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The 2005 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 2005 are presented and a brief summary of the run and hydrological characteristics given.

2. INTRODUCTION

The data in this report represents the 33rd 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.

We are grateful to the Environment Agency, the NERC LOCAR Thematic programme, the Valentine Charitable Trust and the Frome Conservation Trust for support for the continuing running of the adult salmon counting facility.

Data are collected by a Scottish Hydro-Electric (formerly North of Scotland Hydro-electric Board (NSHEB)) Mk X 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 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 direct 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. This year 7 adult fish (PIT tagged as juveniles in previous years) were recorded ascending the weir and one of these was also subsequently also recorded migrating out to sea again (as a kelt). This year we tagged over 11,000 juvenile salmon (probably about 10-20% of the autumn population) and hope to get significantly more information from the project. We already know that there is a substantial migration of parr into the lower Frome in the Autumn and we can now record the origin of these fish and, in subsequent years, look 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

We have also continued 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 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. Part funding for this initiative by the Valentine Charitable Trust and the help of Watergates Fish Farm is gratefully acknowledged as is the kind permission of the river owners for access to the river over the Christmas period. The Environment Agency has also been installing a fish pass into the tributary to help passage upstream past some hatches.

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. 2005 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.

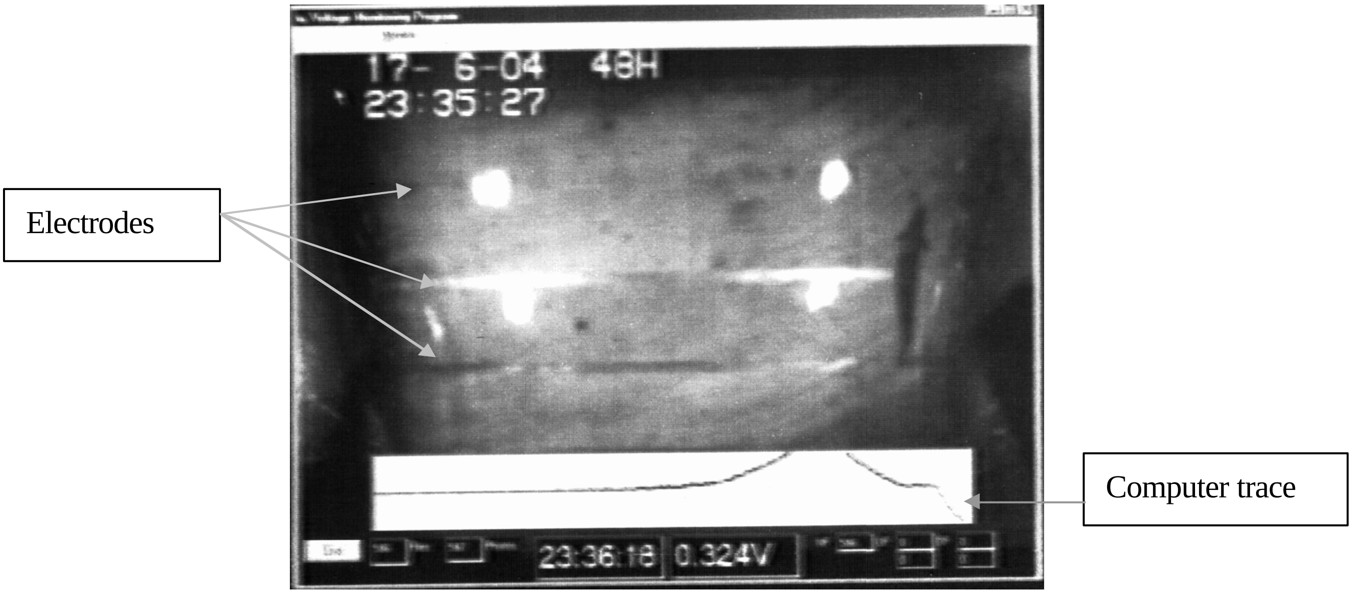


Figure 3a Screen display from the computerised counting and evaluation system. The image shows a 75 cm salmon ascending the weir

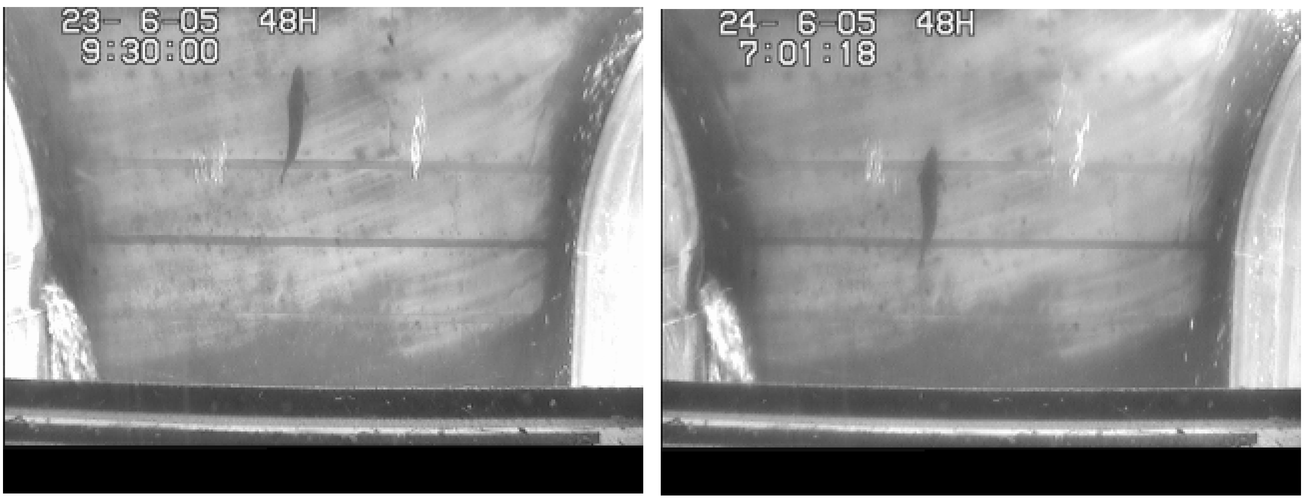


Figure 3b Computer frame grabs from the computerised counting & evaluation system

Verification of the data entailed verifying 1168 upstream and 366 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 (for 2005/06 data this situation occurred for 35 hours). 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 2005 a total of 204 days had usable video data and for 163 days video verification was not available (due to turbid water etc). Overall accuracy of the computer records was 73% but this included one period of low efficiency due to electrical interference affecting the computer. With that data excluded efficiency was 83%. Data presented are not however corrected for verification error.

This year 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 (161 up-counts and 207 down-counts) these fish 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 normally 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 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 655
Nett total for the year was 532

Figure 5 shows that the total nett upstream count for the year was the lowest since nett number were recorded in 1985. The number is close to the average value (672) since the very low run period began in 1999. Gross numbers are estimated at 655, which is the lowest figure since records began in 1973 and well below the post 1999 average of 828. Figure 6 shows a comparison of the nett numbers of fish migrating over the weir for each month, the data is stratified into three categories, 1985-1990 representing the start of the recording of nett numbers and before the 1991 crash in numbers, the years 1991 to 2004 and the current year (2004). The figure shows that the run over the year was low for all months until December when the run exceeded the 91-04 average.

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 270 fish were measured this year (Figure 8) and a few very large fish were in May, with the largest fish being 104 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 are also shown from a high sensitivity light meter (Low Light). This "low light" level data is designed to show bright nights to see if night-time illumination level affects the run pattern. The low light data are plotted as minus values in order to differentiate them from the "normal" light meter readings. Graphs of this data clearly show the clarity of detail available with the hourly time-base. A considerable amount of data was lost this year as a result of a laptop computer being stolen. Some water temperature data has been added that was collected by the LOCAR project but air and light readings are not replicated by that network. Data on water depth has also been added from the LOCAR dataset.

Figure 10 shows mean monthly discharge data (in cubic metres per second (cumecs)) for 2005 together with mean (1966-2004) 5, 25, 75 and 95 percentile discharge data. This data is collated and calculated from Environment Agency records. The river discharge remained below either the lower interquartile (25%) or 5%ile range until October when it rose to stay within the interquartile for November and December. Figure 11 shows the mean annual discharge data for the Frome (together with the 5-year and long-term average) for 1966 to 2004 and shows the three successive years of low discharge we have had on the Frome.

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-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Total
Gross U/S	18	33	4	53	82	78	34	5	224	42	67	15	655
Gross D/S	4	28	1	19	7	5	23	2	26	2	10	4	131
Nett U/S	18	5	3	34	75	73	11	3	198	40	57	15	532

= many u/s kelts

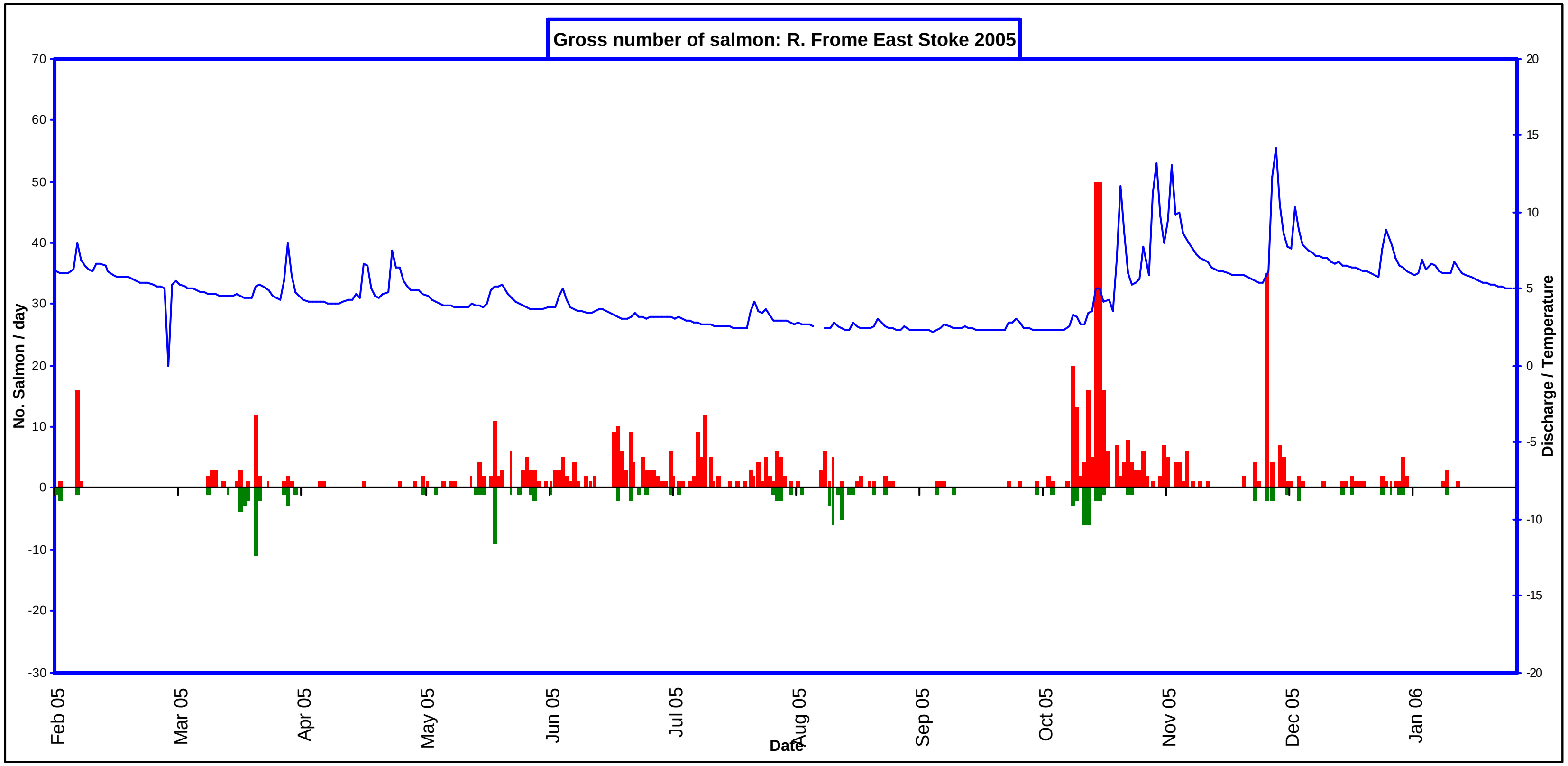
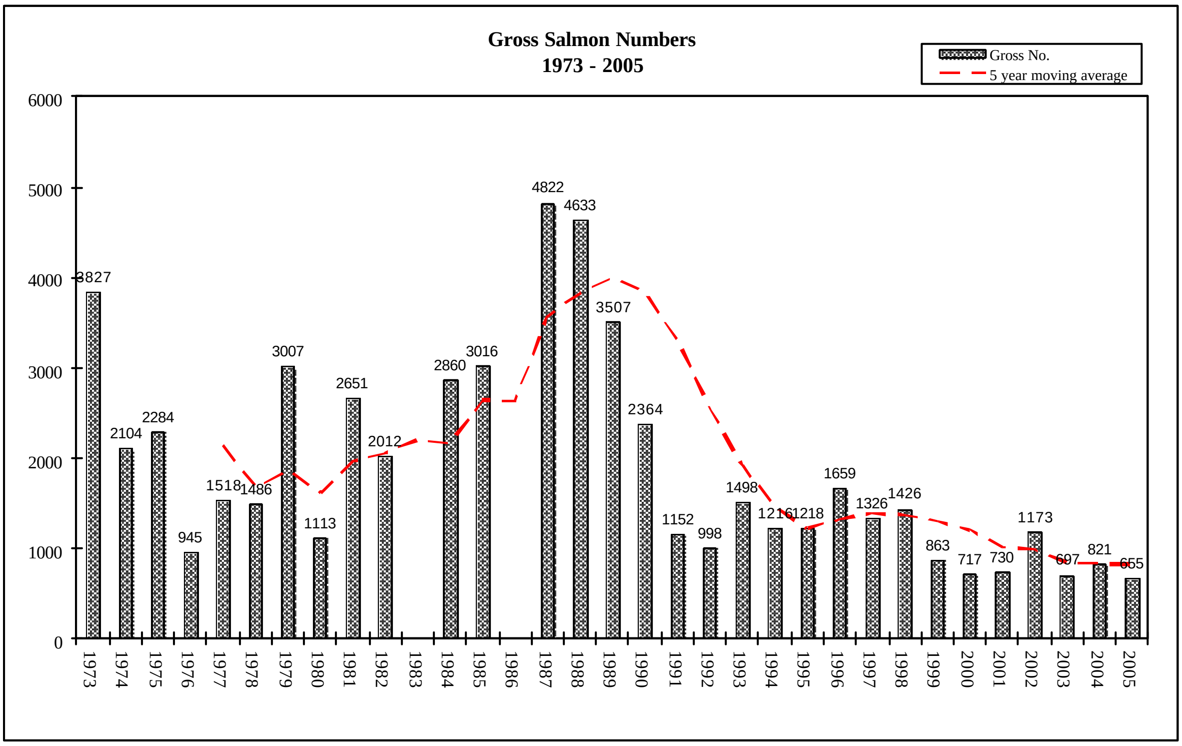


Figure 4 Centre for Ecology and Hydrology: East Stoke Salmon Counter Data 2005



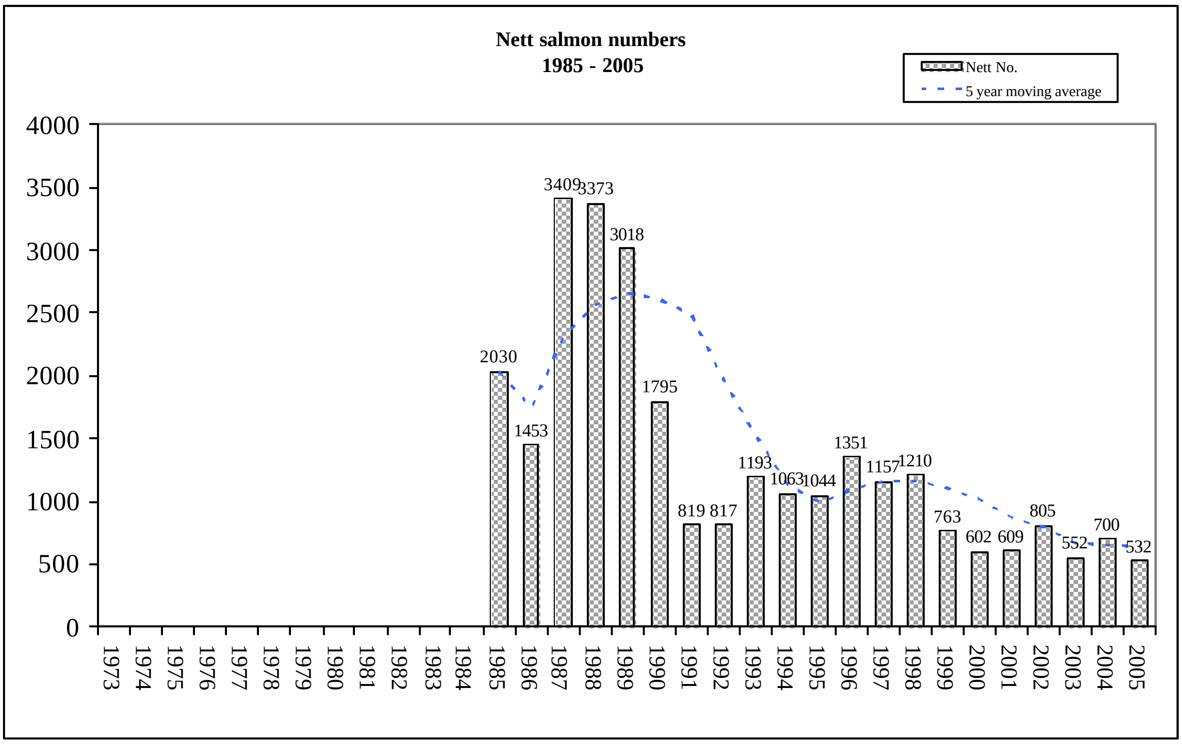


Figure 5: Gross and Nett numbers of salmon ascending the East Stoke weir

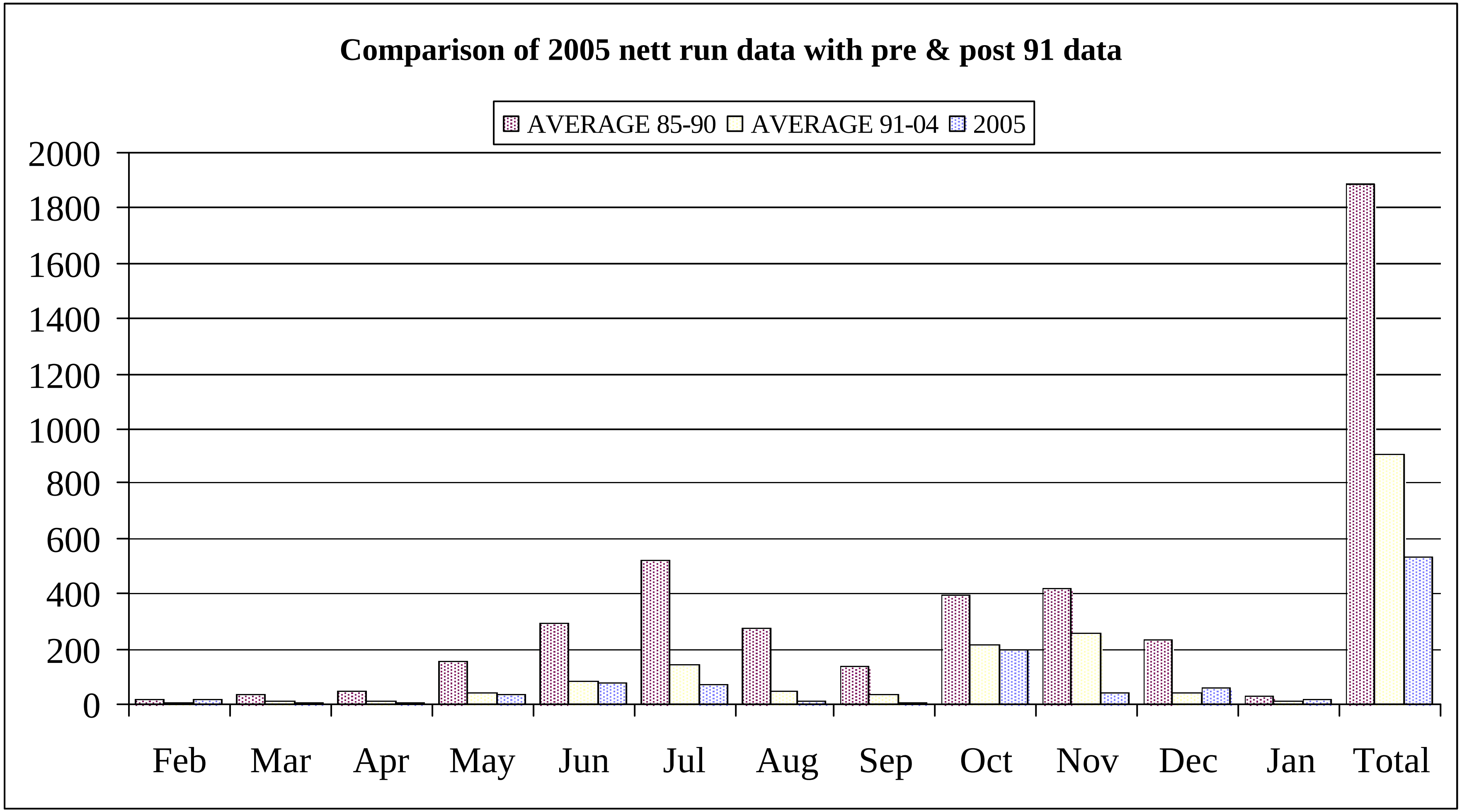

Comparison of 2005 nett run data with pre & post 91 data
AVERAGE 85-90
AVERAGE 91-04
2005
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Total

Figure 6

Time of day of fish movement (Gross counts)

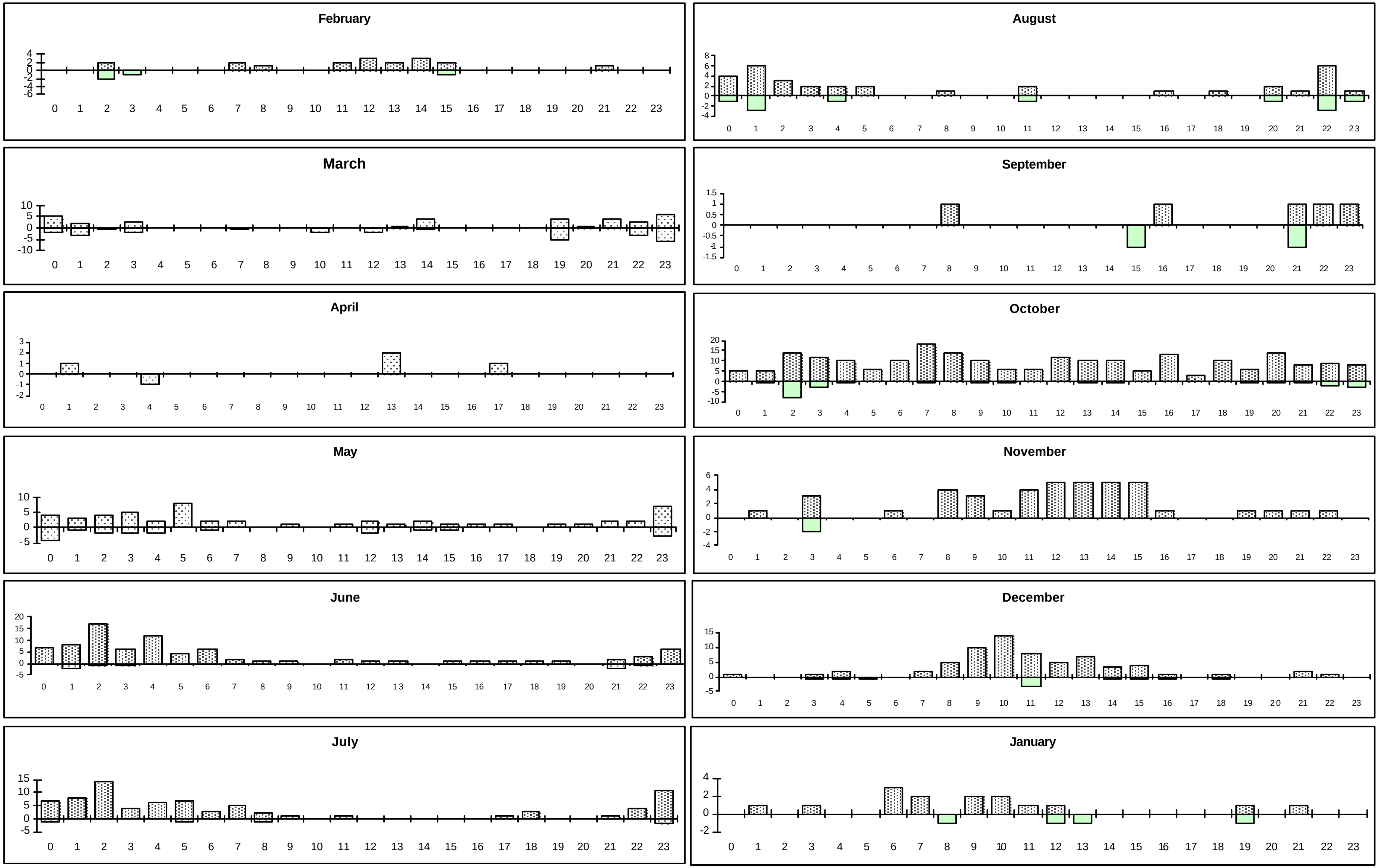


Figure 7

Observed Salmon Lengths 2005

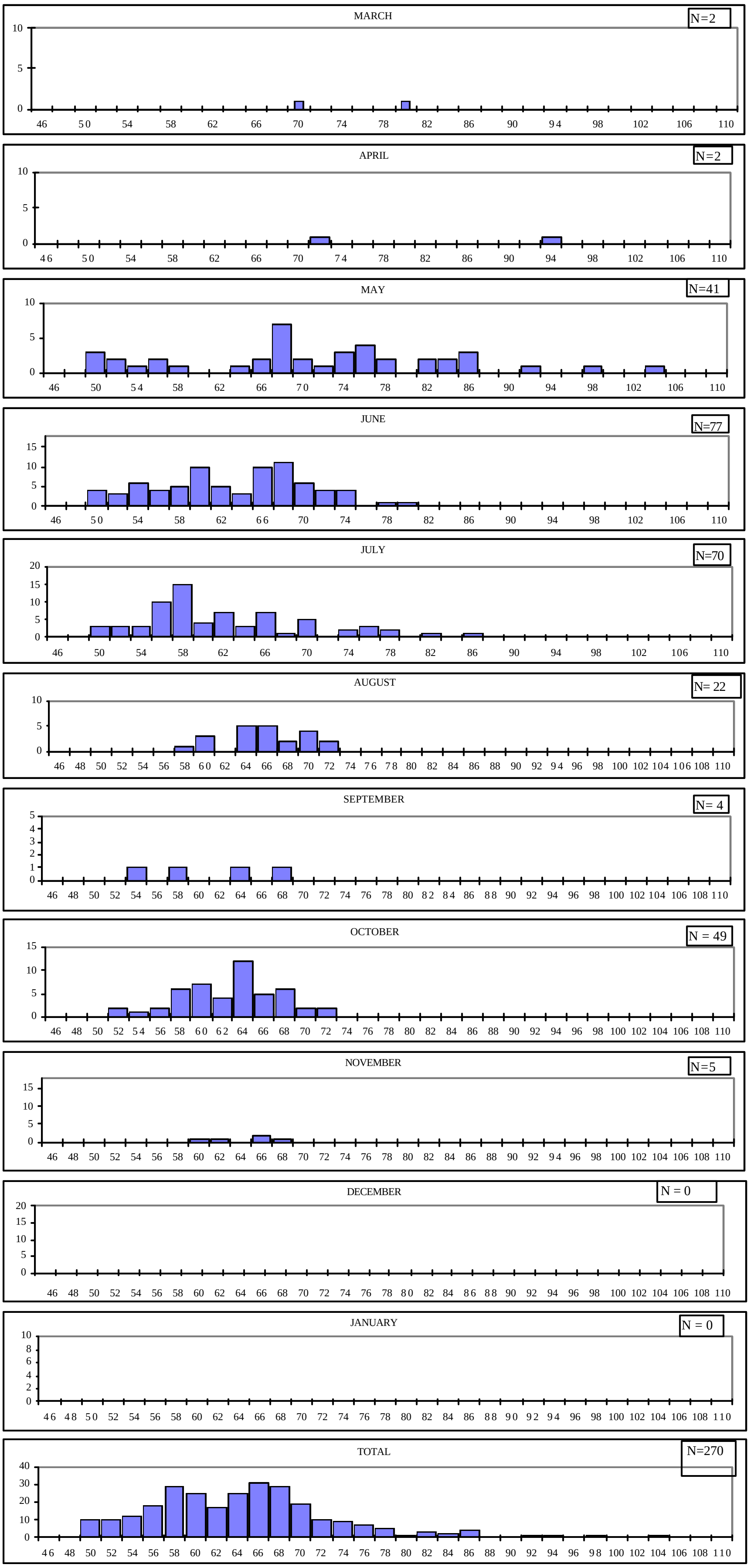
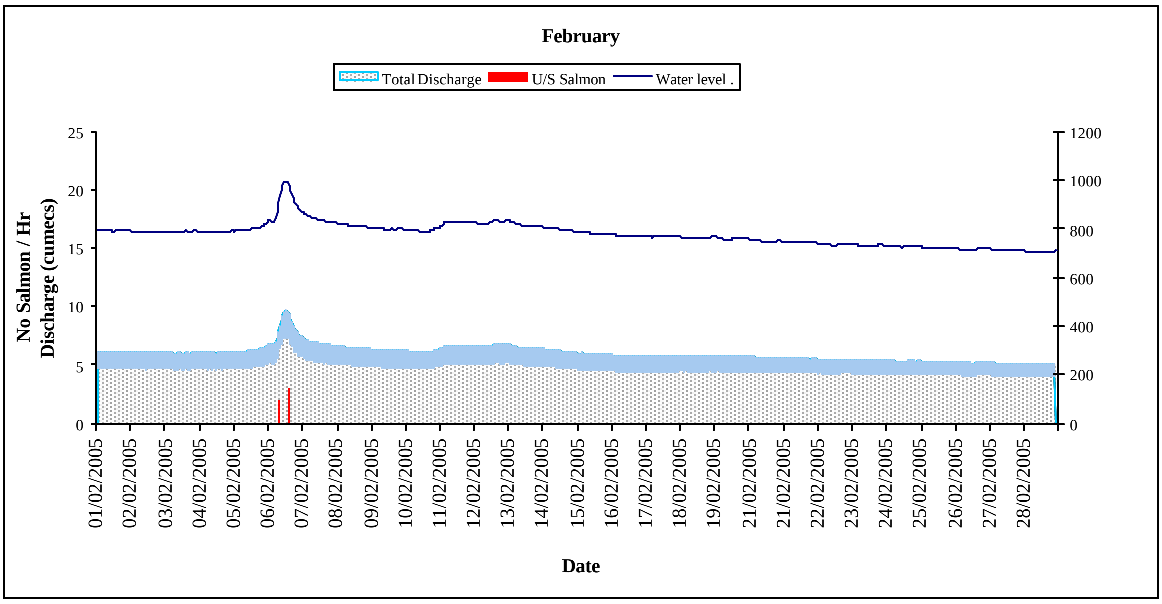
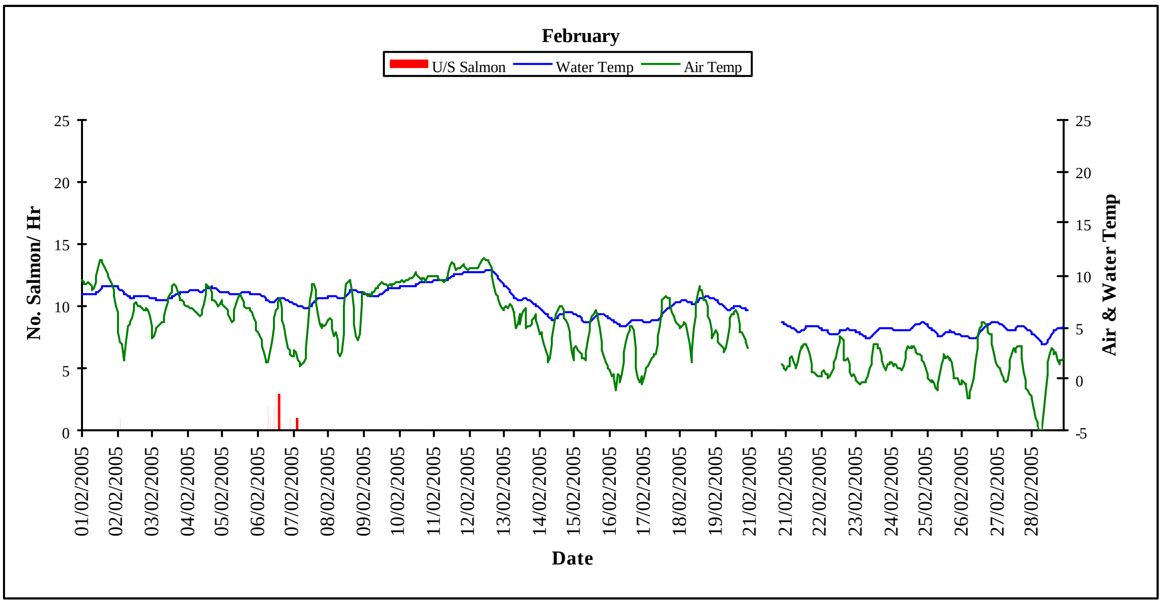


Figure 8


February
Total Discharge
U/S Salmon
Water level .
No Salmon / Hr
Discharge (cumecs)
Date


February
U/S Salmon
Water Temp
Air Temp
No. Salmon/ Hr
Air & Water Temp
Date

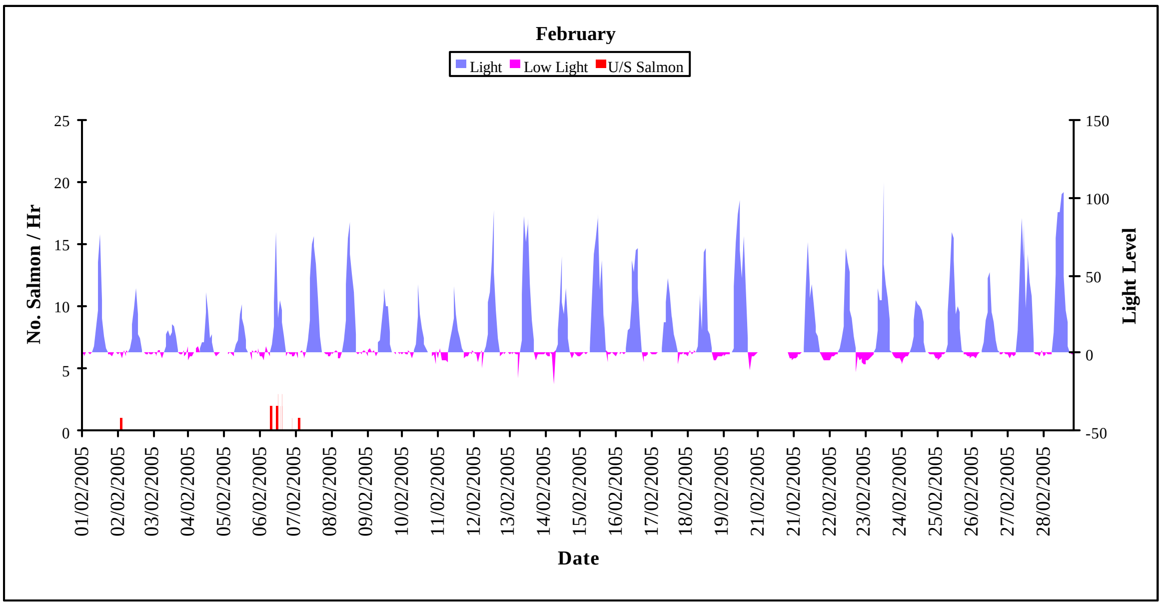
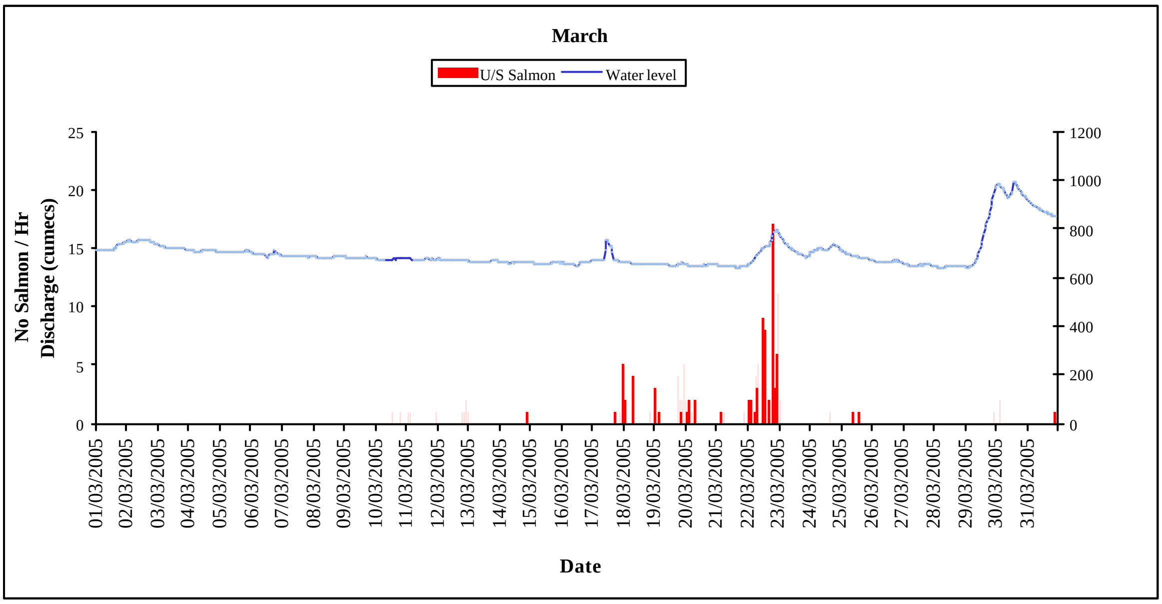
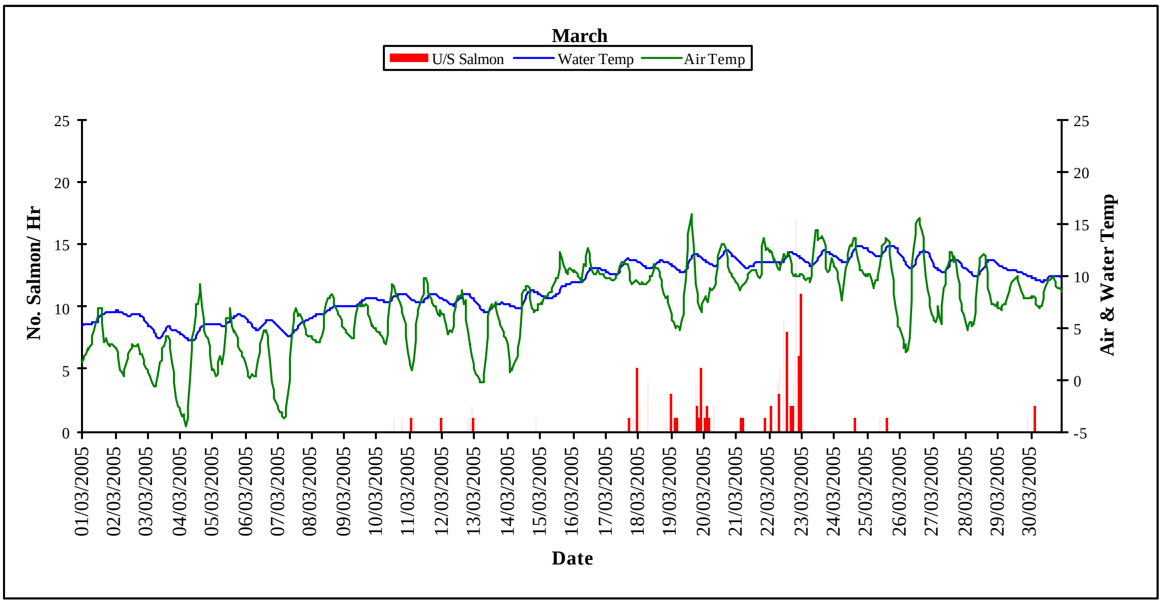

February
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Date

Figure 9


March
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Date


March
U/S Salmon
Water Temp
Air Temp
No. Salmon/ Hr
Air & Water Temp
Date

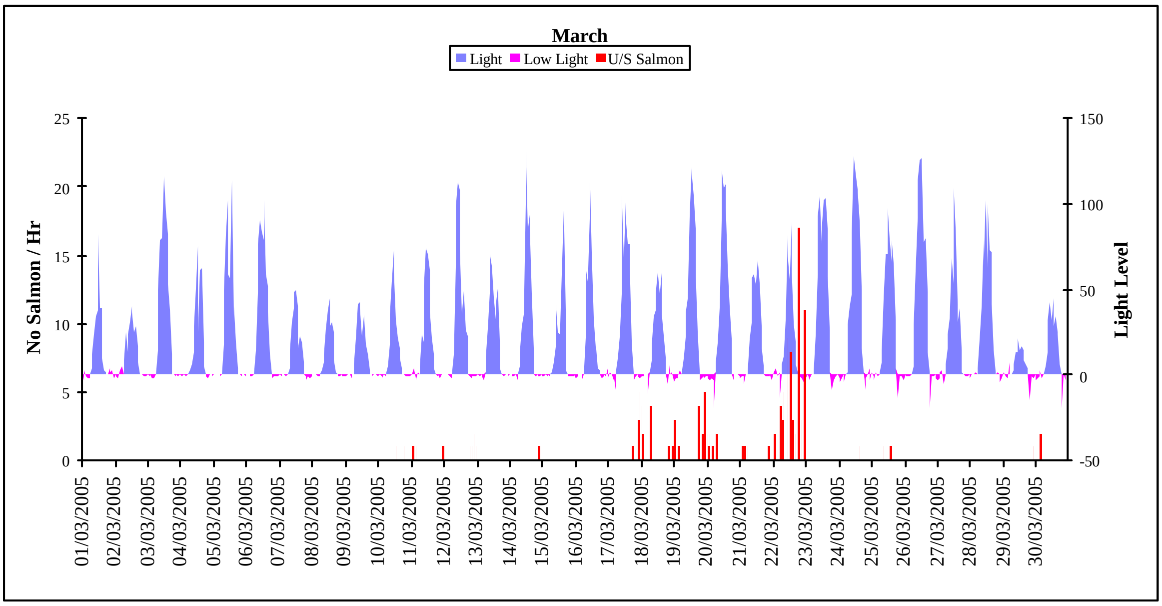
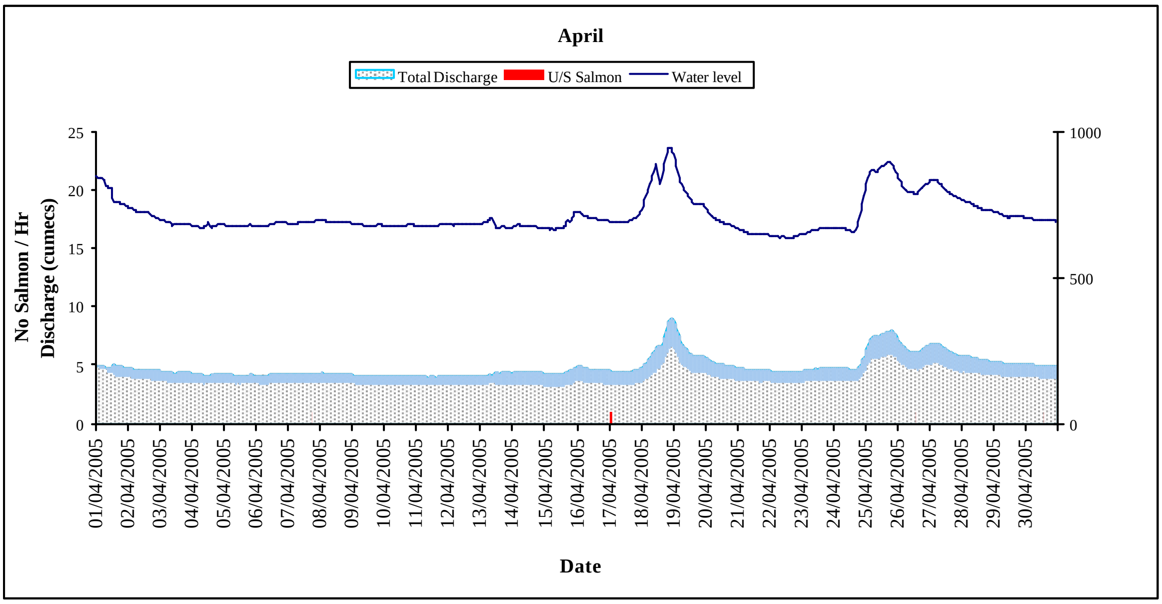
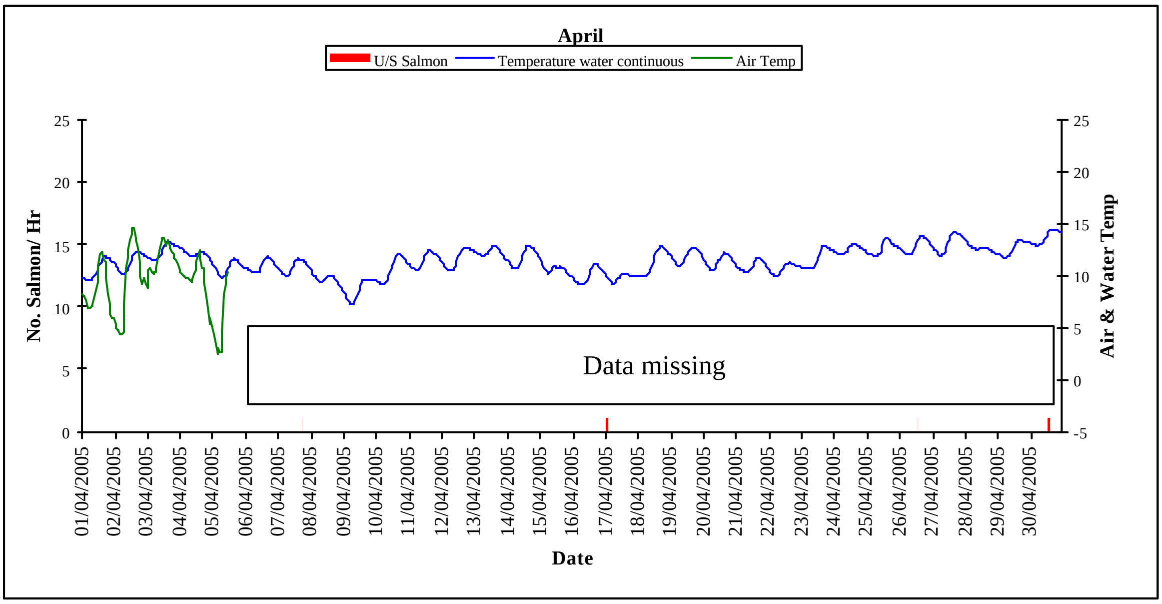

March
Light
Low Light
U/S Salmon
No Salmon / Hr
Light Level

Figure 9


April
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Date


April
U/S Salmon
Temperature water continuous
Air Temp
No. Salmon/ Hr
Air & Water Temp
Data missing
Date

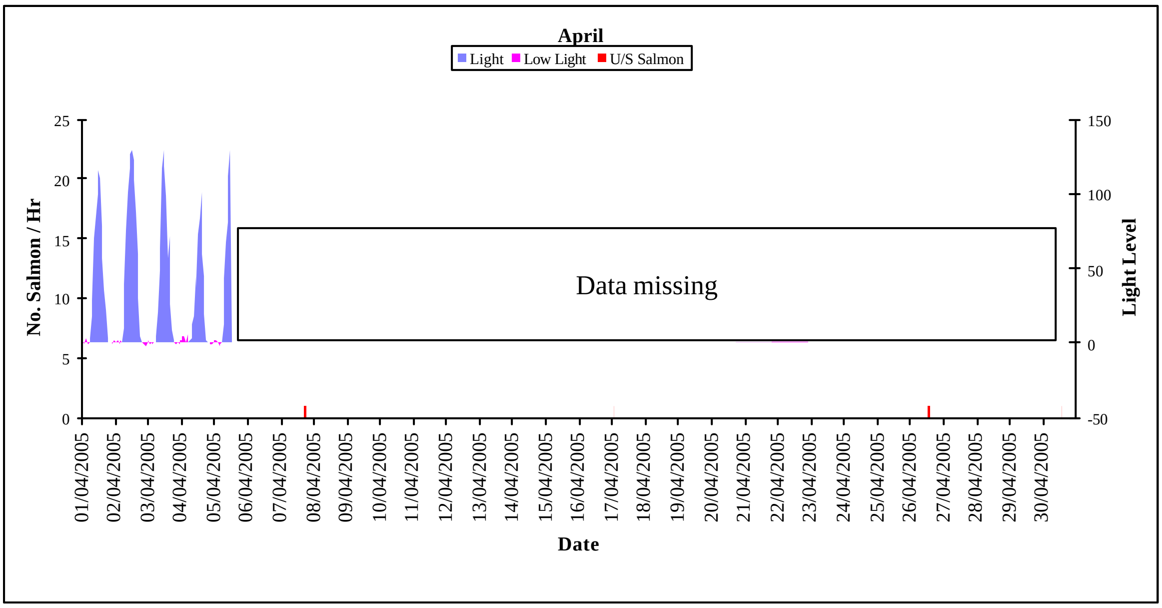
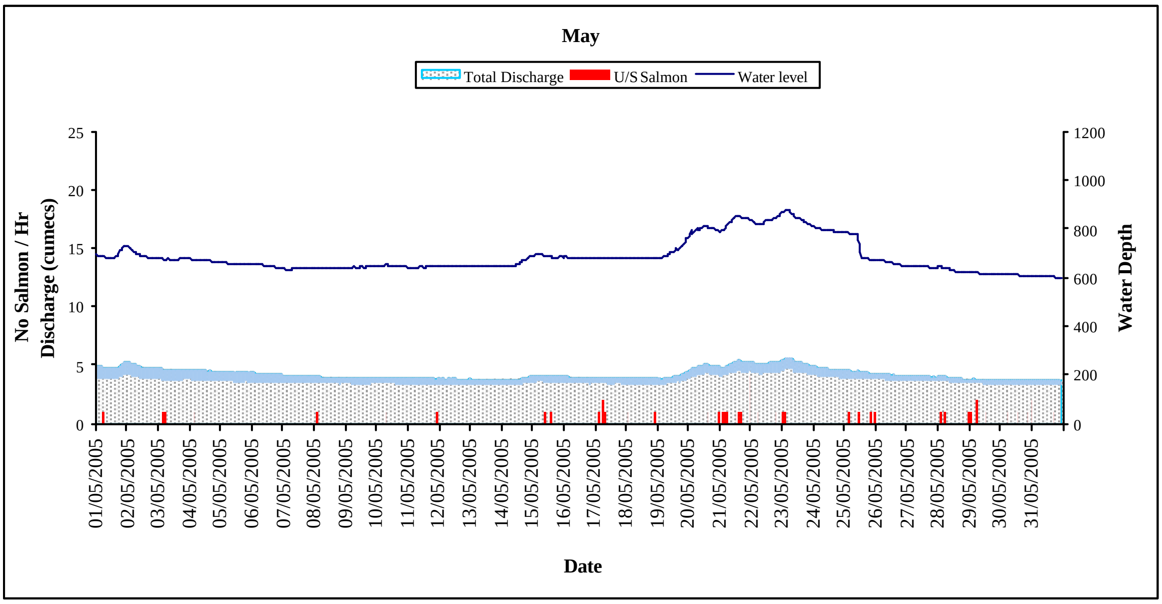
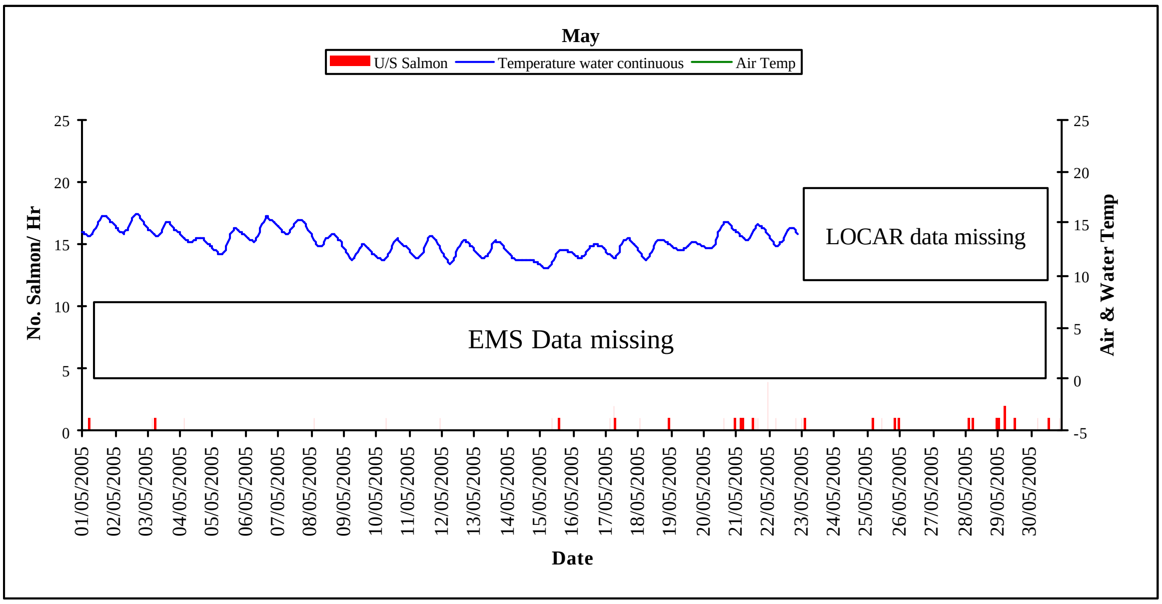

April
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Data missing
Date

Figure 9


May
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date


May
U/S Salmon
Temperature water continuous
Air Temp
No. Salmon/ Hr
Air & Water Temp
LOCAR data missing
EMS Data missing
Date

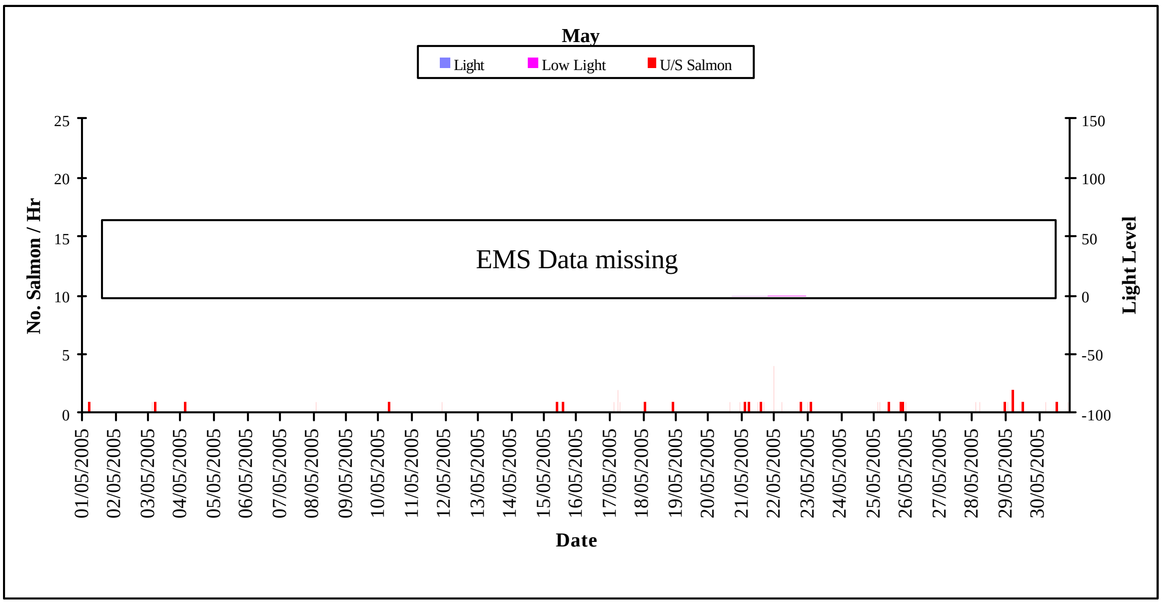
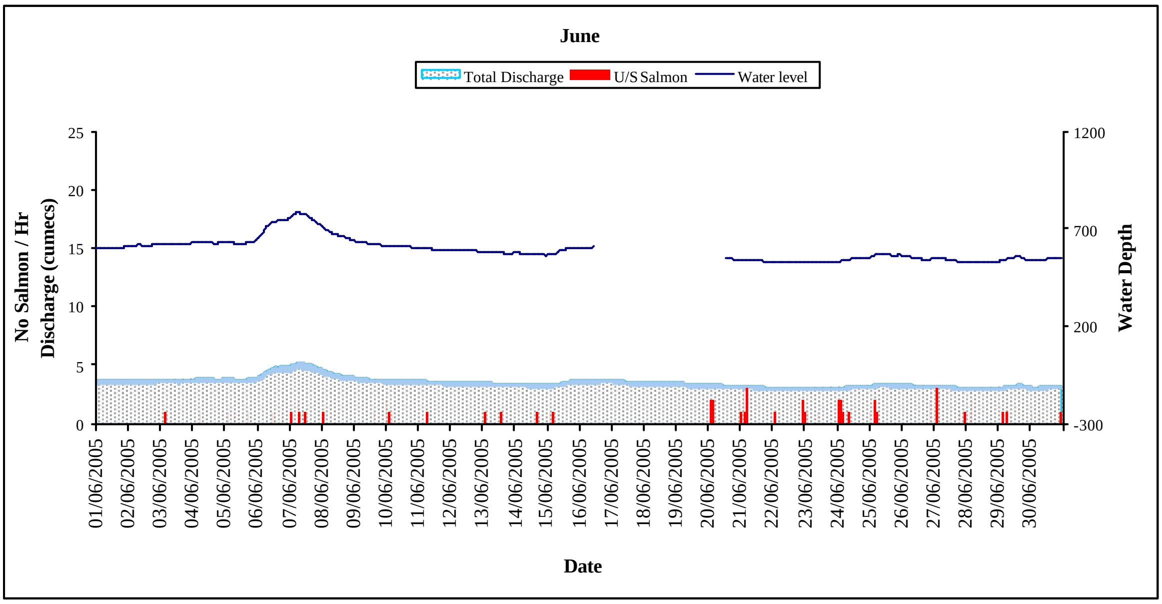

May
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
EMS Data missing
Date

Figure 9


June
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date


June
U/S Salmon
Temperature water continuous
Air Temp
No. Salmon/ Hr
Air & Water Temp
Data missing
Date

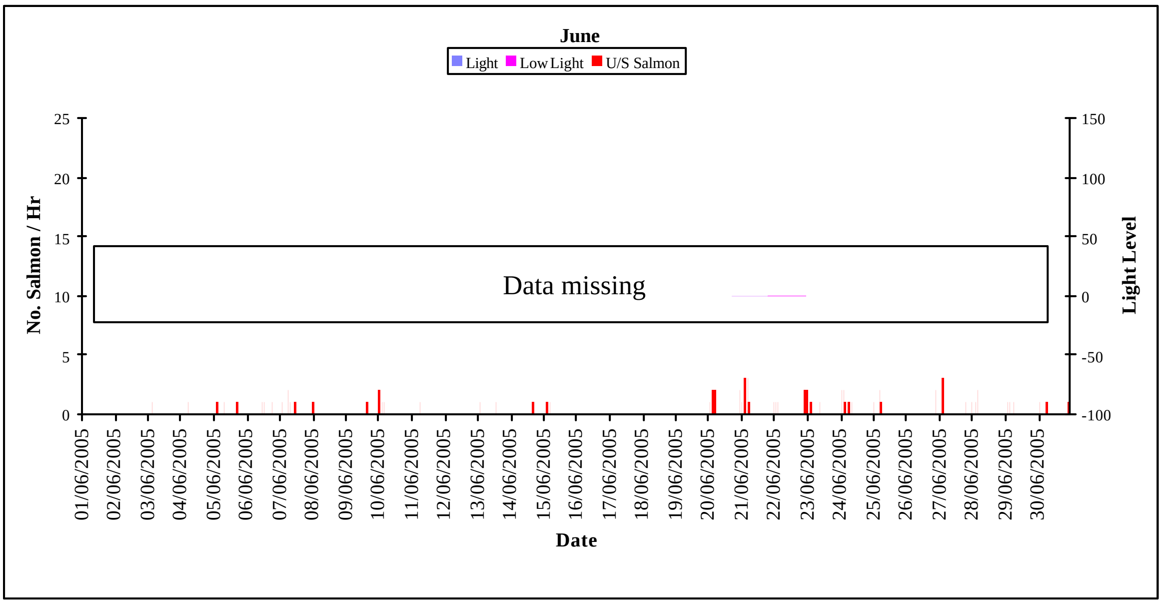
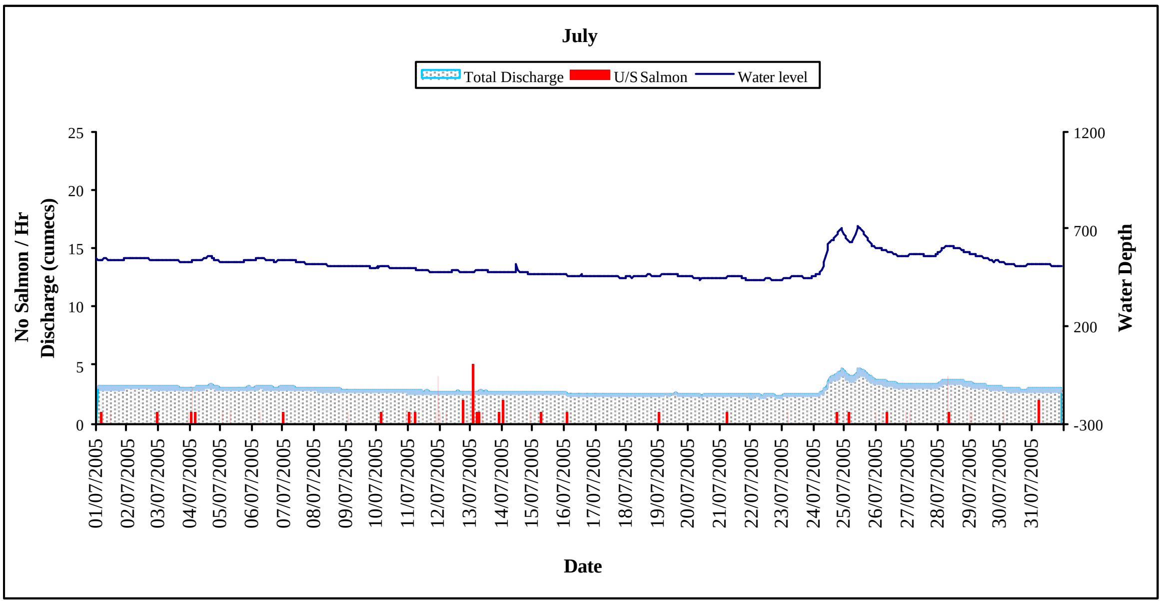

June
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Data missing
Date

Figure 9


July
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date
25
20
15
10
5
0
1200
700
200
-300
01/07/2005
31/07/2005


July
U/S Salmon
Water Temp
Air Temp
No. Salmon/ Hr
Air & Water Temp
Data missing
Date
01/07/2005
30/07/2005

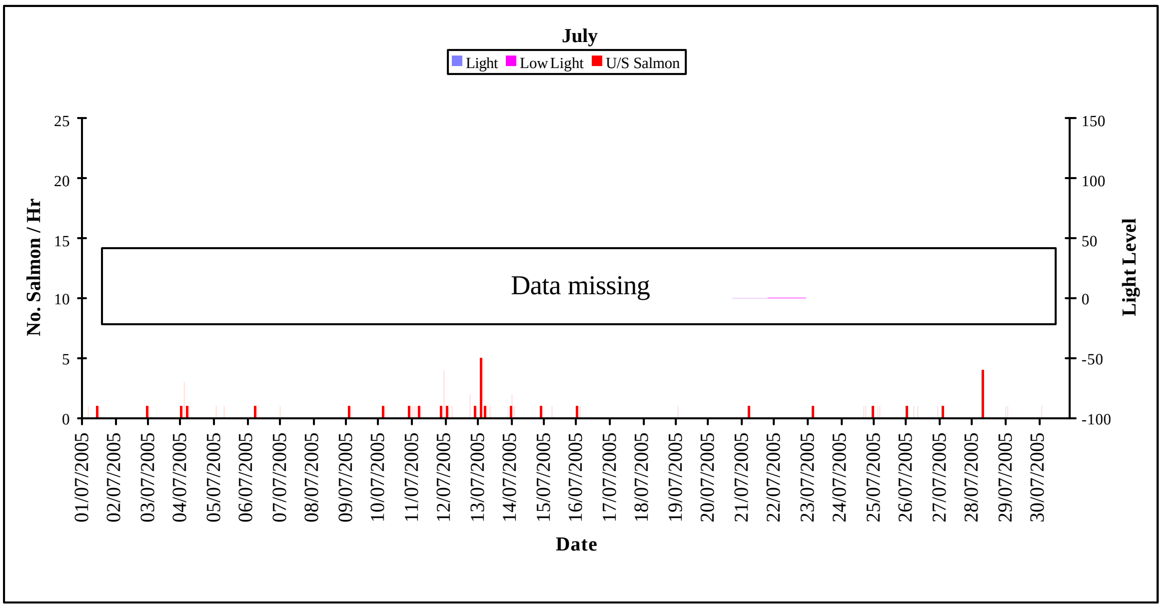
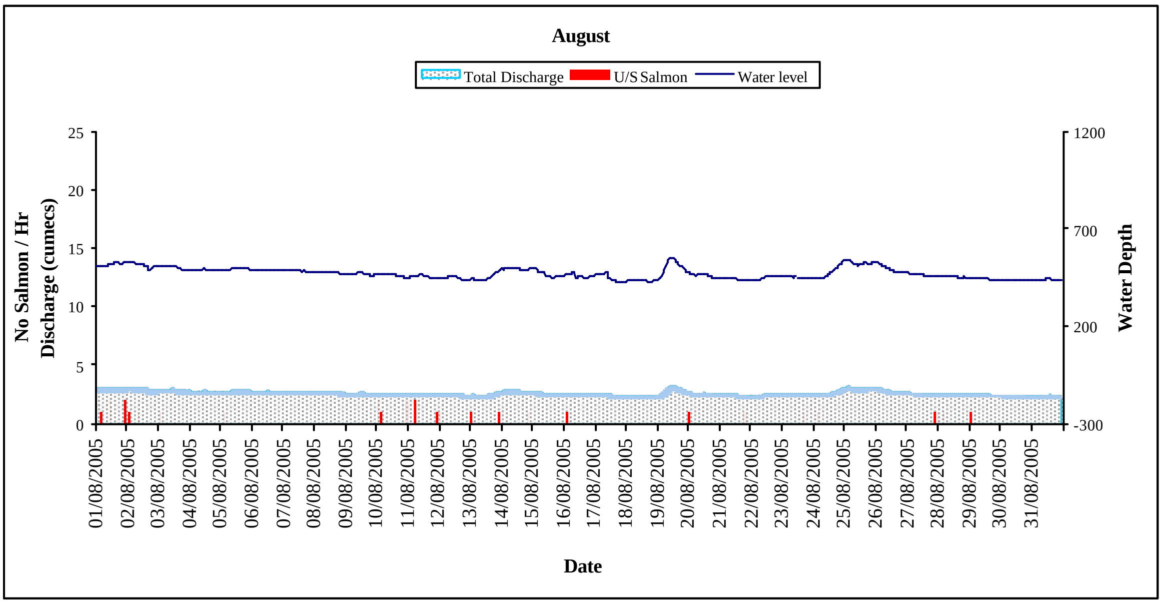
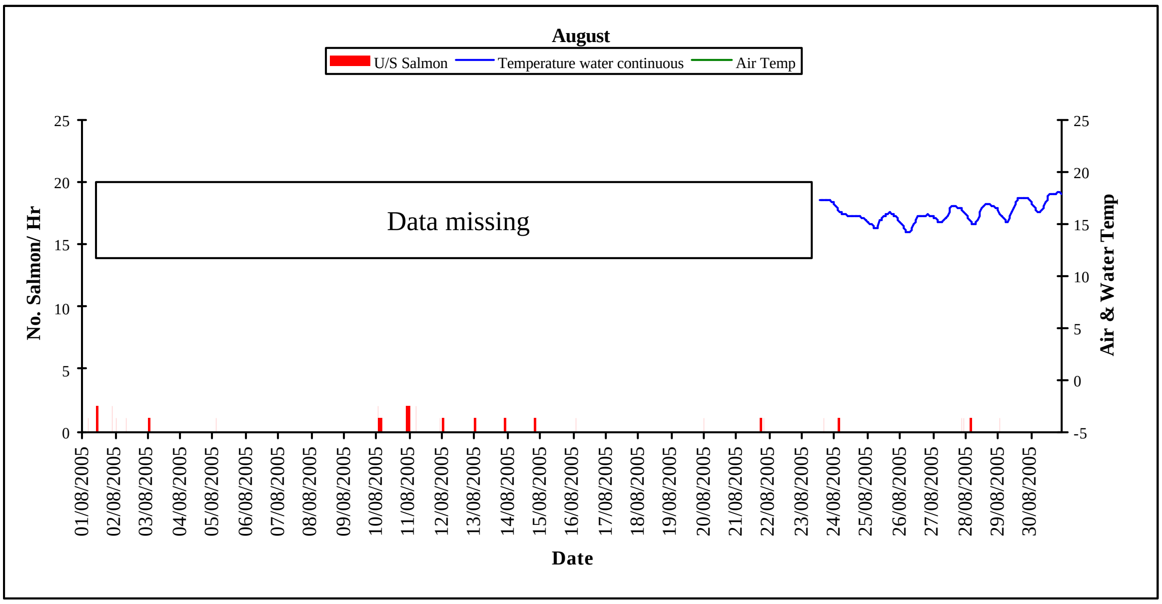

July
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Data missing
Date
150
100
50
0
-50
-100
01/07/2005
30/07/2005

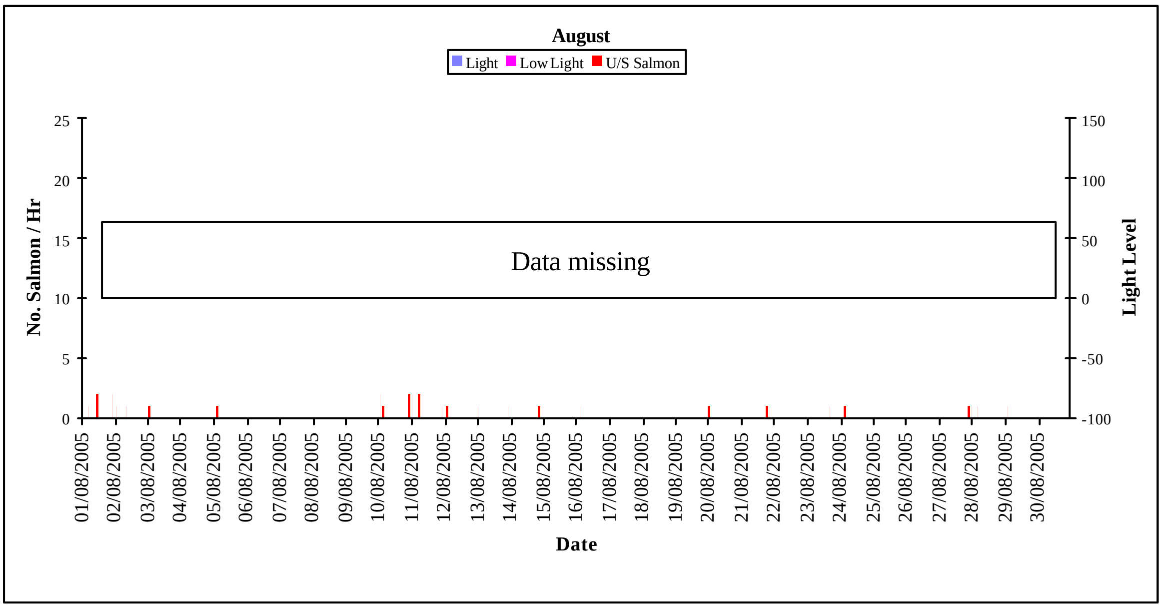
Figure 9



August
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date

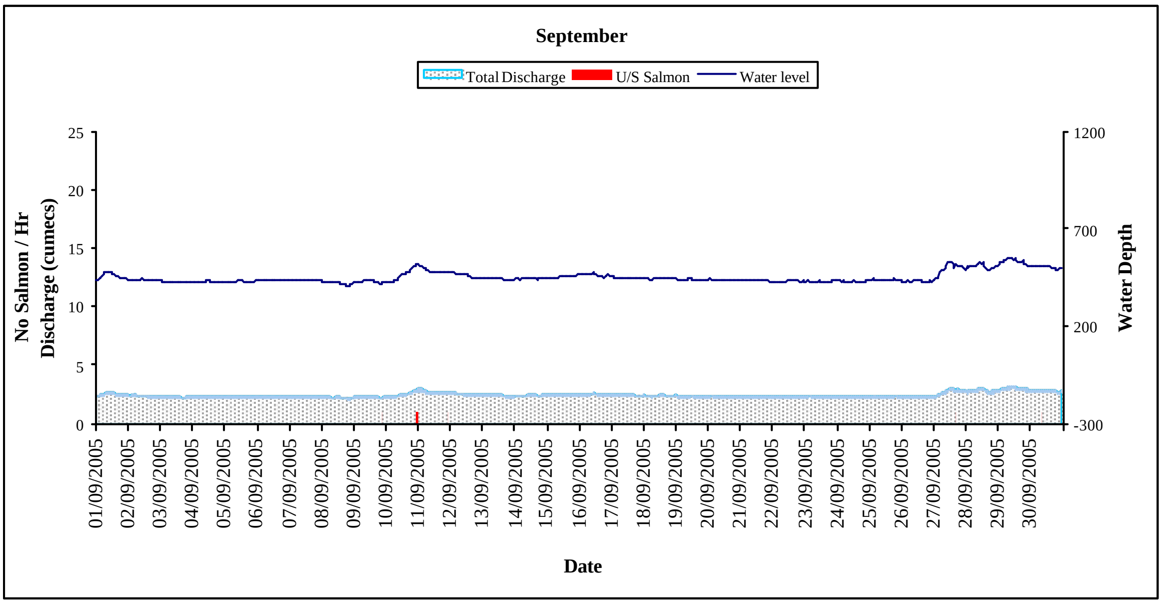


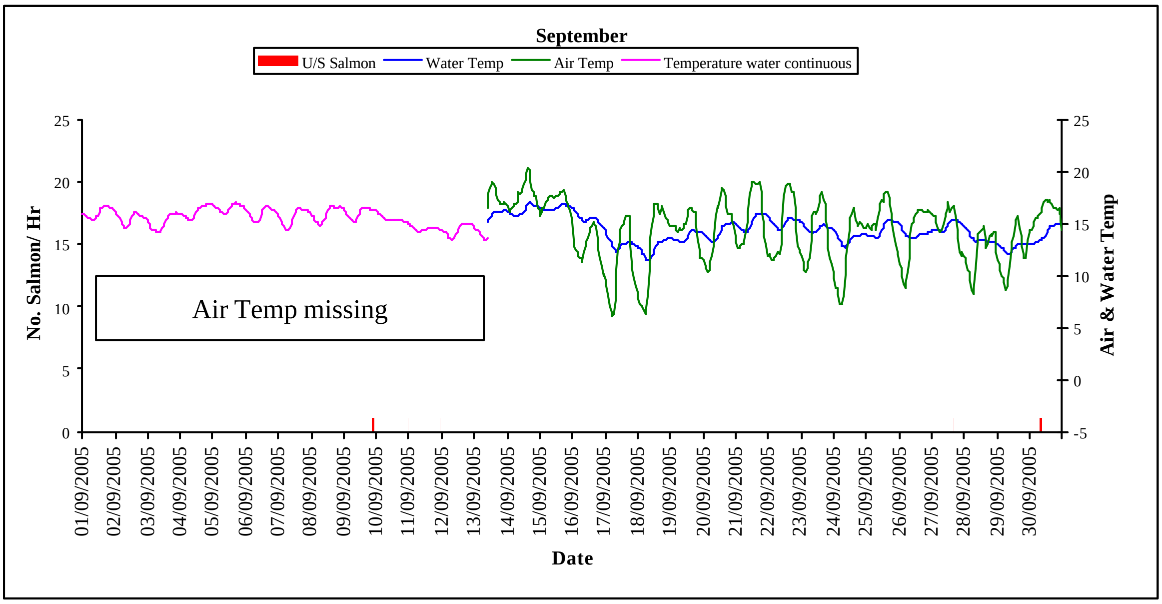
August
U/S Salmon
Temperature water continuous
Air Temp
Data missing
No. Salmon/ Hr
Air & Water Temp
Date



August
Light
Low Light
U/S Salmon
Data missing
No. Salmon / Hr
Light Level
Date

Figure 9


September
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date


September
U/S Salmon
Water Temp
Air Temp
Temperature water continuous
No. Salmon/ Hr
Air & Water Temp
Air Temp missing
Date

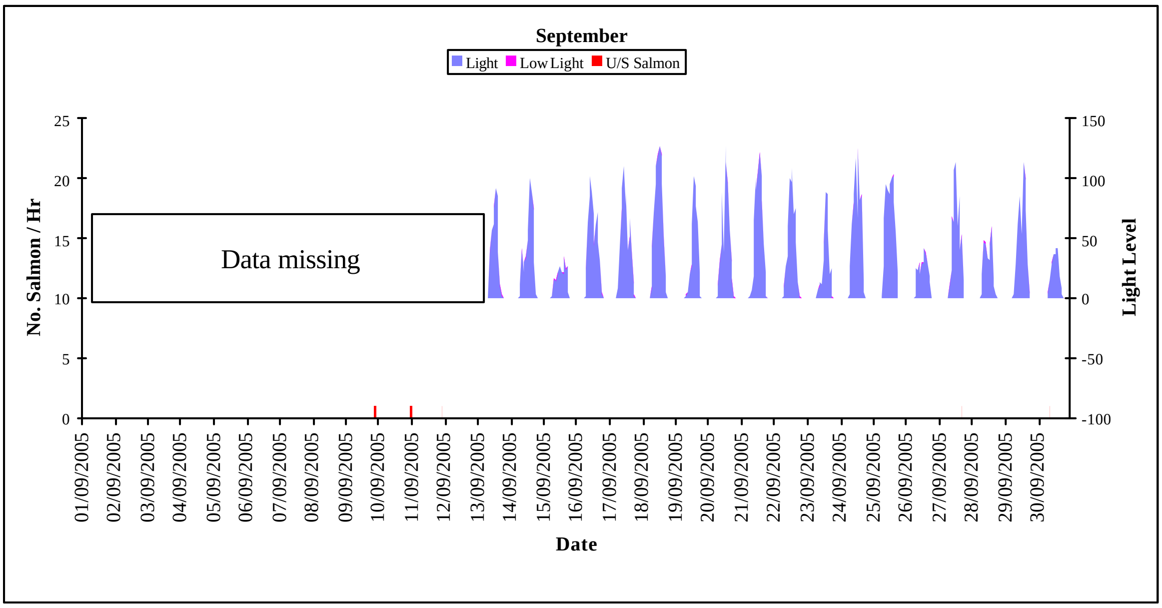

September
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Data missing
Date

Figure 9

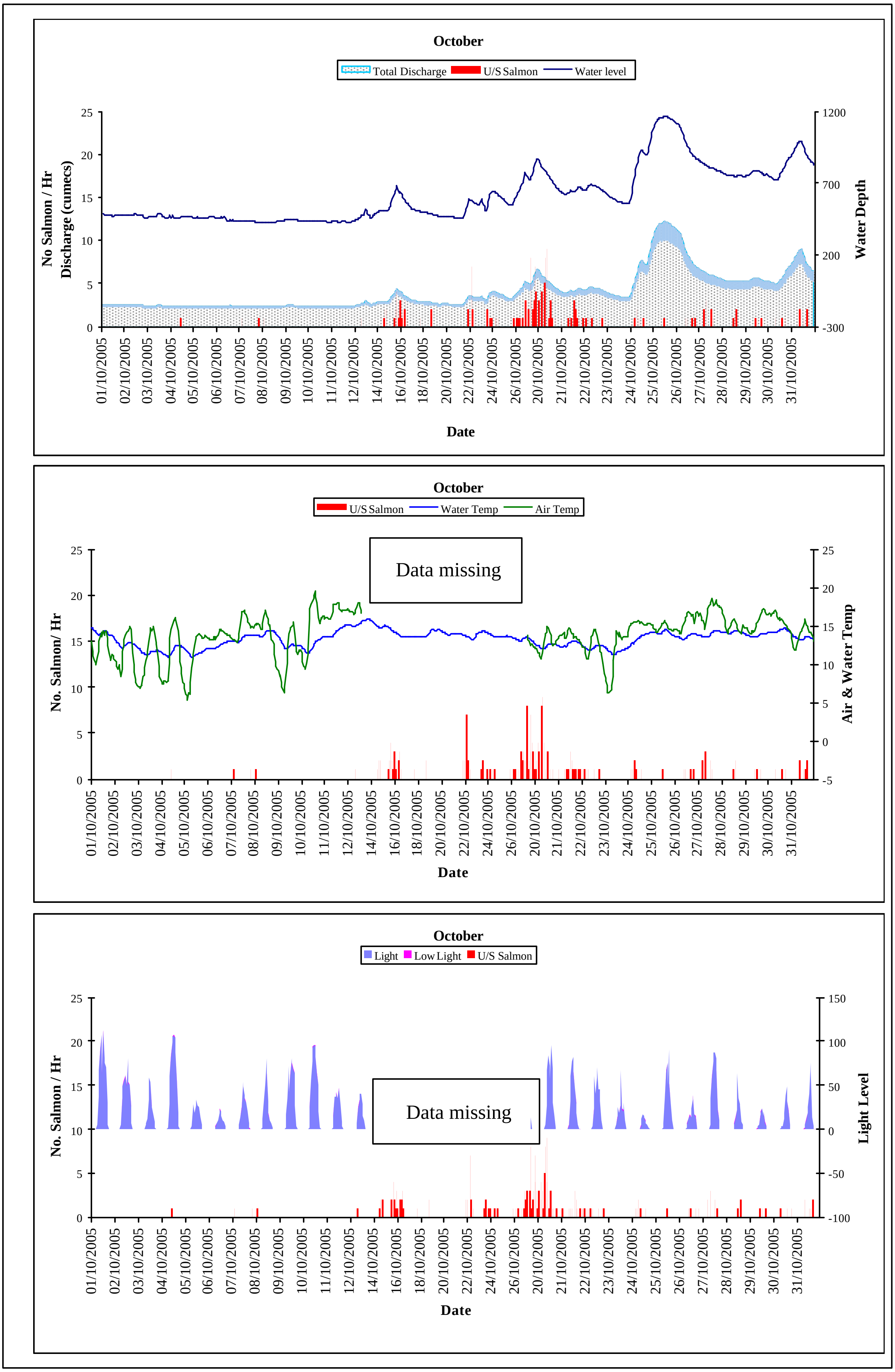

October
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date
October
U/S Salmon
Water Temp
Air Temp
Data missing
No. Salmon/ Hr
Air & Water Temp
Date
October
Light
Low Light
U/S Salmon
Data missing
No. Salmon / Hr
Light Level
Date

Figure 9

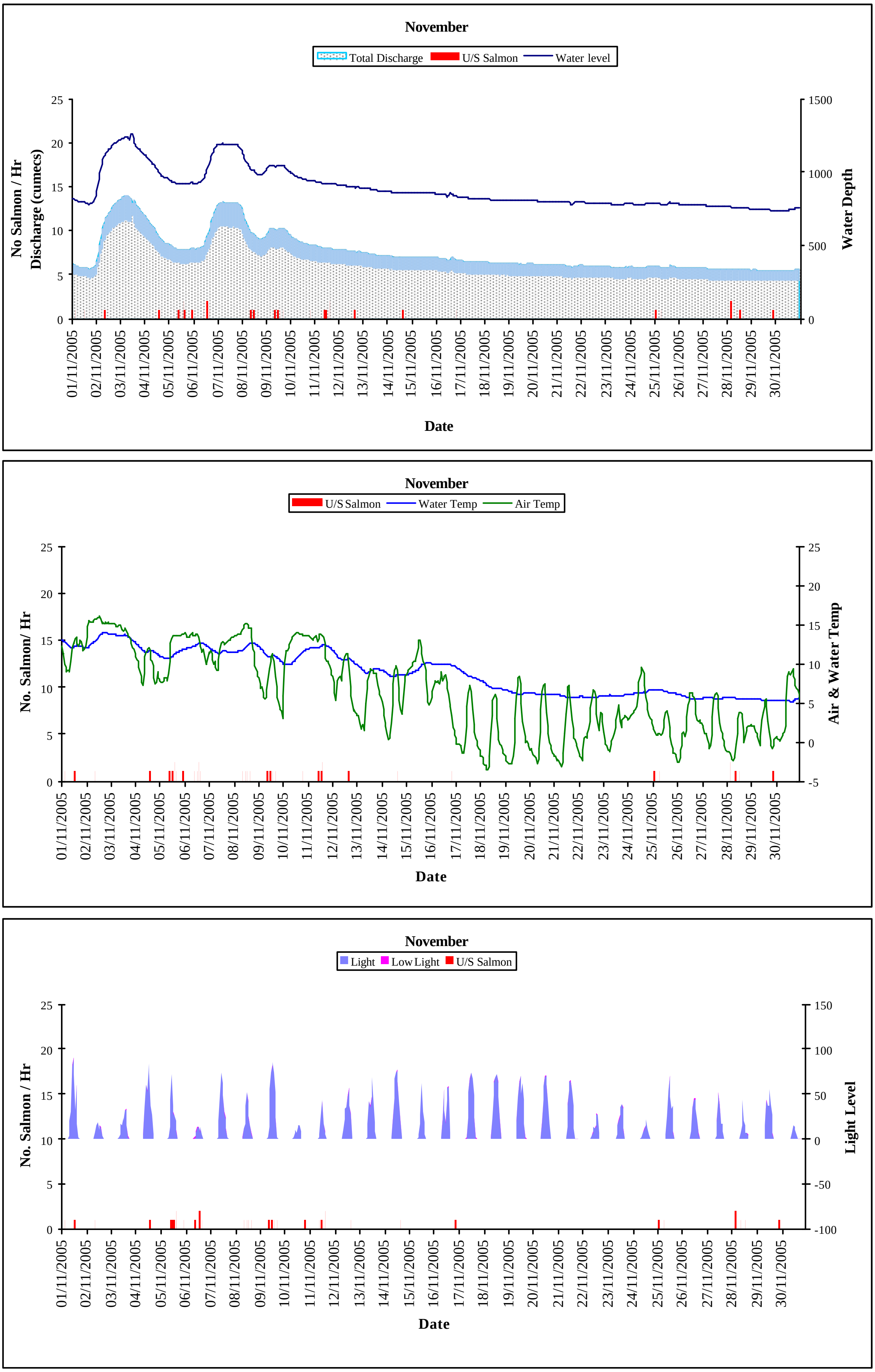

November
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date
November
U/S Salmon
Water Temp
Air Temp
No. Salmon/ Hr
Air & Water Temp
Date
November
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Date

Figure 9

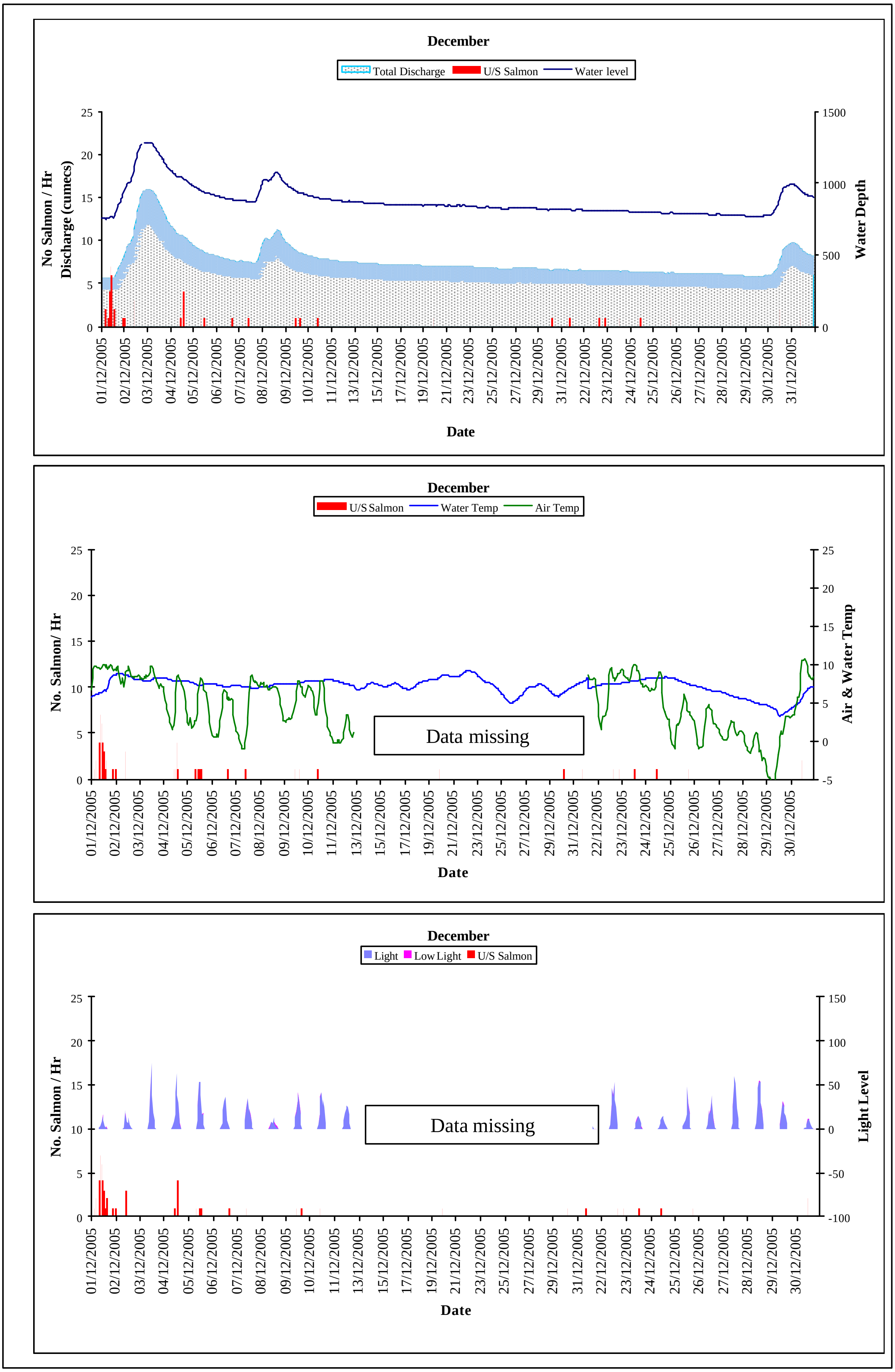

December
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Water Depth
Date
December
U/S Salmon
Water Temp
Air Temp
No. Salmon/ Hr
Air & Water Temp
Data missing
Date
December
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Data missing
Date

Figure 9

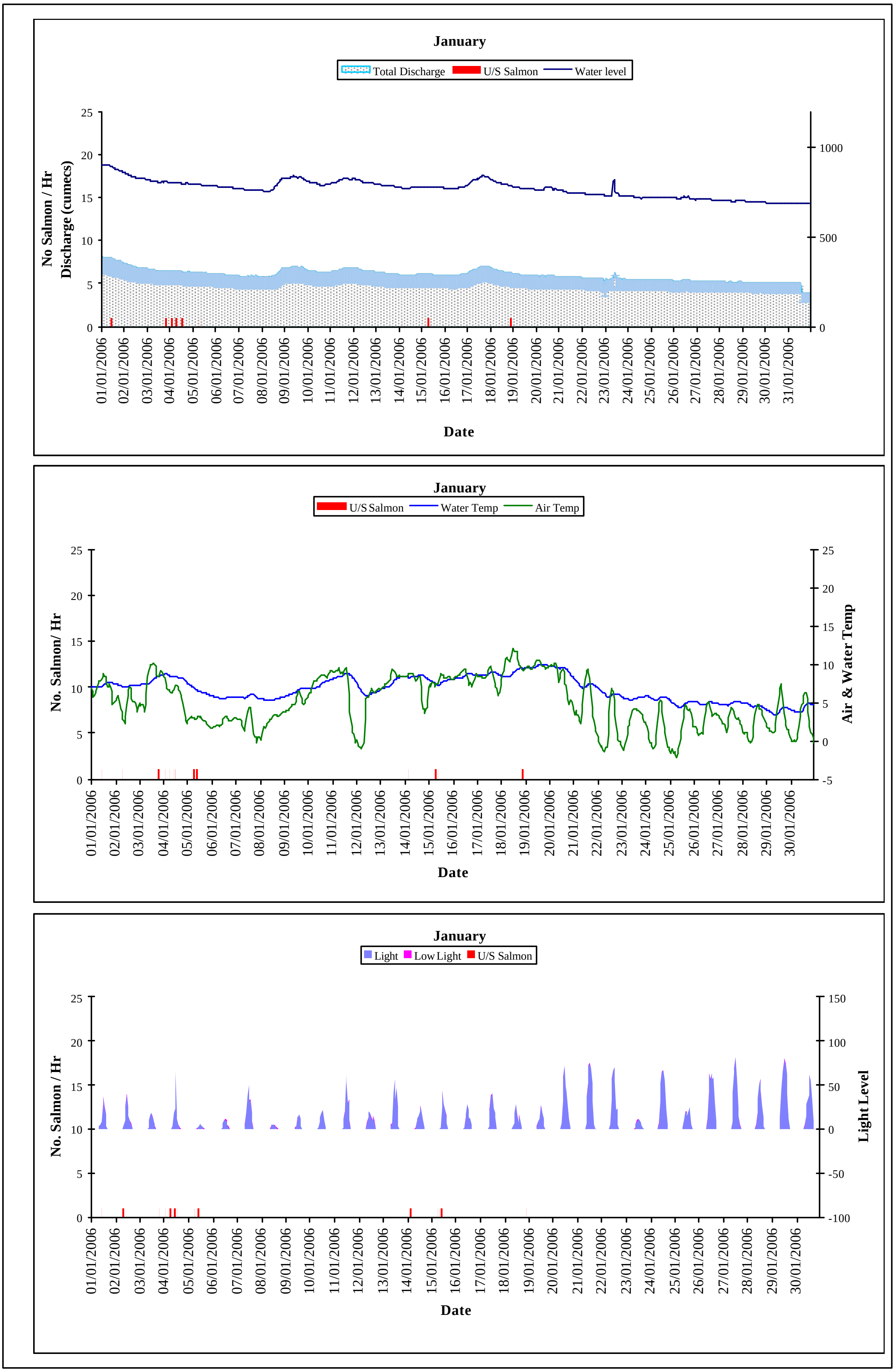
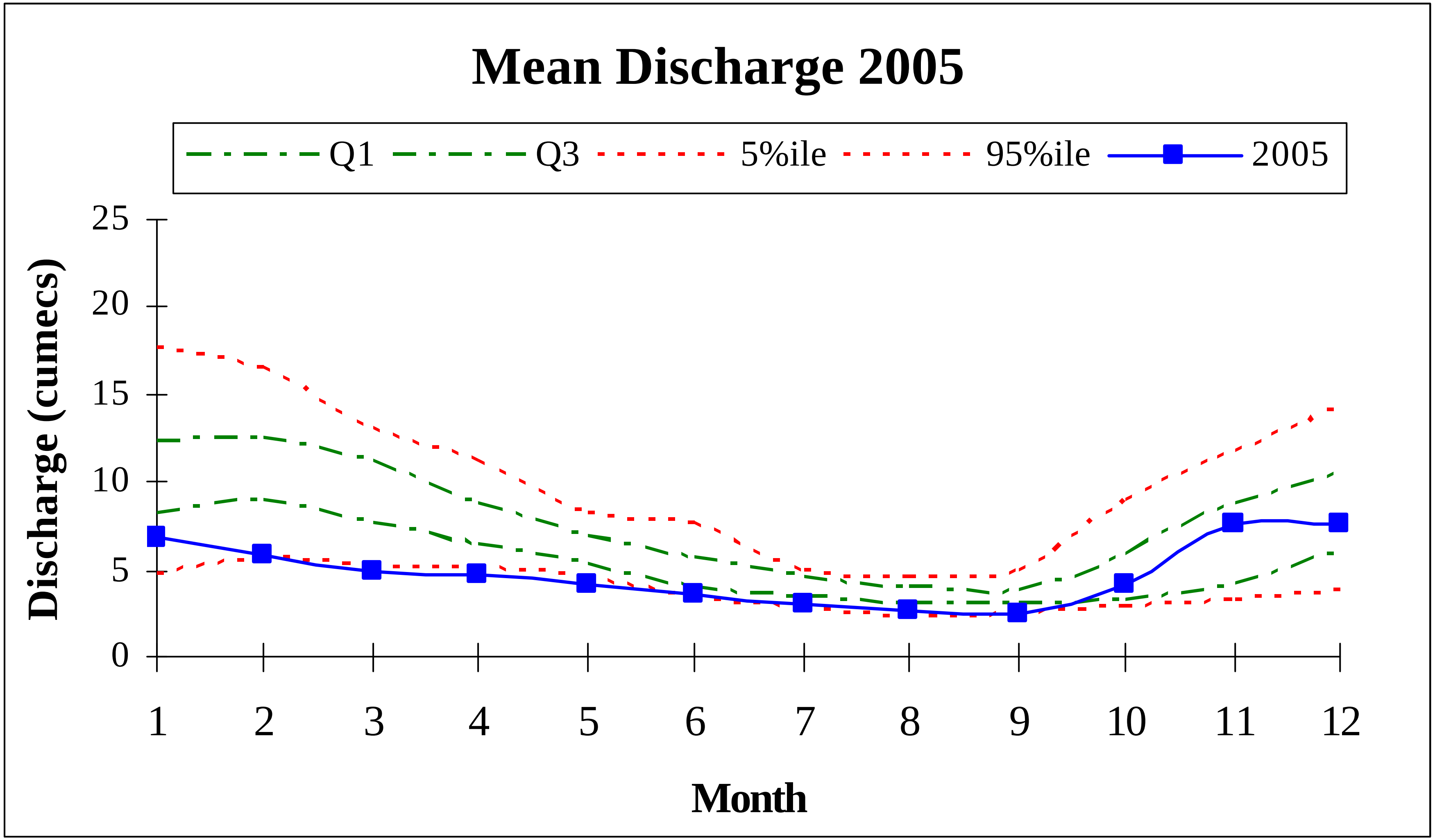

January
Total Discharge
U/S Salmon
Water level
No Salmon / Hr
Discharge (cumecs)
Date
January
U/S Salmon
Water Temp
Air Temp
No. Salmon/ Hr
Air & Water Temp
Date
January
Light
Low Light
U/S Salmon
No. Salmon / Hr
Light Level
Date

Figure 9



Mean Discharge 2005
Q1
Q3
5%ile
95%ile
2005
Discharge (cumecs)
0
5
10
15
20
25
1
2
3
4
5
6
7
8
9
10
11
12
Month

Figure 10

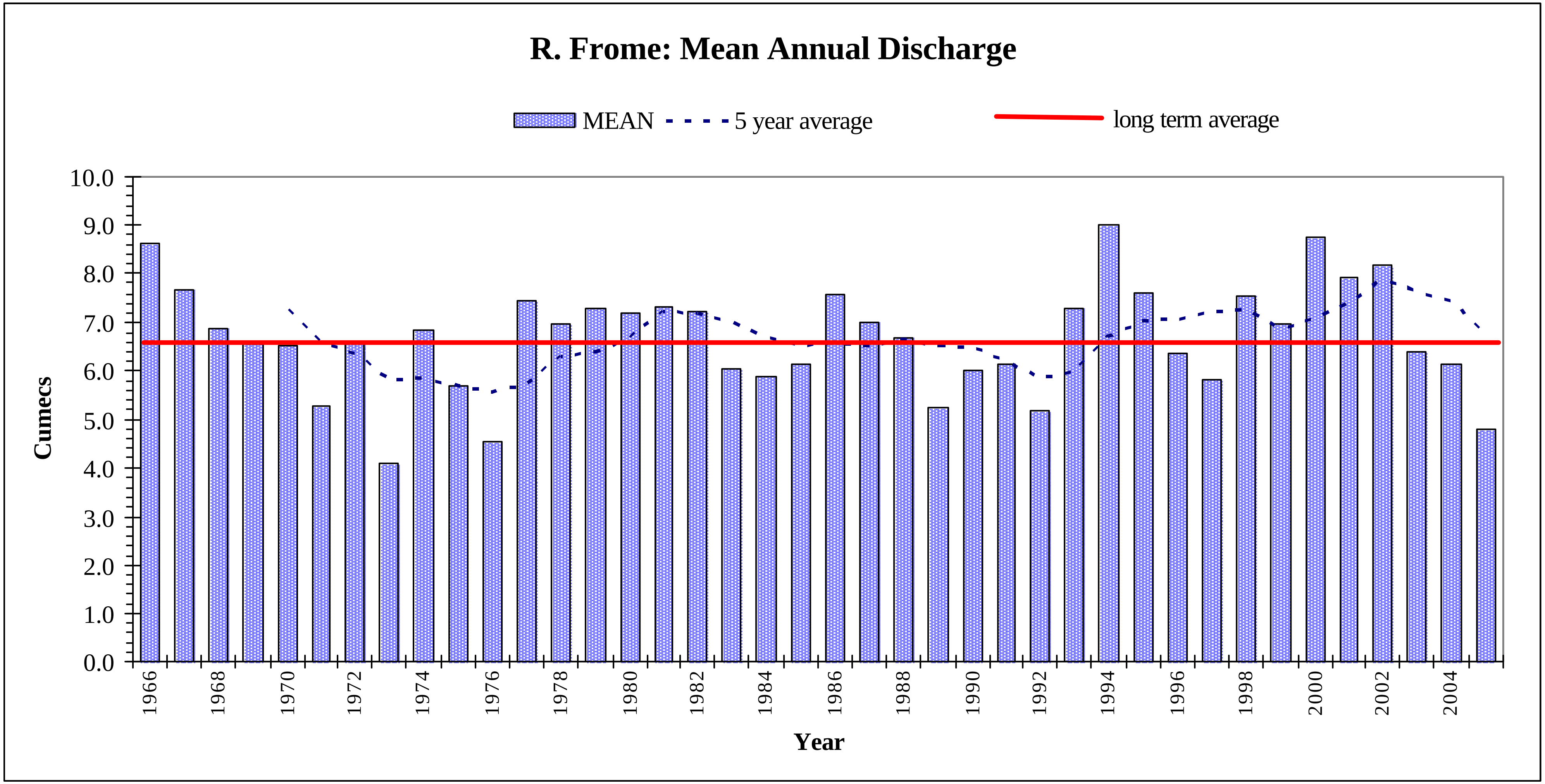

R. Frome: Mean Annual Discharge
MEAN
5 year average
long term average
Cumecs
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year

Figure 11

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