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Egg Survival

Estimates of salmon egg survival for the river Wyre have been very low.Stewart (1971) found a survival of 2.63% from eyed eggs recovered from excavated redds.A total of 4 redds were excavated,two on the 7th March 1962.

Robins (1967) measured survival by 3 methods,planting vibert boxes,burying eggs in artificial redds and excavating natural redds.Survival varied from 0.0 to 100%.The average from all methods using green eggs was 37.3%.Robins concluded that the main river gravels were not very suitable for egg incubation.

Methods

Three methods for estimating egg survival were used.They were,burying eggs in Harris boxes,eggs recovered in freeze cores and excavating redds.

From 19th December 1983 green and eyed salmon ova were buried in salmon redds on the river Wyre.The survival of ova to hatching by April 1984 was 57.22% and by April 1985 it was 47.7% (Clarke 1984 and 1985).

Harris boxes.

Method

Eggs were stripped from Wyre salmon,which were caught while cutting their redds.The eggs were counted into Harris boxes (Harris 1973) within 12 hours of being fertilised.When eyed eggs were used they were from Wyre salmon,incubated at Street Hatchery.Only live eggs were used.50 eggs were counted into each box and mixed with washed gravel,in the 5 mm to 20 mm size range.The gravel was obtained from Hoveringhams Quarry which extract Wyre floodplain deposits above Scorton.

The egg boxes were buried at the side of a salmon redd,at the same level as the egg pockets (see fig).Wyre salmon bury their eggs at depths of 90 to 250 mm.The boxes were left in the gravel till after they were eyed and then the first box was removed.The boxes were removed by carefully digging down through the gravel till the surface of the box was found,the distance to the surrounding gravel surface was measured,then the box was removed,not disturbing the second box.The box was emptied onto a white plastic tray and the number of live and dead eggs counted.When the eggs in the second box were near to hatching,they were exhumed.The burial depth was measured,then a length of 150 mm diameter plastic pipe was placed over top of the box.The pipe protruded above the water surface,the box was removed gently so the loss of silt from the box was kept to a minimum,being protected from the water flow by the pipe.The box,after removal from the river,was immediately placed in a clean white plastic bin liner,the number of live and dead eggs counted,the eggs were removed.The gravel and the box were

kept in the open bag and allowed to dry.This was done at room temperature in clean dry conditions.When the samples had been fully dried,as with the freeze core samples,they were then seived into two fractions.The split at 1 mm.In some samples the fines < 1 mm were subdivided at 1/3 phi intervals (Ottoway et al.1981).

To find wether their was any change in survival with increased depth of egg burial,boxes were buried at 3 different depths,in replicates of 2,at the same site.This was done by burying the boxes,in the side of a redd,as above but with 2 columns of 3 boxes stood on top of each other (fig).The boxes were removed,near to hatching,as above.The eggs counted and the gravel and silt retained for drying and seiving.

With all the egg box experiments 2 control boxes were filled in the same manner and kept at Street Hatchery,they were examined 5 days after filling.The egg death in these boxes was used to give an initial mortality estimate.All the excess eggs,from the batch used in the experiments,were kept at the hatchery.From these eggs any unusual death rate was noted,also the eyeing and hatching times were predicted.It was found that the development of eggs in the river were approximately 7 days behind the hatchery.This would be due to the different temperature regimes between the spring fed hatchery and the colder river (Crisp,1981 Freshwat.Biol. 11,361-368;Ottaway & Forrest,1981 unpubl.report.).

In 1987 the boxes were planted on 27/11/1987,they had eyed by the 8/2/1988 and were starting to hatch on18/3/1988.More boxes were planted on the 3/12/88 and were well eyed by 2/3 89.

RESULTS

Not all the egg boxes were recovered,on some sites the metal stake was washed out and the boxes could not be located.It was found from the scour chain data that this does not necessarily mean the redd was washed out.

The controls of the boxes planted in 1987 had a high initial mortality of 10%,these eggs had a 21% mortality rate to hatching,in the hatchery.This was well above the usual 2 to 10% rate.There was a 4% error in counting in 1 box,it had 48 instead of 50 eggs.When all the control boxes,for all river Wyre experiments,were counted the mean number of eggs was 48,this will be the assumed number of eggs in a box.The posts and boxes of 4 sites were lost before the first box was recovered.After the eggs eyed a further site was lost.

The percentage survival was estimated by counting the number of live eggs or alevins against the number buried.(Harris,1973).In 1987/88 the survival to eyeing was 47.6%.This is the same percentage as was

calculated,dividing the number of live eggs by the total number of eggs found in the box.This shows there is no decay of eggs before the retrieval of the first box.Stewart (1963 unpubl.report) noted a characteristic blue-black staining on the gravel of redds were eggs have died,the dead eggs in the boxes first go white and then go blacker and softer as they decay,when they start to disintegrate they are completely black and lose their spherical shape.The survival to hatching in 1987/88 was 24.3%,the number of eggs or alevins recovered from the 15 boxes found at hatching was 705 the expected number was 720.There was a egg disintegration of 2.1%.

In 1988/89 only 1 box was buried at each site,it was recovered when the boxes were well eyed.The mean survival from the 7 sites was 91.4%.

The eyed eggs planted at different depths showed increased survival with in the 2 deeper sets of boxes,a mean survival of,46.2% in the eggs buried between 0 and 65 mm below the gravel surface,97.0 for those at depths of 65 to 130 mm and 95.1 at depths 130 to 195 mm.

	% Survival	% survival
Depth	site 1.	site 2.
0-65mm	78.3	14.1
65-130mm	97.0	97.0
130-195mm	94.0	96.2

The sites had the same eggs planted within 1 hour,when recovered all the live eggs had hatched at site 2,at site 1 a 0 - 65 mm box had 40 alevins and 3 live eggs.The other boxes had 221 live eyed eggs and 12 alevins.The boxes were recovered within 2 hours,the sites were 1.4 km apart and 1 small tributary enters between them.A change in the temperature regime between the two sites has caused a difference in rate of development of the eggs.

When green eggs were planted at different depths in 1988 there was no difference in survival with depth.The boxes after burying had 150 mm of gravel deposited on them.The eggs were buried at final depths of 150 - 215 mm,215 - 280mm and 280 - 345 mm,the corresponding survivals were,97.9%,95.9% and 100.0%.

The amount of fines < 1 mm in the egg boxes varied between 8.5% to 33.0%,the mean was 21.0%.The mean for boxes planted in 1987 was 21.7% and for 1988 was 18.3%.The amount of fines < 1 mm in redds,from freeze cores,was a mean of 6.6% (0 to 100 mm)and 9.9% (100 to 200 mm).When removed from the gravel egg boxes have between 2.1 to 3.2 times more fines than the redd.This could be an underestimate because the method of egg box retrieval always lost some fines.

Dead eggs in the boxes were often found in clumps.When an egg dies it is attacked by fungus,this

fungus then spreads to nearby eggs and kills them.This is seen in eggs kept in hatcheries.From freeze cores eggs in redds are much more widely spaced than in boxes.The eggs in the redds will be much less susceptible to dying from a fungal attack from a nearby dead egg.

Freeze cores.

The second method of estimating the survival of eggs in the redds was by counting the number of live and dead eggs found in freeze cores.After the core was removed from the river it was allowed to thaw,sorted and any eggs removed.Green eggs from the core stayed alive until they were removed from the core,live eyed eggs were taken from the core and kept till they hatched,the only live eyed eggs that died were those which were disrupted as the corer was driven into the redd or were very close to the metal pipe.These eggs died after they were thawed probably due to cold shock.Apart from disrupted eggs it was always possible to see wether they were alive when cored.The cores were checked for any blacking from dead eggs.

Results

107 salmon eggs were obtained in freeze cores.They consisted of 29 found after eyeing 79.3% were alive,3.4% infertile and 17.2% dead.These were from 3 different redds.The 78 green eggs came from 5 different redds,97.4% were alive.No sign of blackening of the gravel was seen in any core.

Excavating redds.

Due to the small number of eggs retrieved in freeze cores a third method of estimating the survival of eggs in the redd was tried.Stewart (1971),in 1960 and 1962,marked salmon redds on 7 rivers including the river Wyre.In 1965 Robins marked more redds on the river Wyre.Stewart dug up the redds,after the eggs were eyed.The eggs were caught in rectangular net,15 inches by 40 inches at the mouth.By digging up completed 4 fresh redds Stewart had found that 85.9% of the eggs in a redd were retrieved using this technique.Robins only found one redd of those marked,which he excavated after it had hatched.

In 1989 1 redd was excavated,using a net of the dimensions given by Stewart.To limit damage to the redds they were only partially dug over,as soon as about 20 or more eggs were seen floating down stream the digging ceased.The redds were dug to a depth of 30 cm to retrieve eggs from all depths.A further 6 redds were excavated in 1990,also included is data for a redd excavated in 1982.All the eggs found were eyed and from 1 redd in 1990 2 alevins were found.

Results

Of the 8 redds excavated,in 1 redd nothing was found,from another redd (on the same riffle) 1 eyed egg was retrieved,on the same day a third redd had alevins present.It is not known if the low number of eggs retrieved was due to the redds hatching or if no eggs had been deposited in them.These 3 redds were completely excavated.Another redd had 16 dead eggs found in it,it was only partially dug over,the same day.

Date	Eggs	Live Alevins	Dead Eggs	% Survival
15/2/1982	106	0	4	96.4
9/2/1989	28	0	6	82.4
23/2/1990	0	0	0	
23/2/1990	1	0	0	
23/2/1990	42	0	19	68.9
23/2/1990	0	0	16	0.0
23/2/1990	48	0	4	92.3
23/2/1990	6	2	0	100

The mean of mean survival is 73.3%.There was no blue-black staining seen in any of the redds excavated.From egg boxes it is seen there is only a 2.1% decay of eggs to hatching in the river Wyre.Robins (1967) was retrieving large numbers of dead eggs from his baskets examined in February and March,Although approximately 500 eggs were placed in the basket many eggs,in some baskets,must have been lost to the surrounding gravel due to the 3/4 inch mesh size.1 basket retrieved in March had 416 live eggs and 191 dead eggs,as only about 500 eggs were put in the basket there can have been very little egg decay.Robins also recorded a 100% retrieval from Vibert boxes which had been examined at hatching.There is no error in the survivals calculated from the redds dug over due to egg decay.

In.the redd where there was no survival the eggs had died after eying,another redd was excavated on the same riffle.This redd was 3 metres upstream in a similar depth and flow of water,the eggs showed a 92.3% survival.

DISCUSSION

From the 3 different methods post eyeing survival rates of,24.3% and 91.4% from egg boxes,79.3% from freeze cores and 73.3% from redds dug over.The survivals of eggs planted in the river Wyre are in the same range as found by Ottoway et al.(1981 unpubl report.) 27-85% for brown trout.On the river Wyre survival from egg boxes is normally lower than survival eggs from natural redds.With increased siltation and less spacing of eggs,increased mortality can be expected.Robins (1967) was burying salmon eggs in artificial redds on spawning riffles,the choice of site may not be in an area that a female salmon would chose.The eggs were buried in the baskets at depths of

250 mm,99.0% of eggs were found,in redds, at depths of >200 mm.The low percentage survivals in April could be due to alveins migrating from the baskets rather than mortality.If the March figures are used then a mean survival of 60.8% is found.Stewart (1971) calculated survivals from the number of live eyed eggs recovered against the number of eggs thought to be in the redd.Eggs could be lost from the redds by washout,the redds could have hatched or no eggs deposited in the redd when it was cut.With only 4 redds examined the 2.63% survival is not necessarily a measure of egg survival within the redds.

Although the data is limited,the 79.3 and 73.3% post eyeing survivals are most accurate.The close correlation between the two sets of data,for eggs found in natural redds,increases confidence in the results.Barber et. al.(1986) found a survival of 80% of eggs in natural redds,cut on Avon and Dorset rivers.