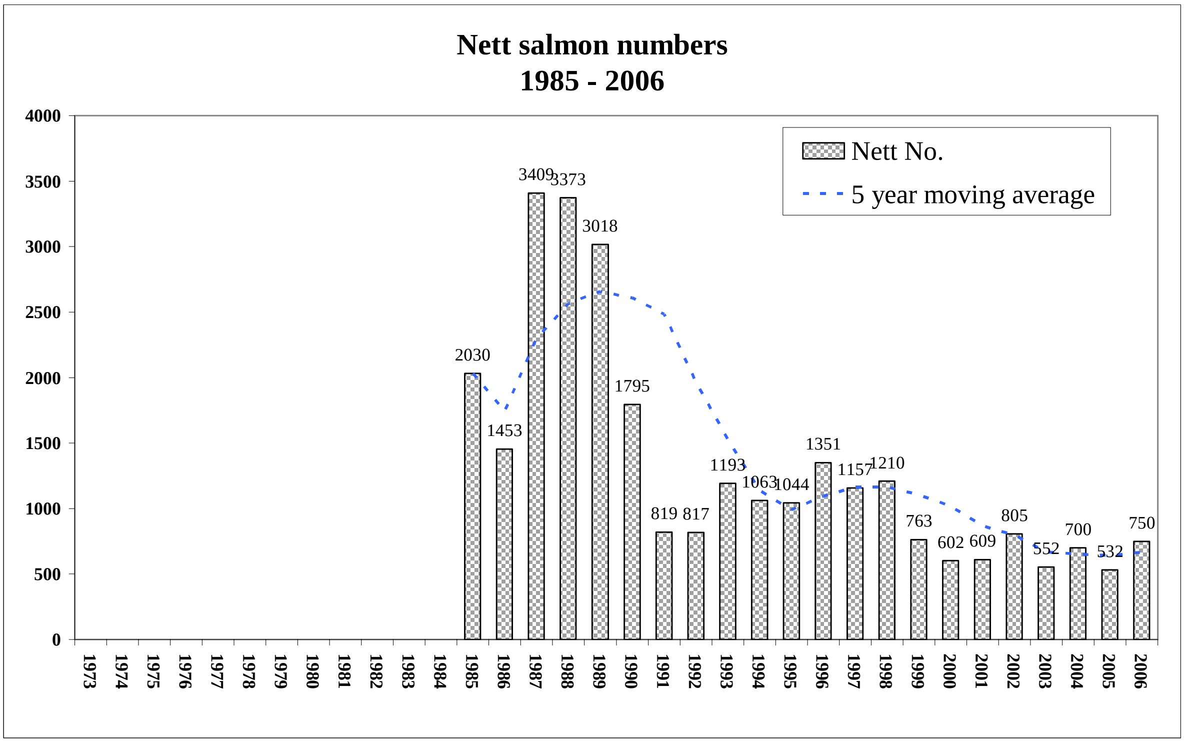


Figure 5: Gross and Nett numbers of salmon ascending the East Stoke weir

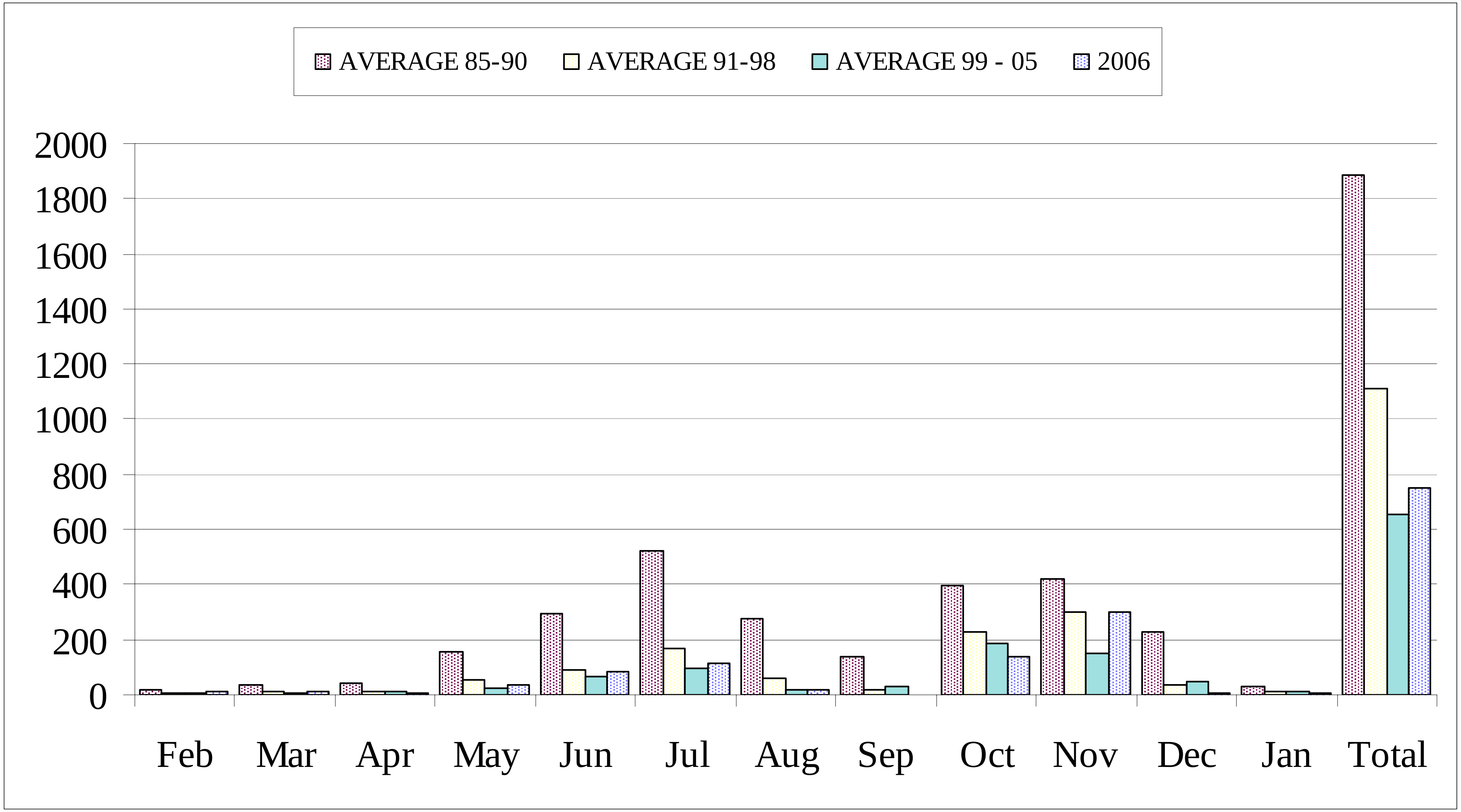


Figure 6: Comparison of Nett 2006 data with previous years

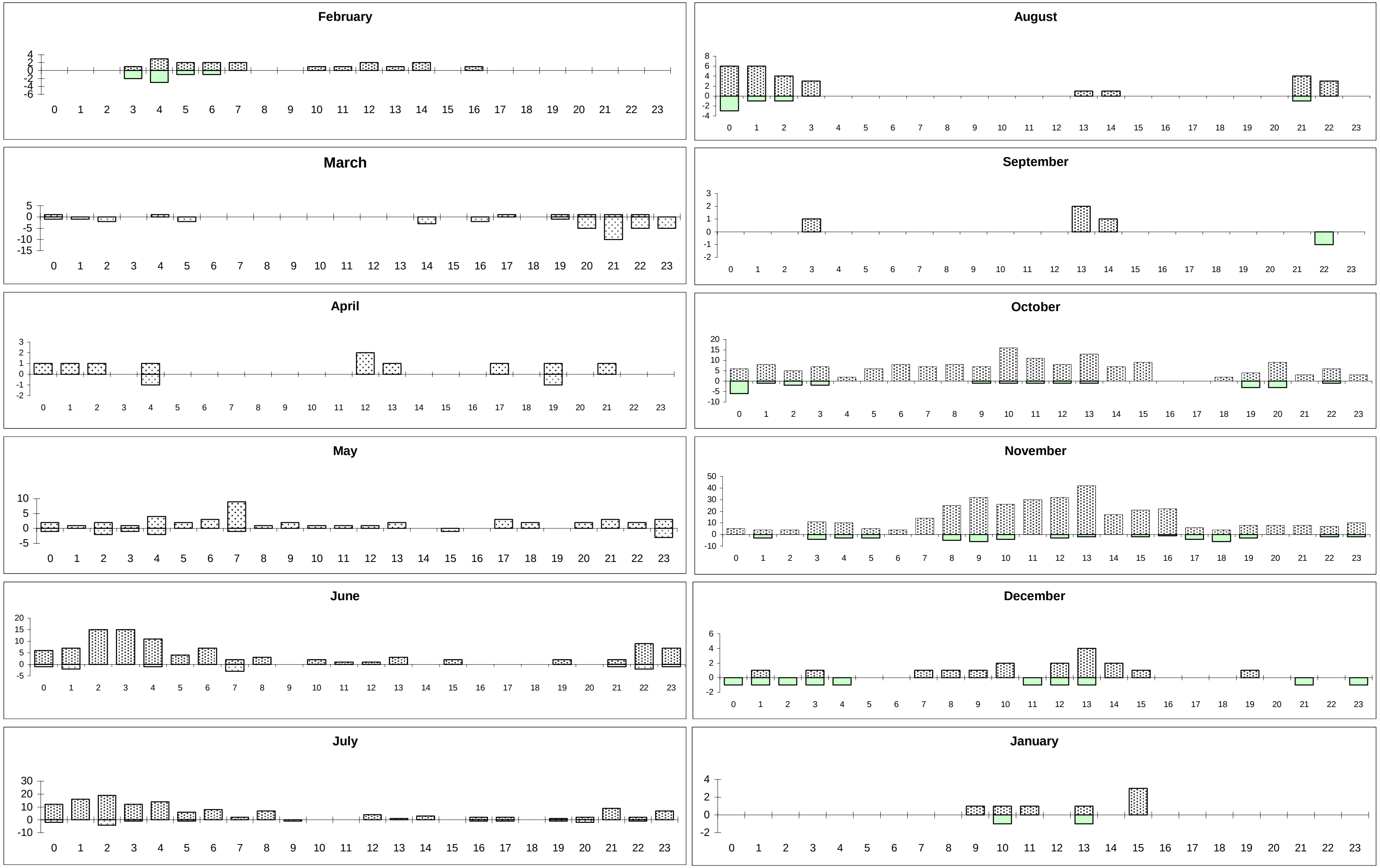


Figure 7: Time of day of movement (Gross count data)

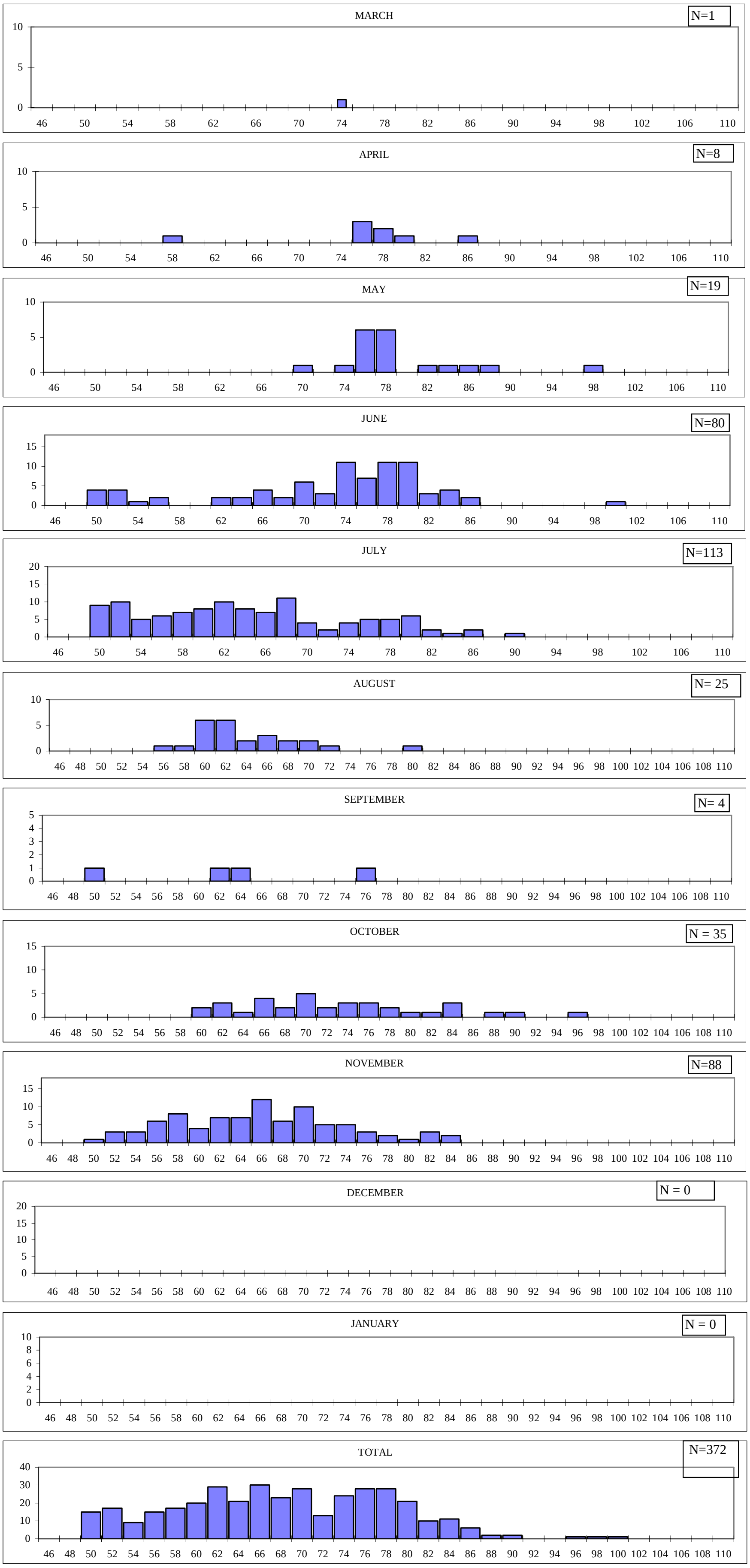
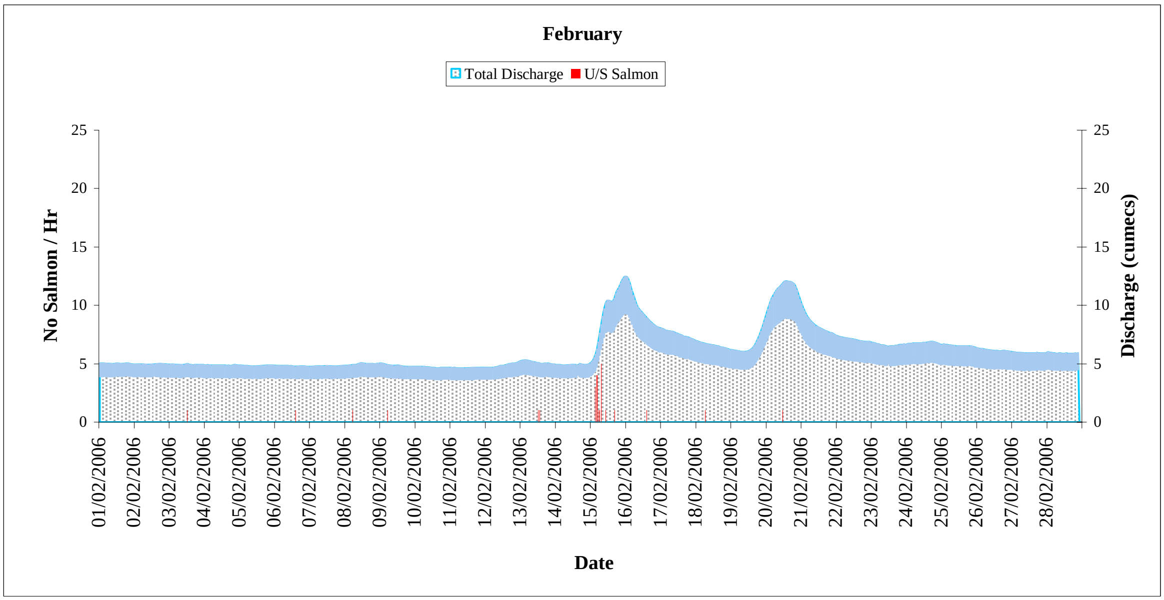
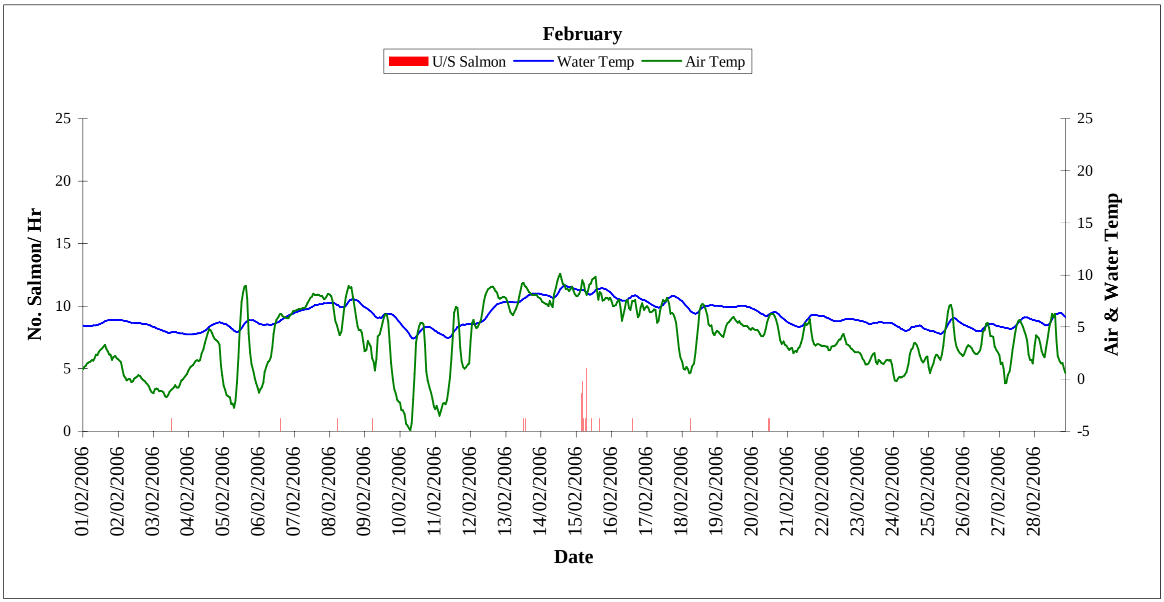


Figure 8: Observed fish lengths





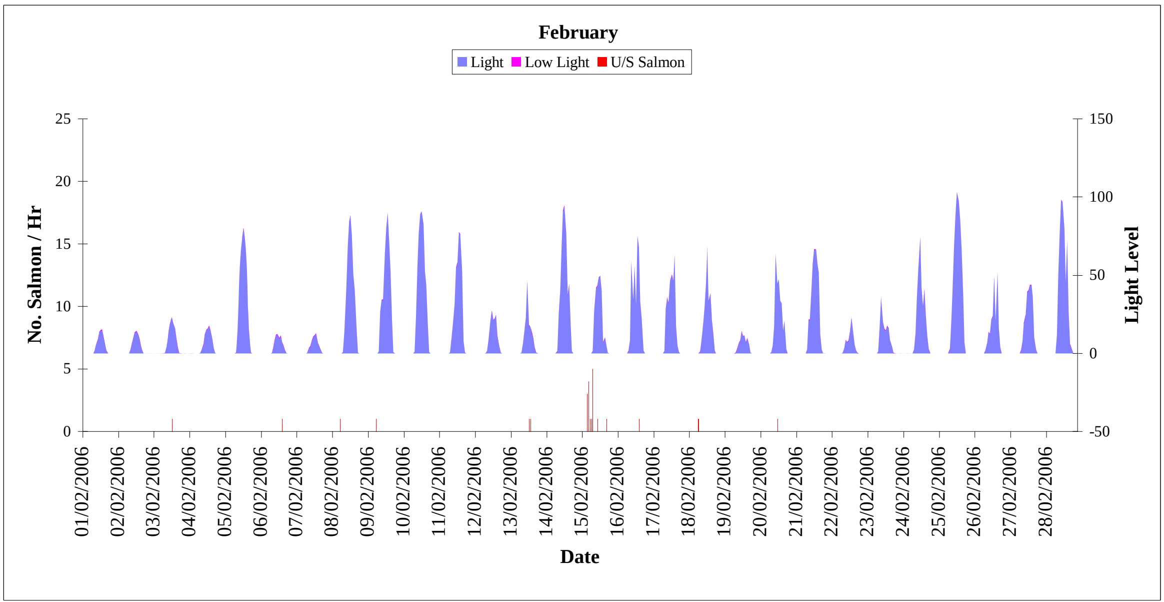
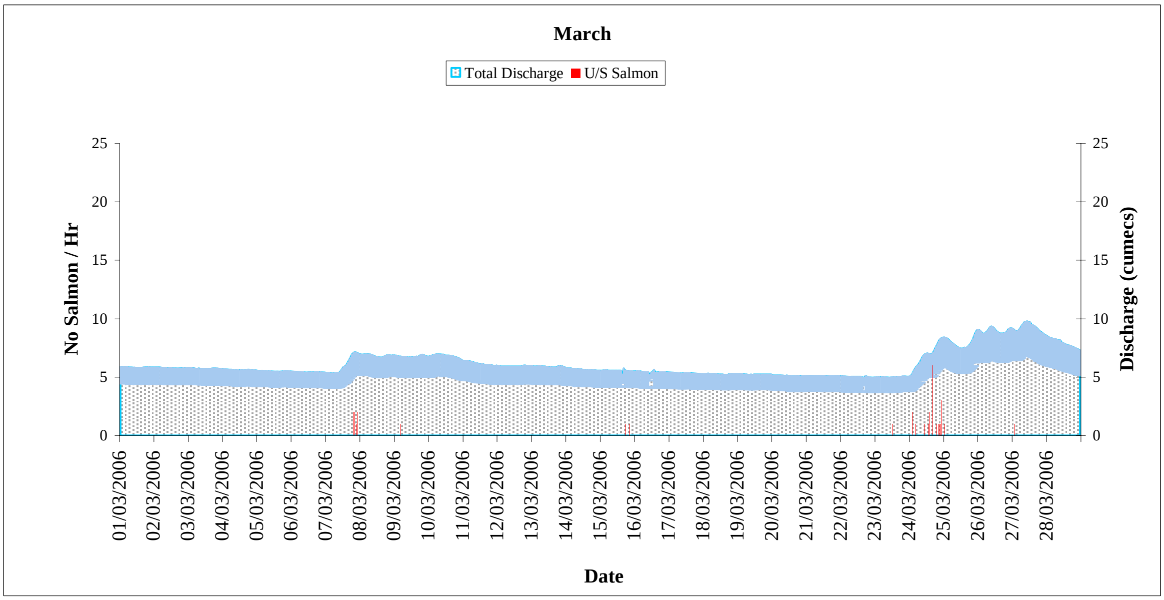
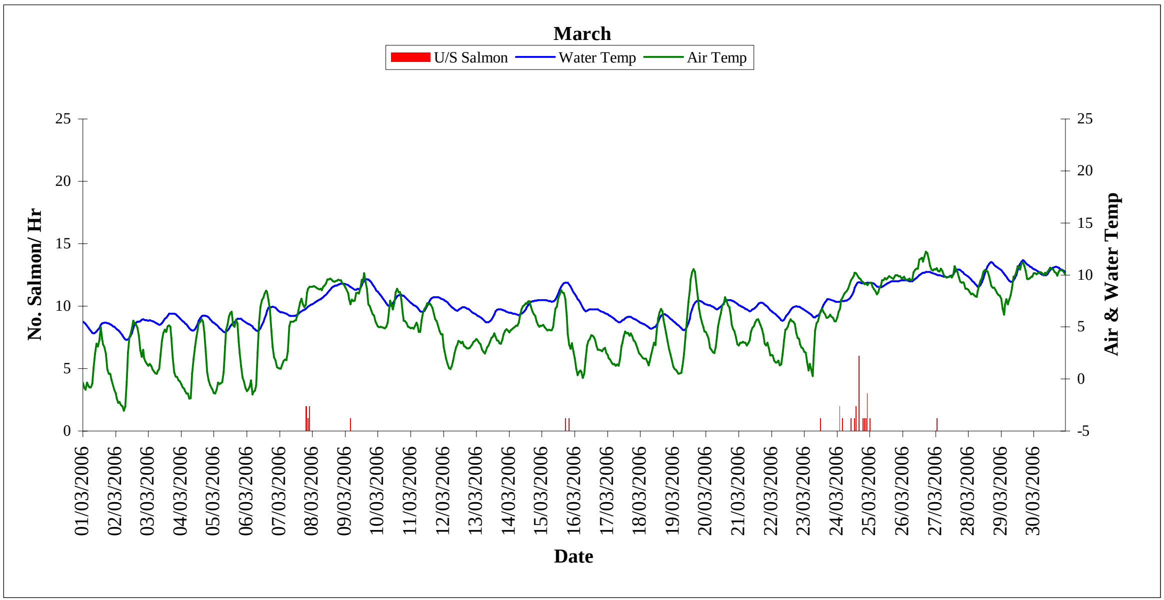
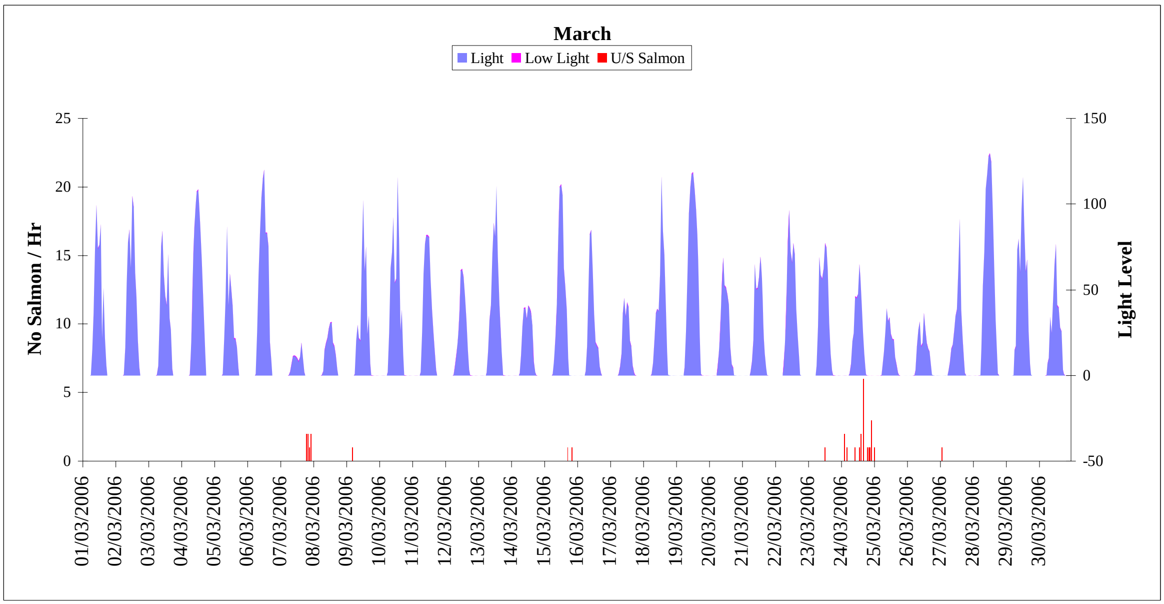


Figure 9: Hourly data







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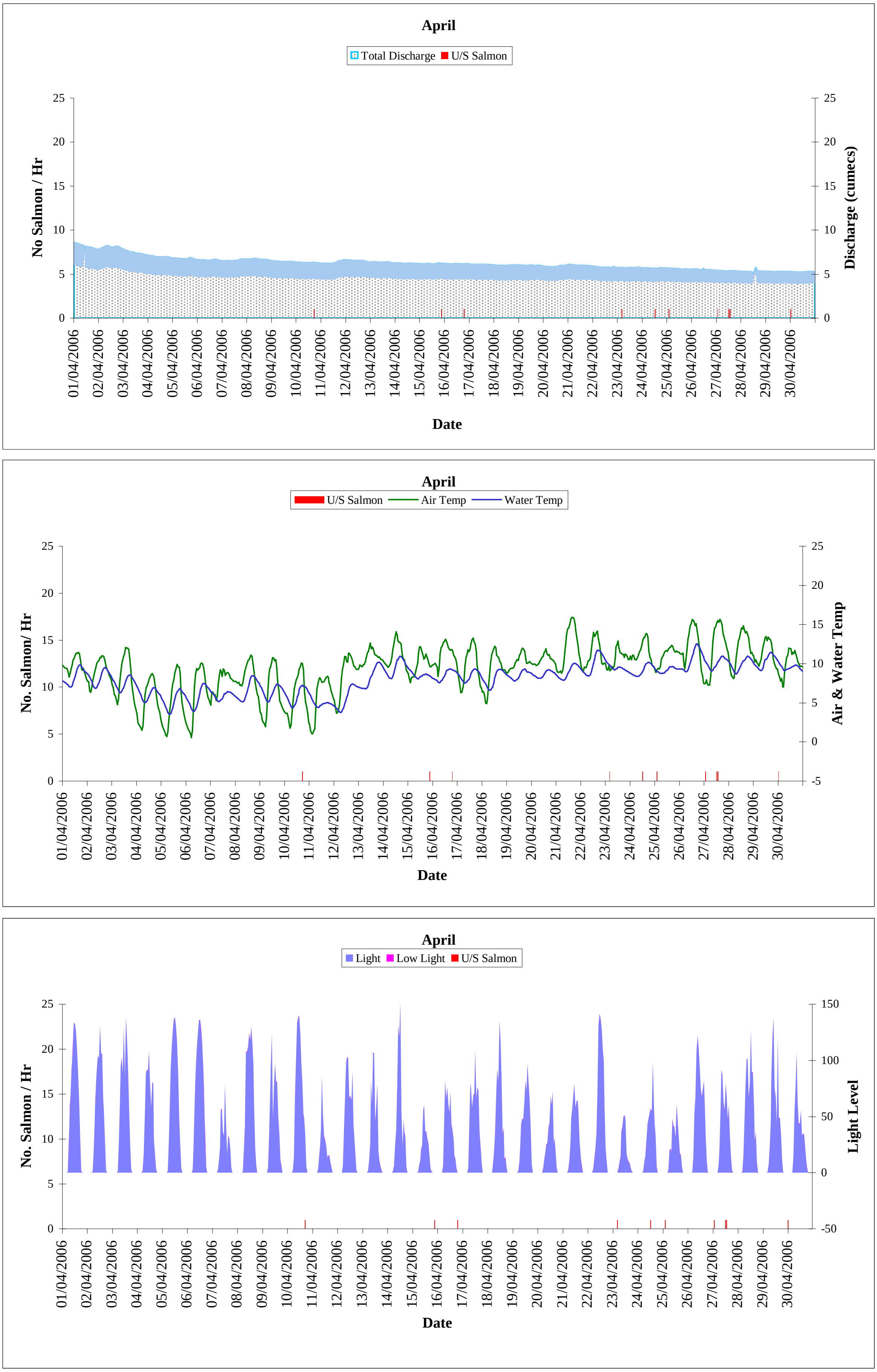

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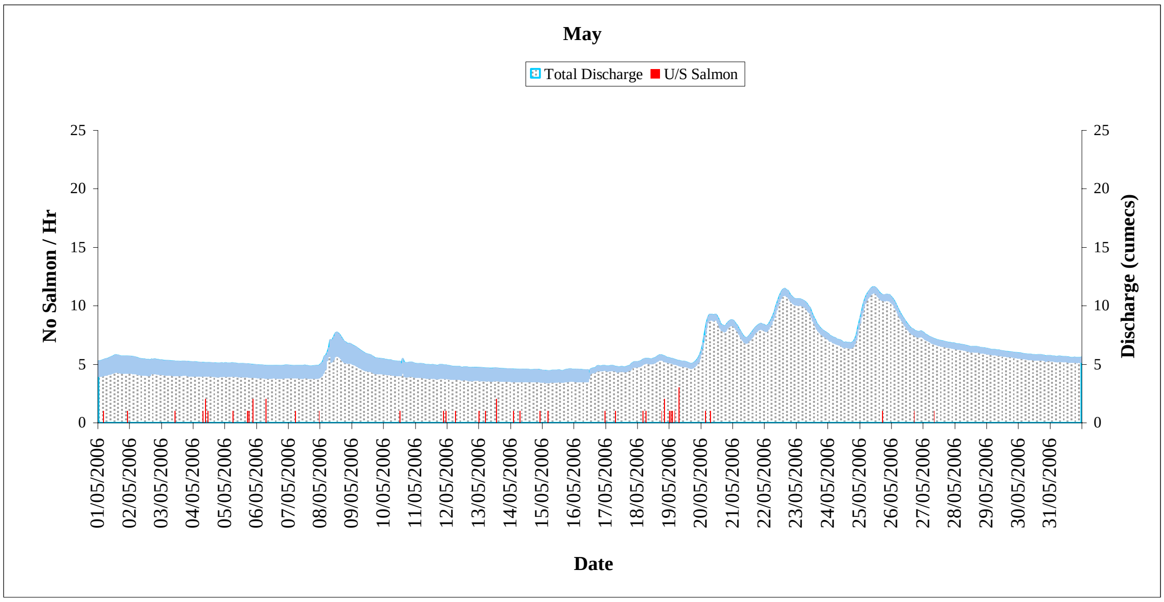

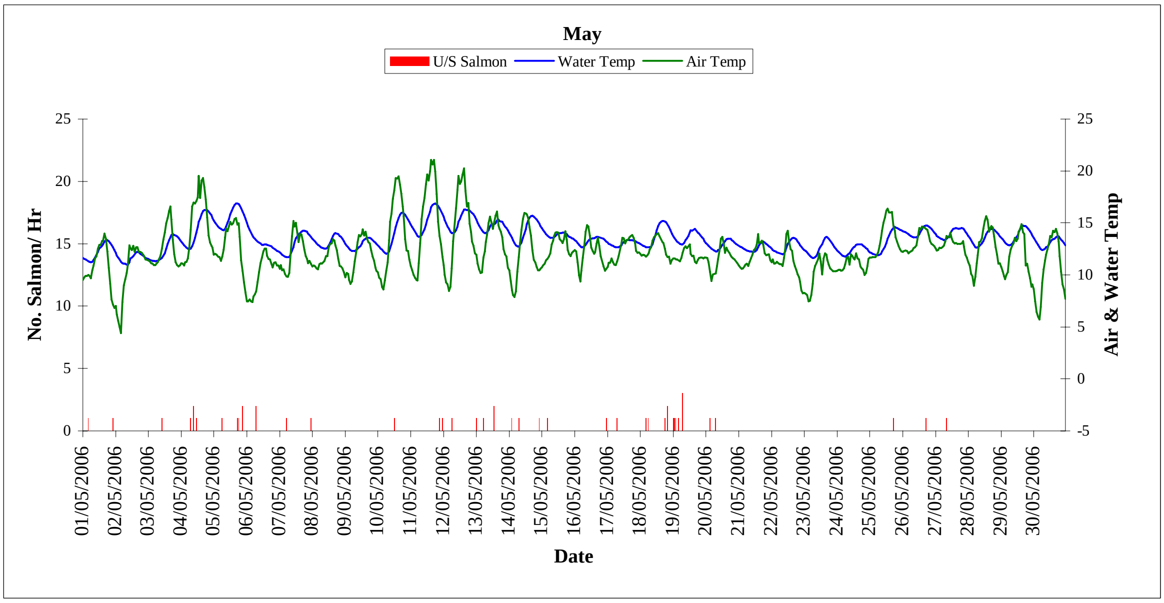

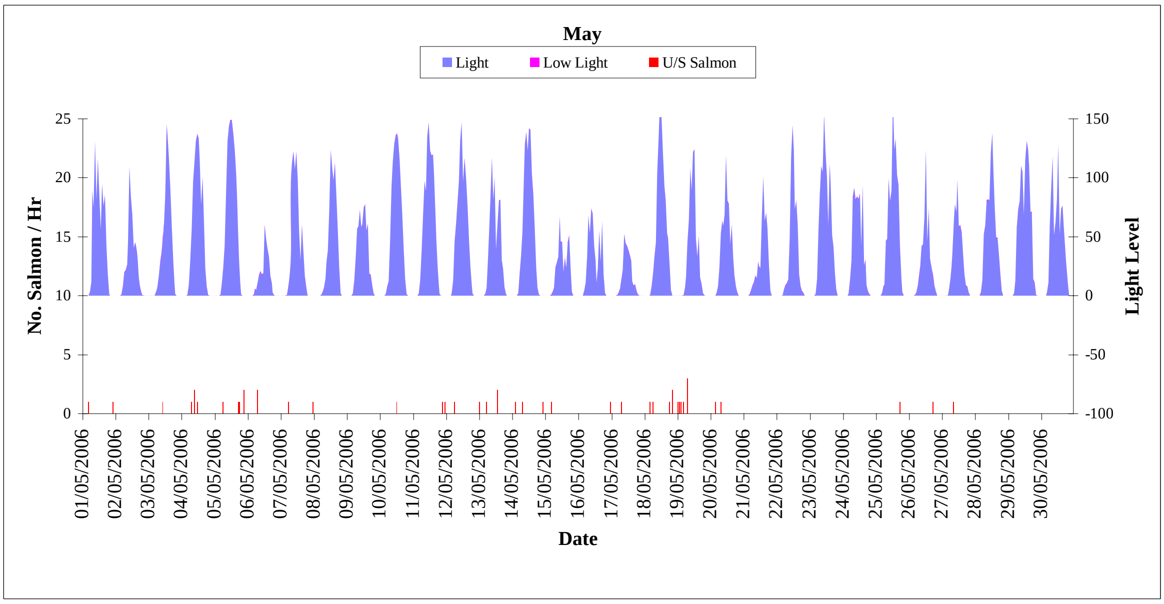

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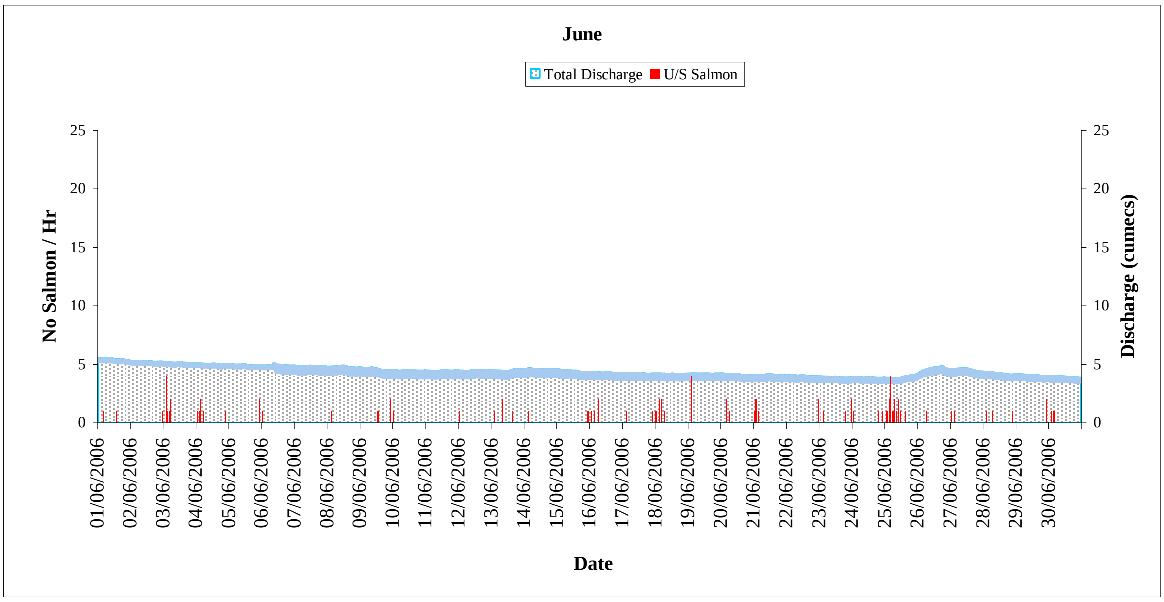

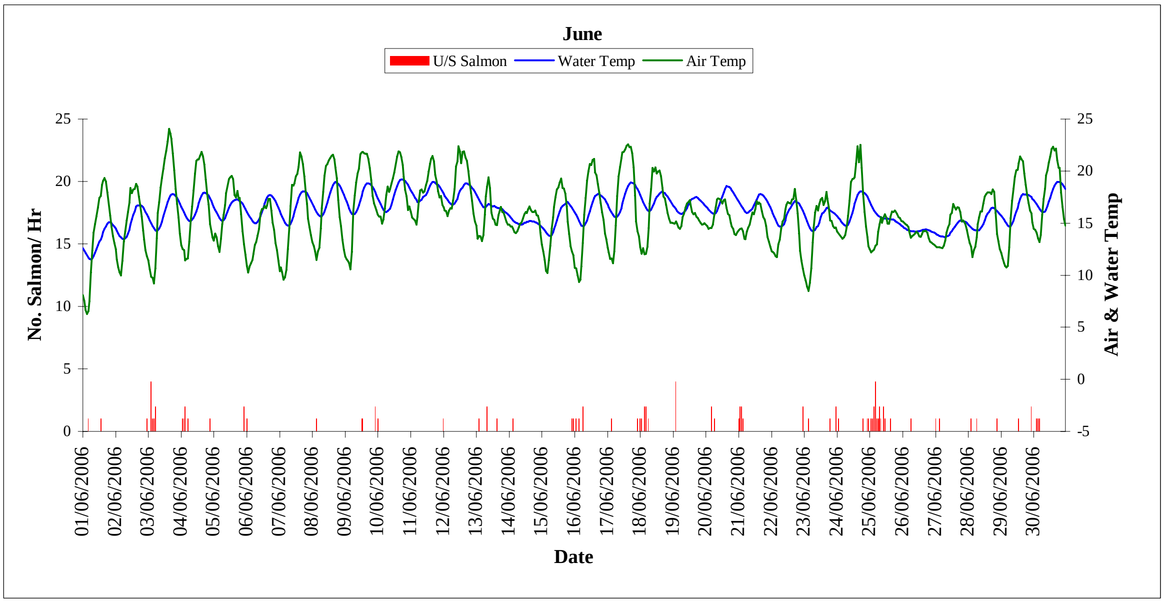

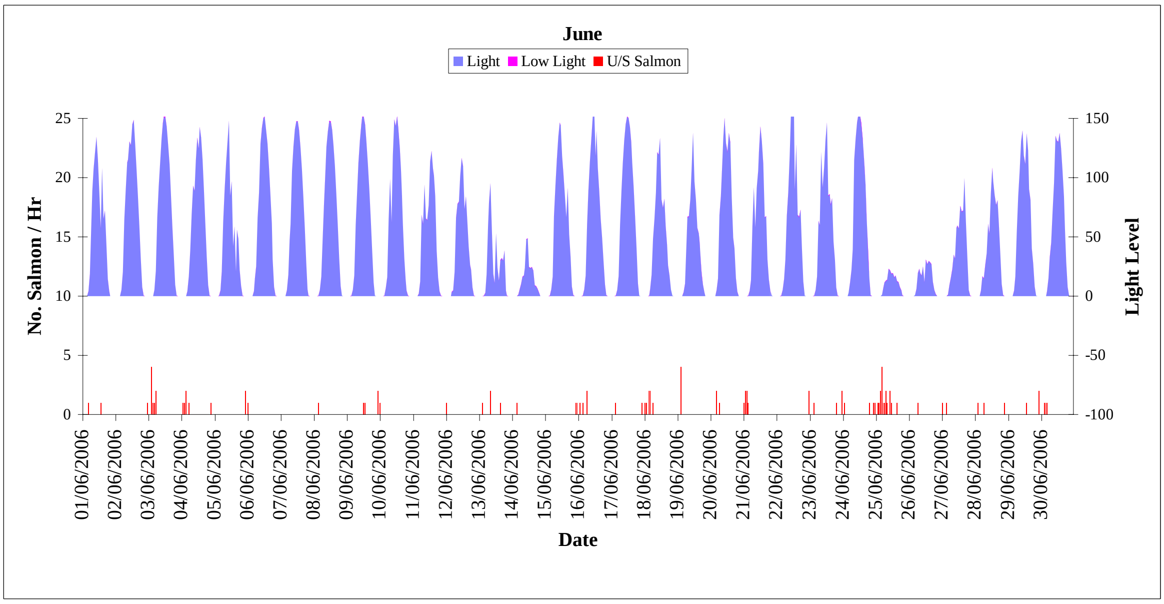

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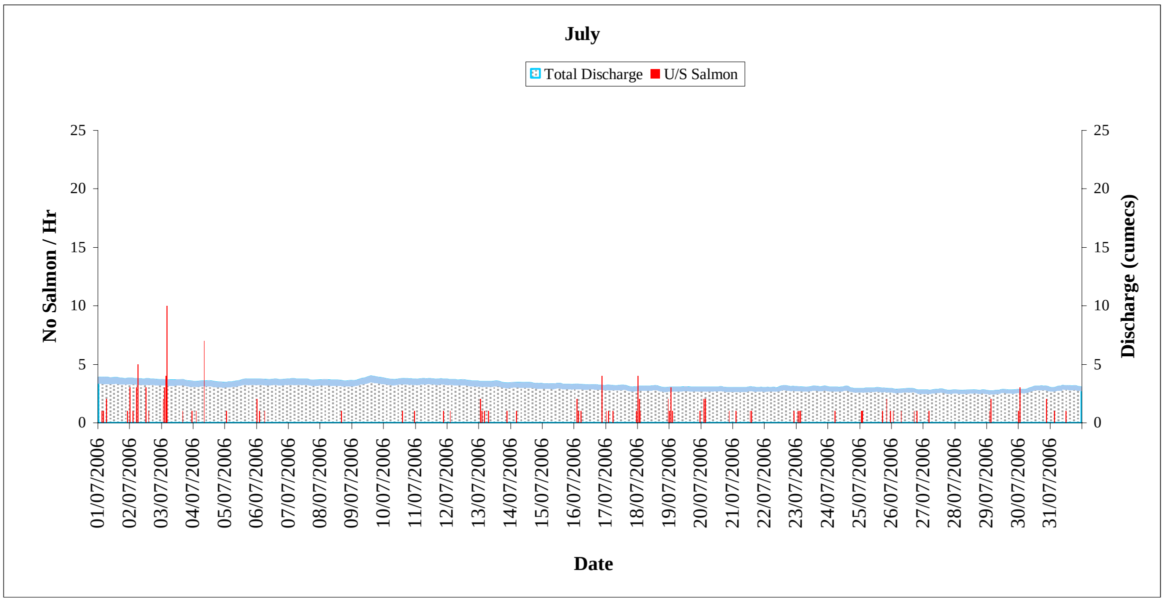

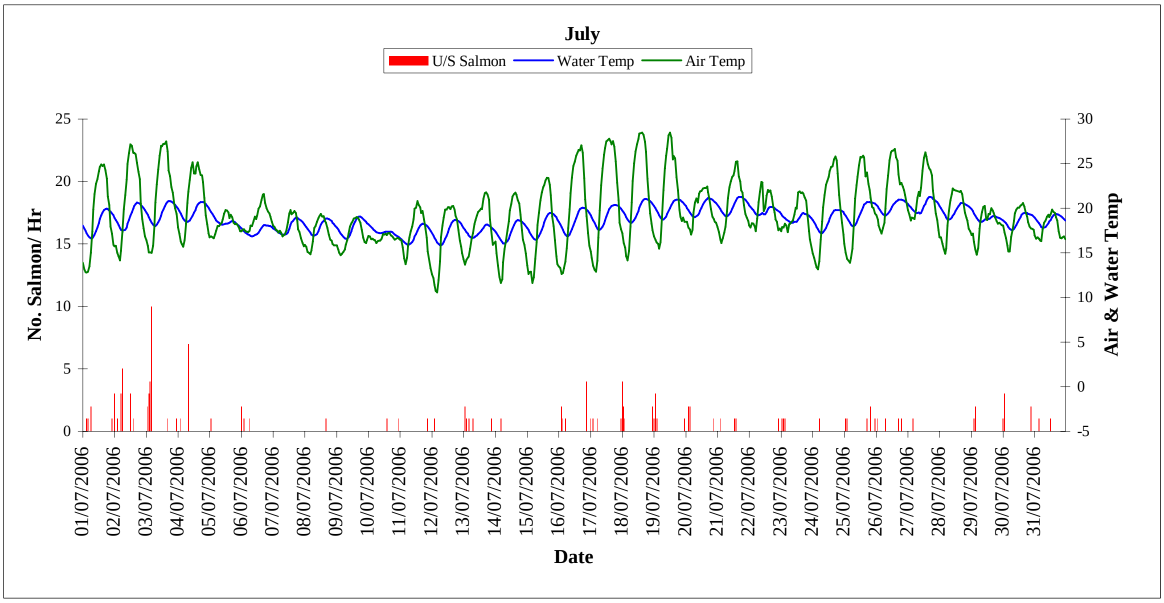

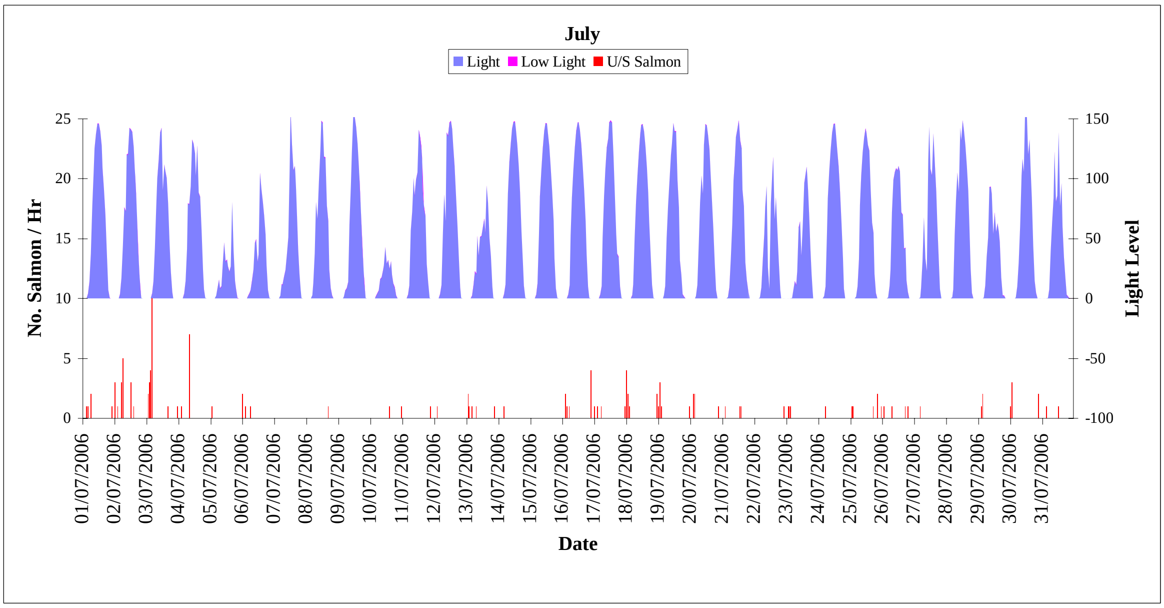

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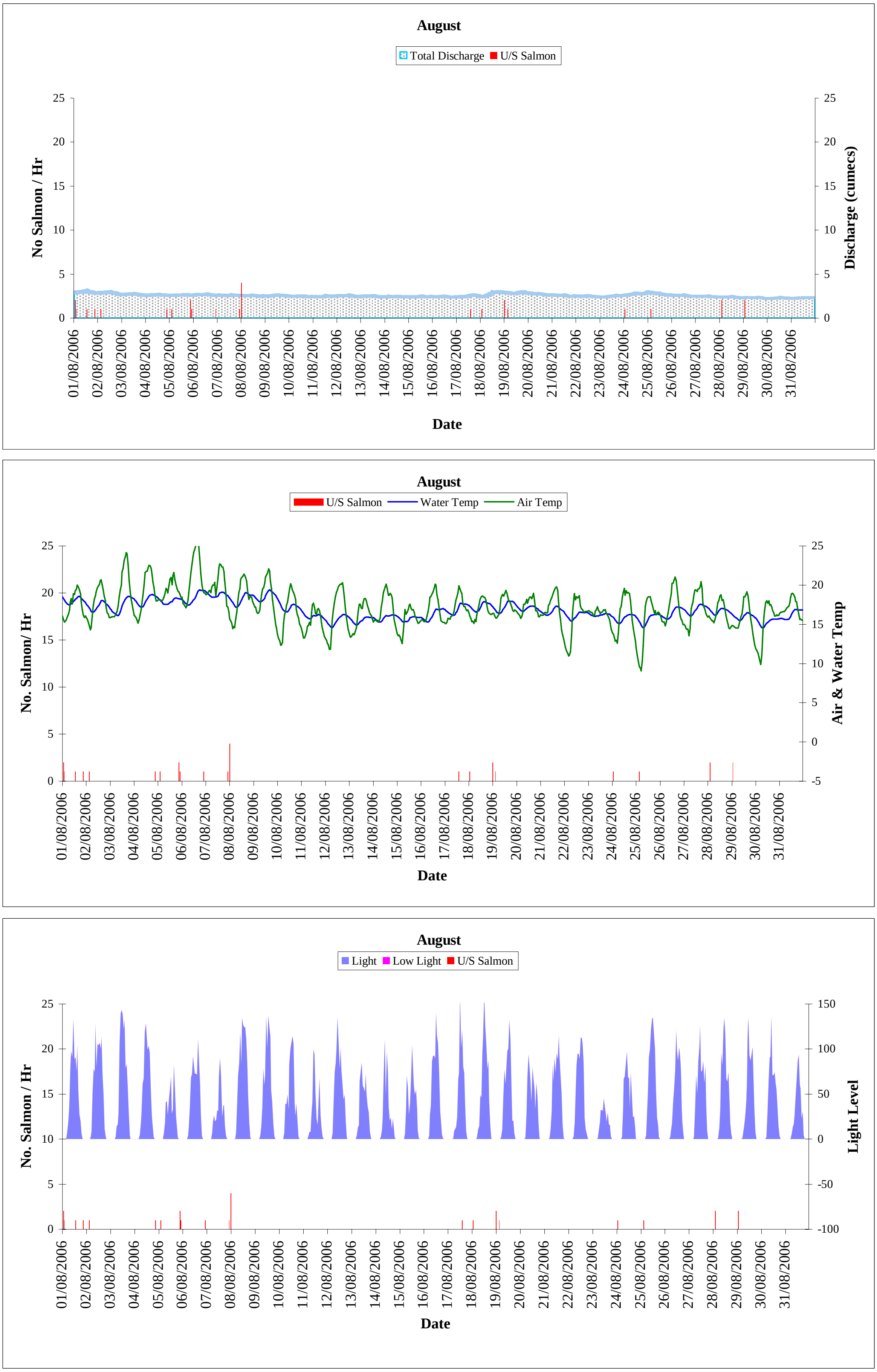

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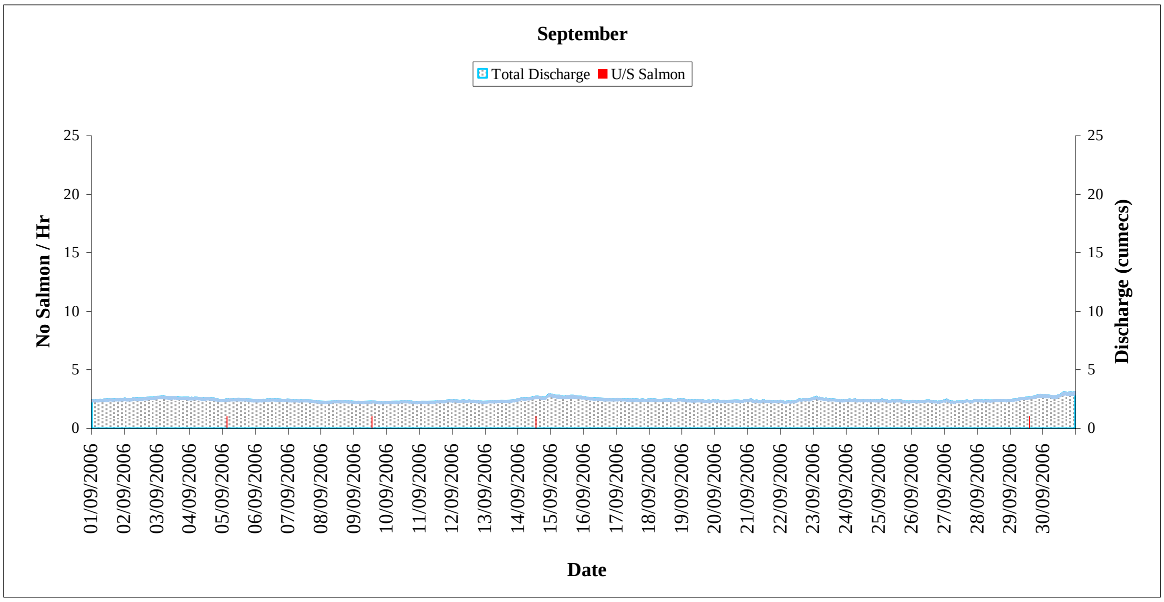

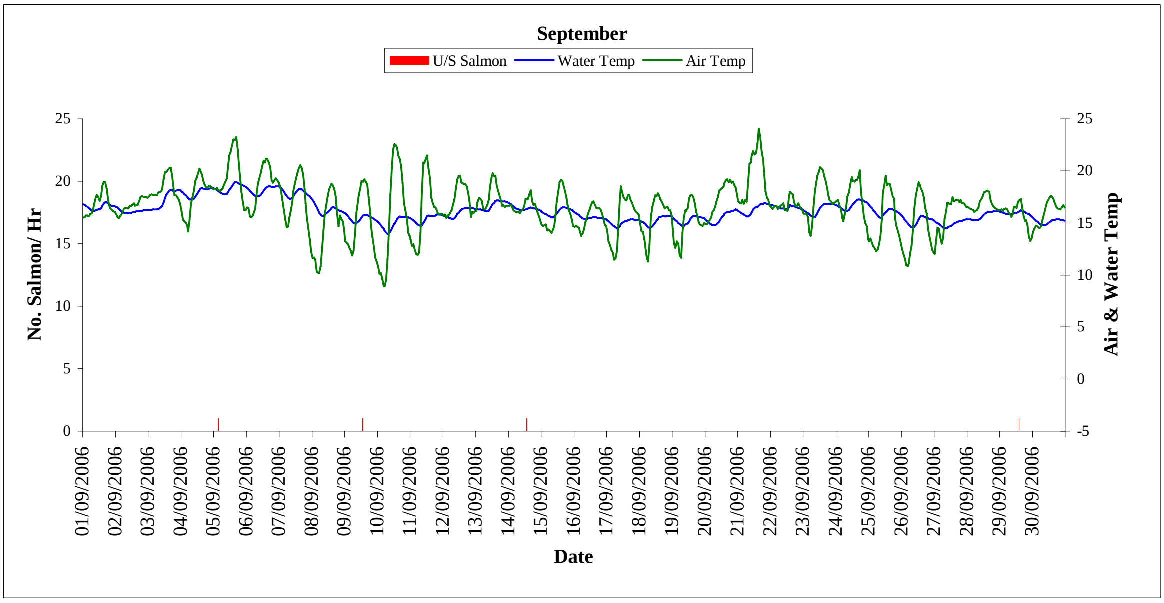

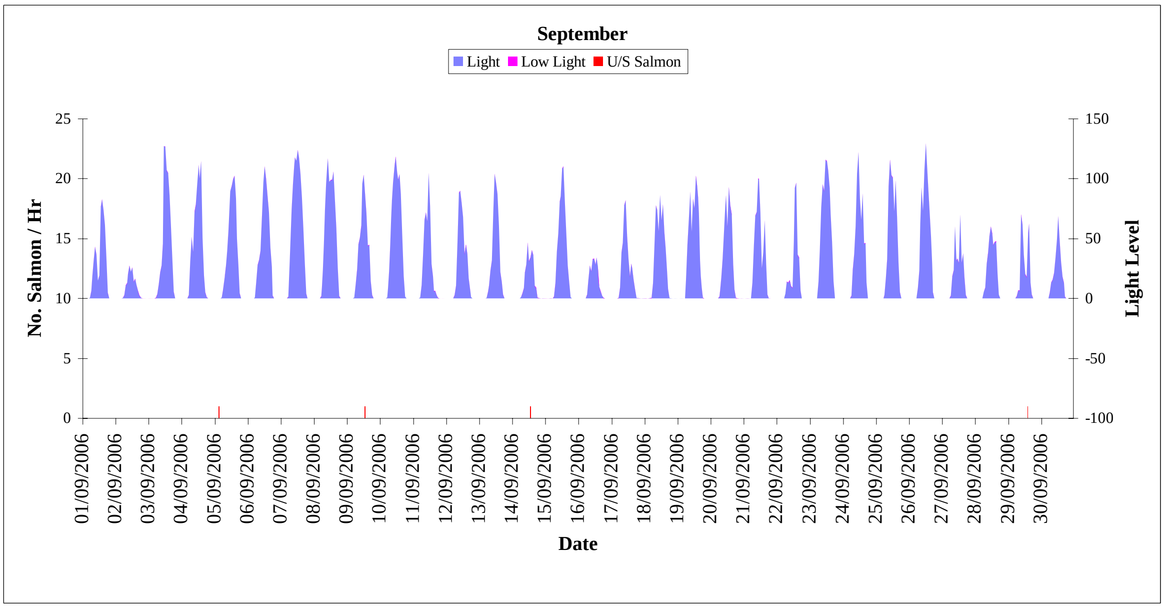

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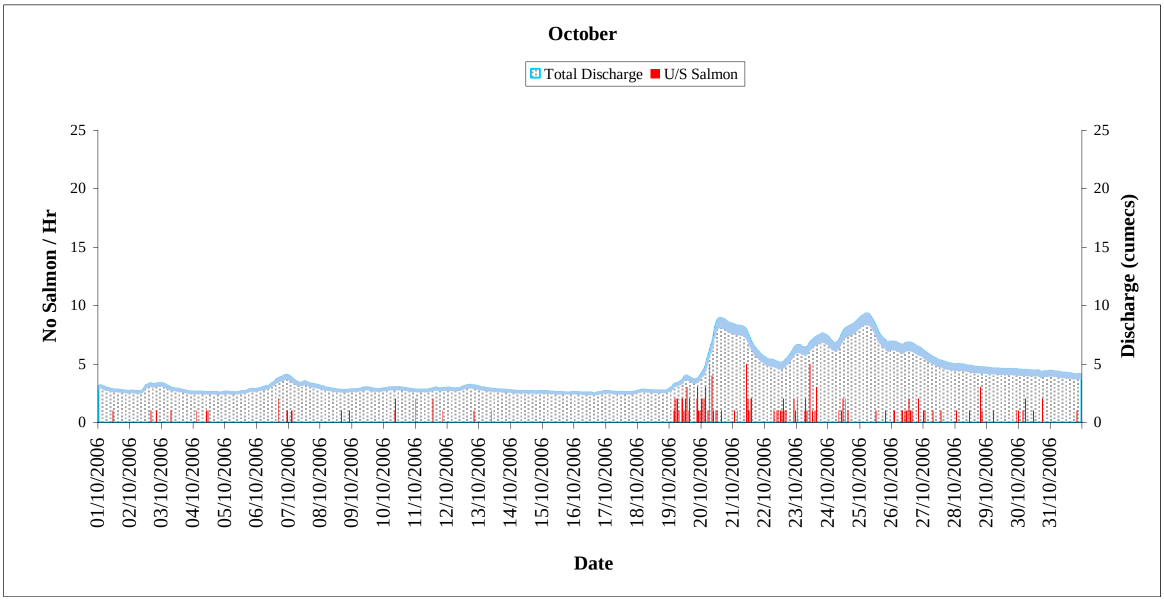

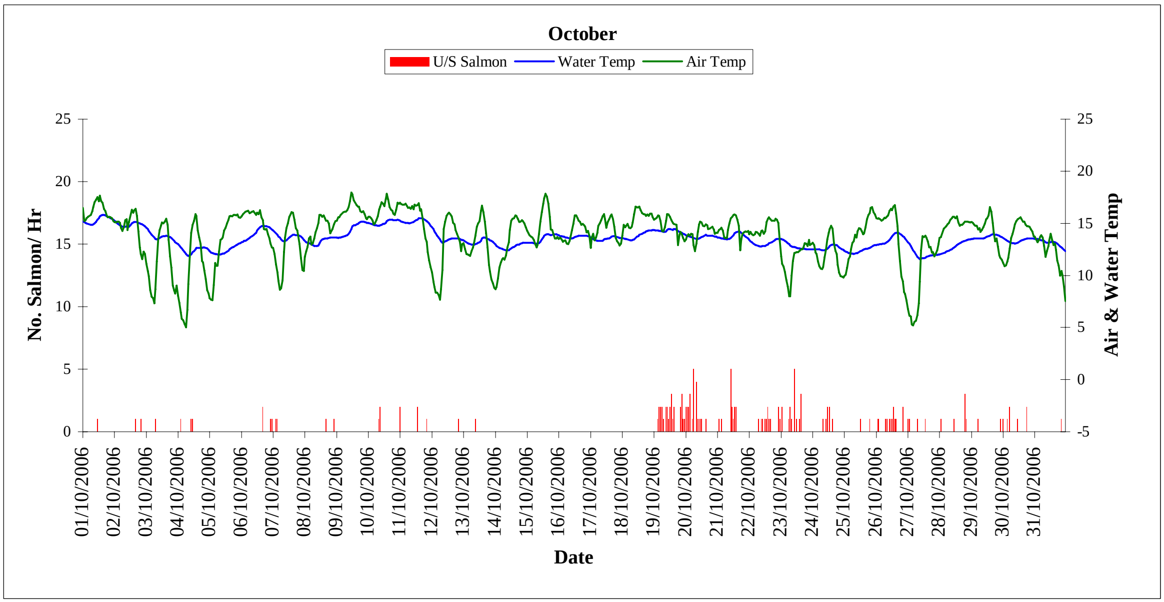

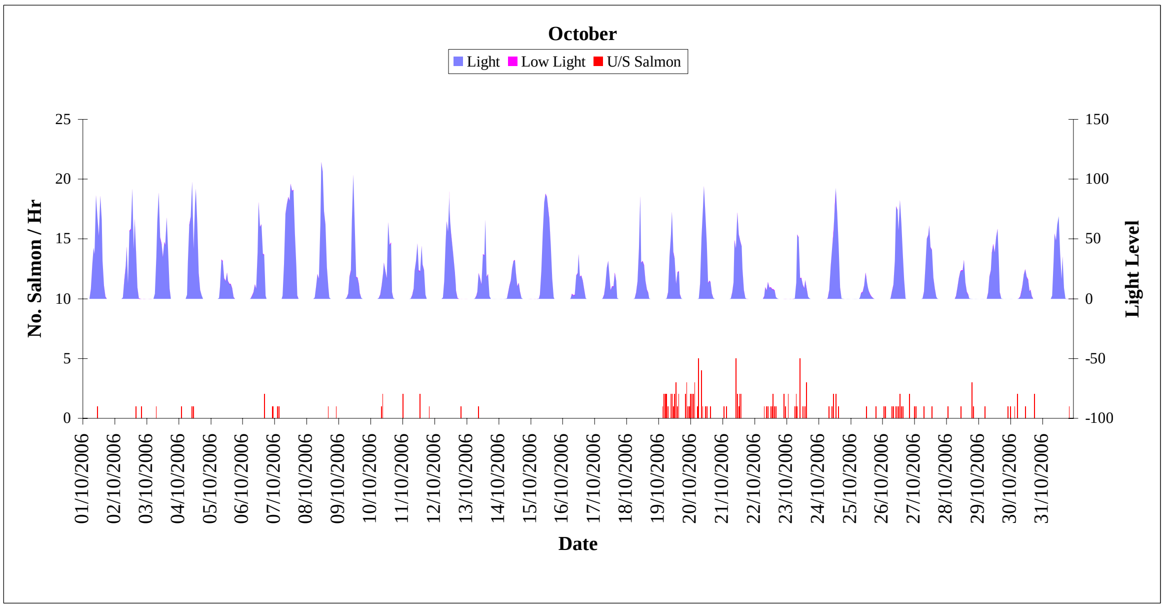

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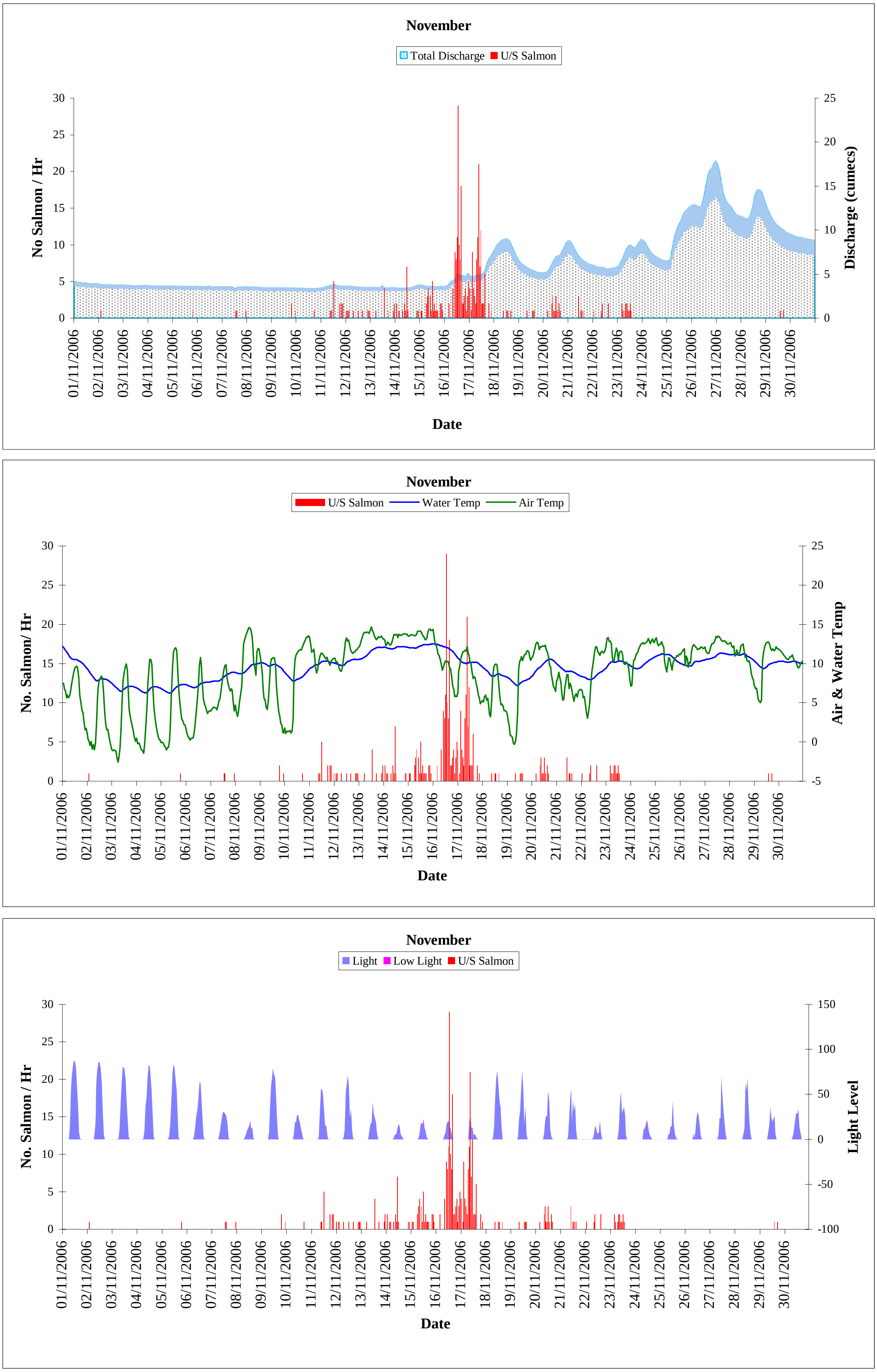

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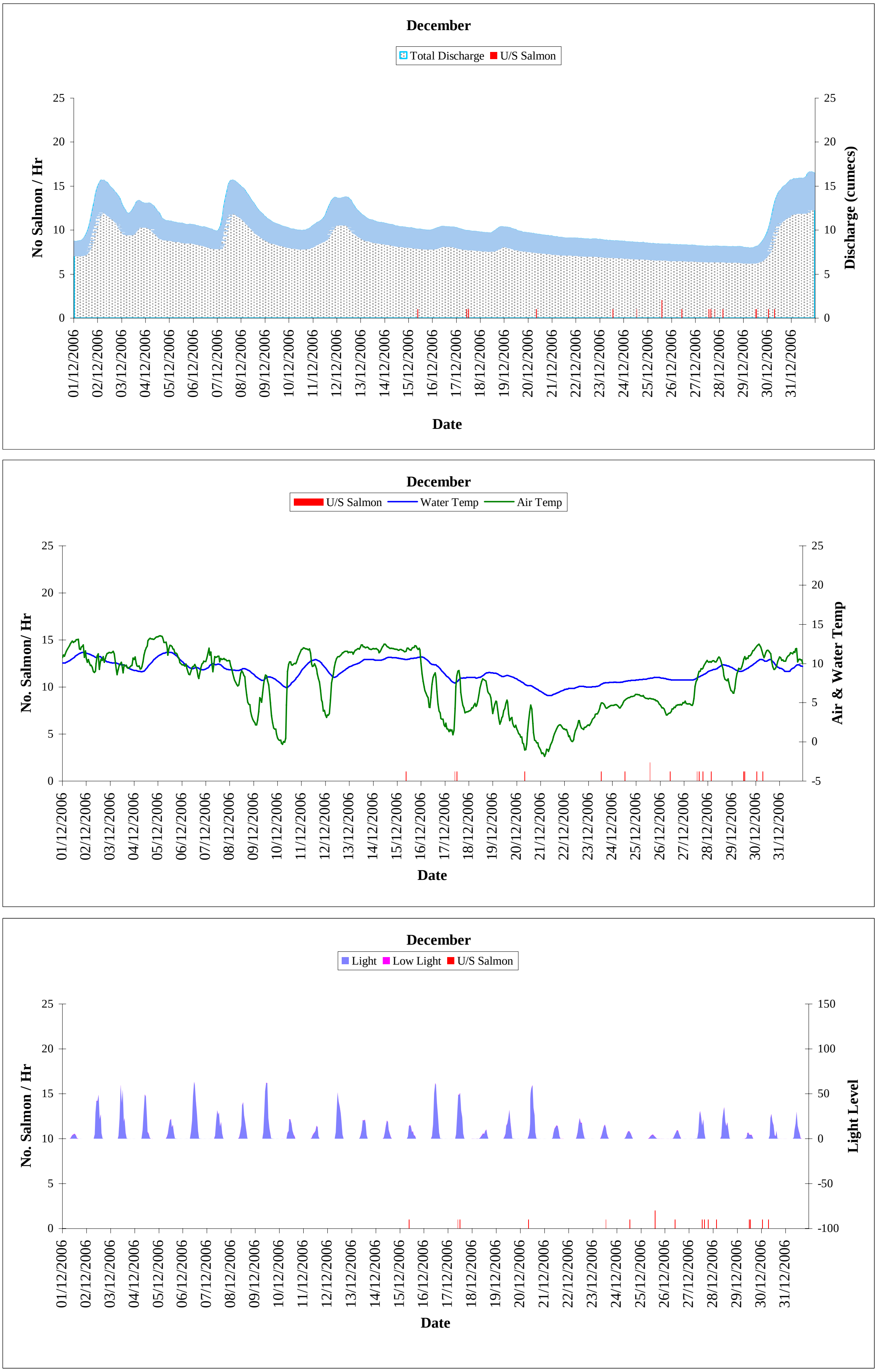

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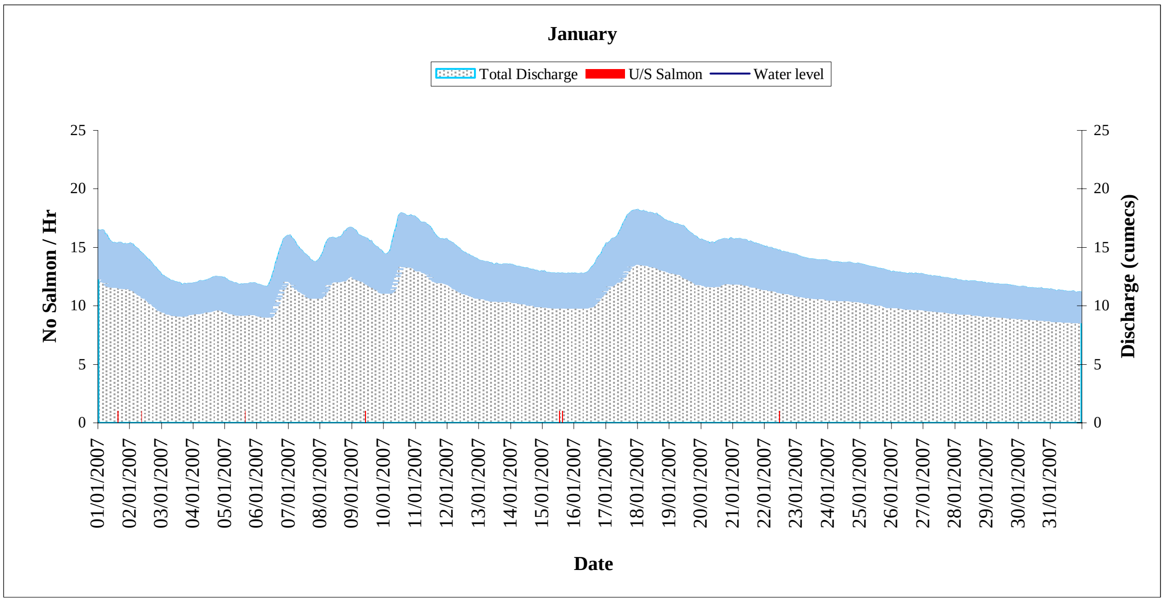

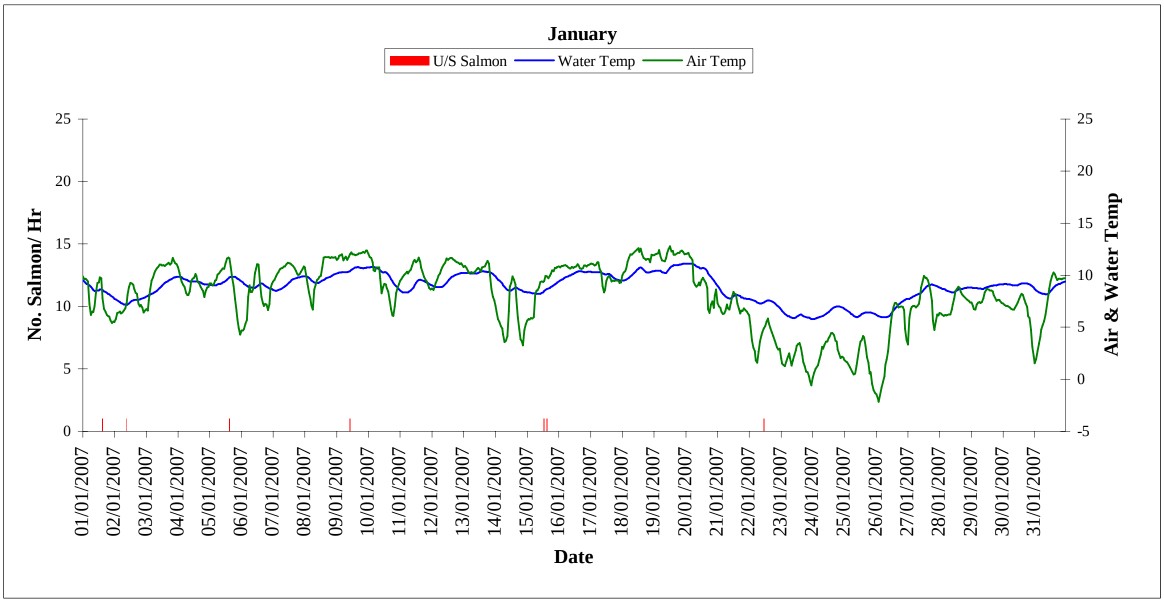

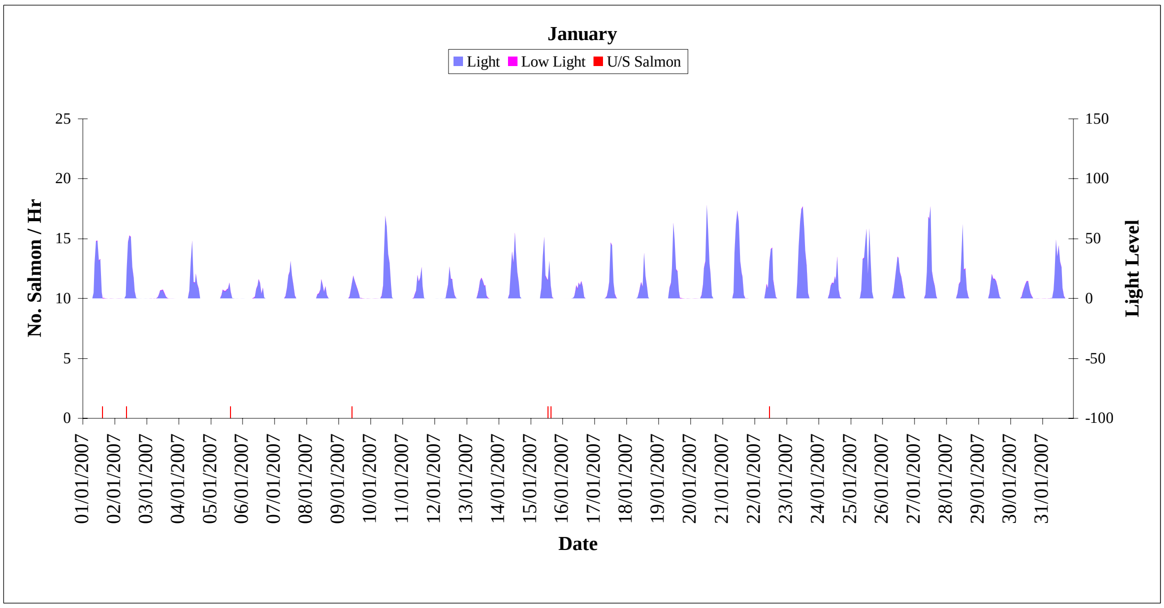

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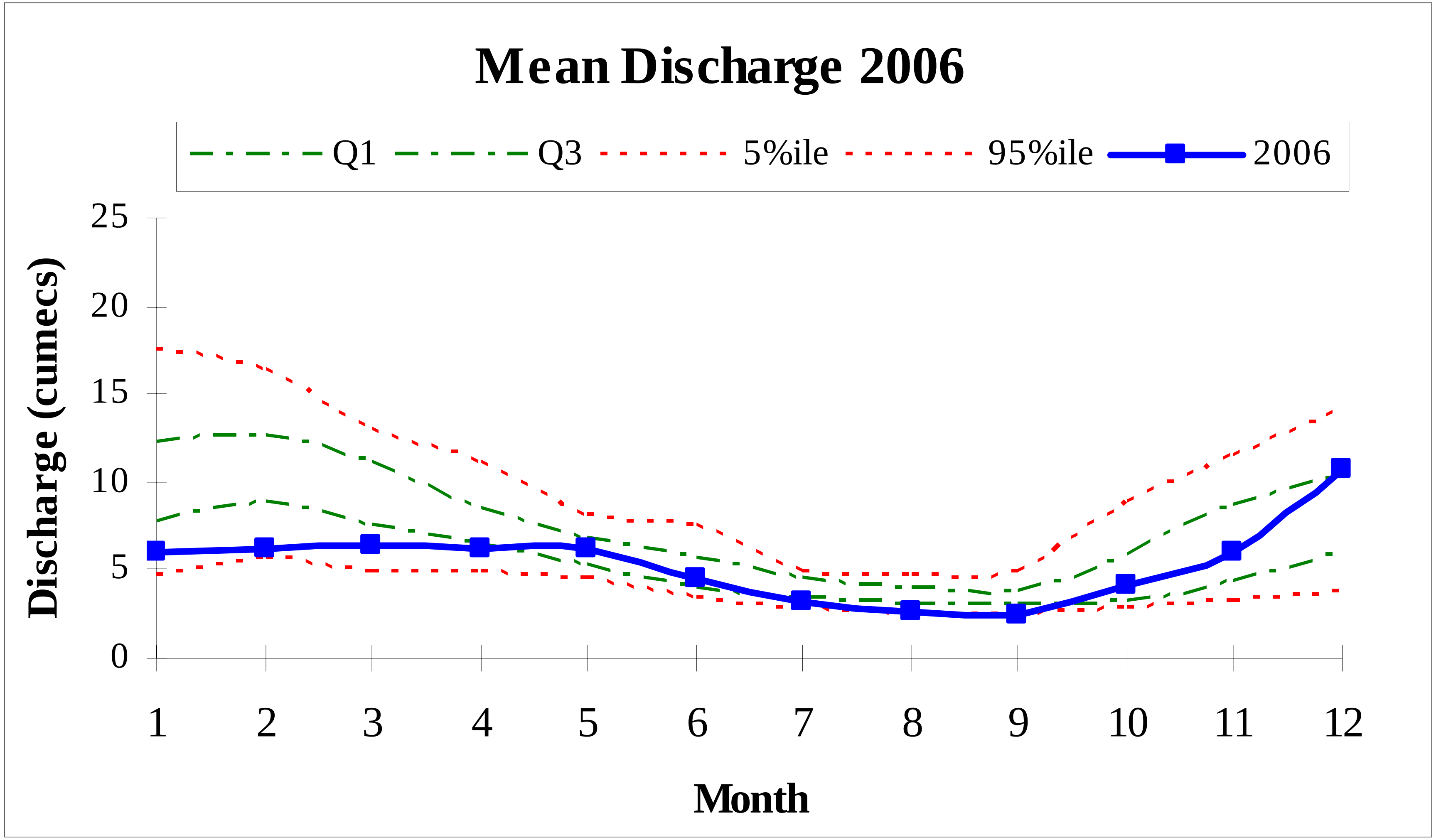

Figure 9: Monthly mean discharge and long-term percentile data

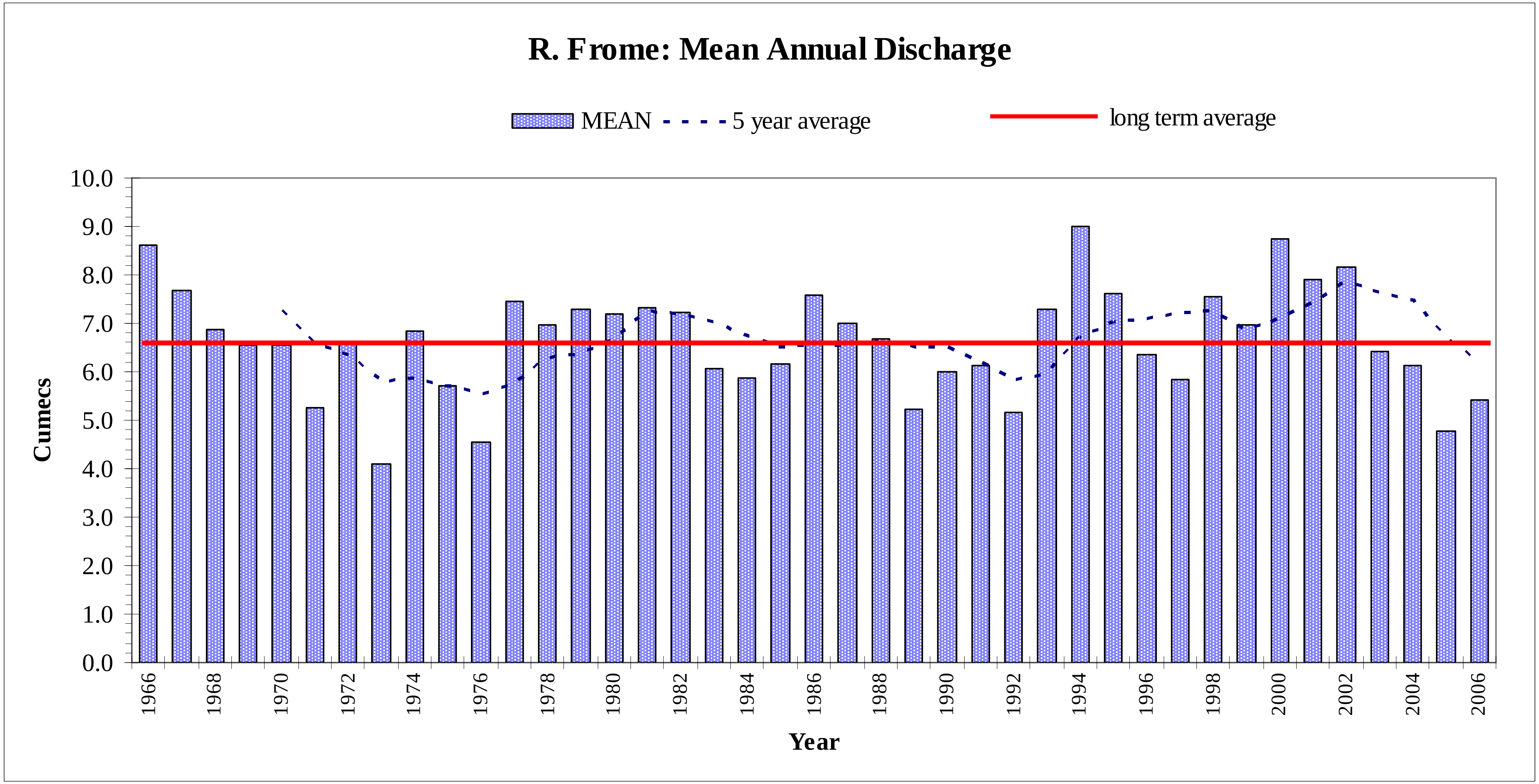

Figure 10: River Frome long-term annual discharge

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G **General access -** General access to anyone as required.