

Remote Site Incubators: Construction and Installation.

Remote Site Incubators (RSI) are used to rear fish eggs in isolated locations. They provide the eggs and developing fry with protection and habitat, increasing their survival rates. The general design of the RSI described here is a five gallon bucket fitted with an upstream inlet pipe and an outlet hole. Freshwater enters at the inlet pipe that directs the water into the bottom of the bucket, where the water percolates up through the bucket and out the outlet hole. The internal components of the bucket include a basket that contains a layer of gravel, on which the eggs are placed and a layer of neutrally buoyant bio-media that cover the eggs. The gravel simulates the natural spawning habitat of many trout species and the bio-media provides habitat for the fry to develop in before escaping through the outlet hole.



Image 1: A) RSI setup in an inlet to High Lake. B) Recently emerged fry in a RSI.

Materials (per one RSI):

Part	Component	Quantity	Supplier	Price (each)
A	20' of 1" Inch PCV schedule 40 piping	1	Mountain Supply Co.	\$6.48
B	1" PVC Cross fitting	1	Mountain Supply Co.	\$1.95
C	1" PVC End caps	4	Mountain Supply Co.	\$0.36
D	1" PVC Threaded female end fitting	2	Mountain Supply Co.	\$0.36
E	1" PVC Tee fitting	1	Mountain Supply Co.	\$0.59
F	1" PVC Threaded male end fitting	4	Mountain Supply Co.	\$0.40
G	1" PVC Shut off valve fitting	1	Mountain Supply Co.	\$9.02
H	Bottle (1 liter round squirt bottle)	1		\$2.00
I	2" Hose clamp	1		\$2.00
J	Black 5 gallon buckets w/ press-on lid	2	U.S. Plastic Corp.	\$6.56
K	12" x 12" Stainless mesh (size 14) screen	1	TWP Inc.	\$6.95
L	12" Nylon string	2		\$1.00
M	Bio-media, Intalox saddles poly-pro 35% CaCO ₃	1ft ³	Kock Glitsch	\$85.00
N	PVC Primer	1	Mountain Supply Co.	\$8.52
O	PVC Glue	1	Mountain Supply Co.	\$7.12

Total: \$147.51

Required Tools:

- Reciprocating saw.
- Electric drill.
- Grinder.
- 1 1/4" inch hole saw.
- Propane torch.
- Large 1/8" thick metal plate.
- 3/8" drill bit.
- 1/8" drill bit.
- Tin snips.
- Sand paper.
- Utility knife.
- PPE.

Building the RSI:

Part 1 – Inner Plumbing – See Figure 1.

1. Cut three 2.75" pieces (A1) and one 3" piece (A2) of 1" pipe. Use sand paper to remove burrs and rough spots.
2. Prime and glue the four pieces of pipe into the cross fitting.
3. Prime and glue three end caps (C) to the ends of the 2.75" pipe pieces (A1).
4. Prime and glue a threaded female end fitting (D) to the remaining 3" pipe piece (Image 2).
5. Drill eight 3/8" holes into one side of part 1 as seen in Image 2.

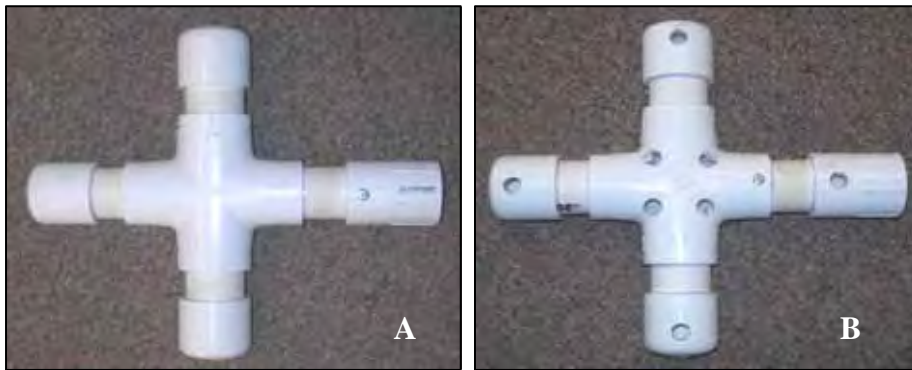


Image 2. A) Top side of part 1. B) Bottom side of part 1, notice location of the drilled holes.

Part 2 – Outer Plumbing- See Figure 1.

6. Cut two 3" pieces of 1" pipe (A2). Use sand paper to remove burrs and rough spots.
7. Prime and glue two 3" pipe pieces into the sides of the tee fitting (E).
8. Cut a 12" pipe piece (A3). Use sand paper to remove burrs and rough spots.
9. Prime and glue the 12" pipe piece (A3) into the top of the tee fitting.
10. Prime and glue two threaded male end fittings (F) onto the 3" pipe pieces (A2).
11. Prime and glue an end cap fitting (C) onto the 12" pipe piece (A3).
12. Drill a 1/8" hole through the top of the end cap fitting (C) attached to the 12" pipe piece (A3).
13. Screw on shutoff valve fitting (G) on to one of the threaded male ends (F) (Image 3).



Image 3. Outer plumbing assembly.

Part 3 – Inlet Pipe(s) and Straining Bottle.

14. Cut one 15' piece of 1" pipe (A4). Use sand paper to remove burrs and rough spots.
Note: Cut three 5' sections if easier transportation is required, also if RSI will be in a low gradient area add more 5' sections for extended reach.
15. Prime and glue a threaded male (F) and female end fitting (D) onto the ends of the 15' pipe piece (A4).
16. Cut off the top of the bottle (H), so that the top of the bottle fits on the end of the 15' pipe piece (A4).
17. Drill several dozen 1/8" holes into the side of bottle (H).
18. Using the pipe clamp (I), attach the bottle to the female end fitting (D) of the 15' pipe piece (A4) (Image 4).



Image 4. Straining bottle attached to end of inlet pipe.

Part 4 – Bucket and Lid.

19. Drill one 1 1/4" hole into the side of one bucket (J1) about 1" from the bottom.
20. Drill one 1 1/4" hole into the side of the same bucket (J1), on the opposite side of the first hole, near the top (Image 5A).
21. Cut lid (J2) tabs (little holes around edge). Remove all tabs except two, on opposite sides (Image 5B).

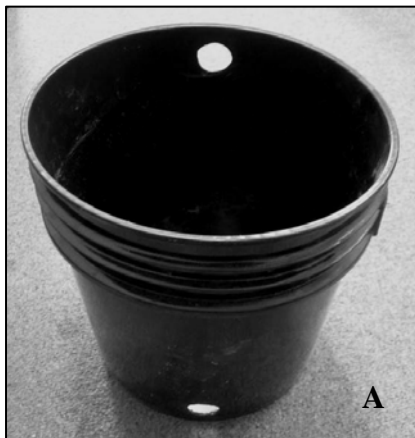


Image 5. A) Bucket with hole drilled into opposite sides. B) Bucket lid with all but two tabs removed; provides easy access into the inner workings.

Part 5 – Egg Basket.

22. Using the reciprocating saw cut the bottom out of a 5 gallon bucket (J1). Use 1 1/4'' hole saw to cut starter hole. Cut the burrs and high spots off with a sharp knife.
23. Measure and mark up 6'' from the bottom of the second bucket (J). Cut around the side of the bucket at the line.
24. Keep only the bottom half of the bucket (J3). Use sand paper and knife to remove burrs and rough spots.
25. Heat the bottom of the metal plate with the blow torch until the top of the metal plate is hot enough to melt the bucket plastic (Use a piece of scrap bucket as a test).
26. Place the mesh screen onto the metal plate, then push the bottom of the bucket section (J3) into the screen, so that the plastic melts into the mesh (K).
27. Continue rotating the bucket section until the entire bottom of the bucket section is melted into the mesh. Let cool. Note, mesh will likely warp to a bow shape.
28. Trim off mesh round bottom of bucket section with tin snips. Use grinder to remove sharp edges (Image 6A).
29. Drill two 1/8'' holes (one on each side) near the top of the bucket section (J3).
30. Tie a loop through each of the 1/4'' hole with nylon strings (L) (Image 6B).

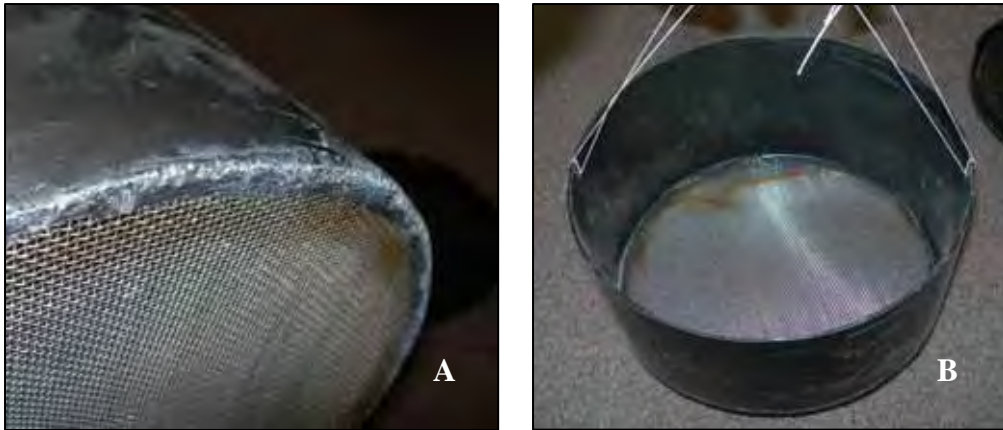


Image 6. A) Mesh melted into the plastic bucket. B) Finished egg basket.

Final Assembly – See Figure 2.

31. Place the inner plumbing into the bucket, with the holes faced down.
32. Push the male end of the outer plumbing into the hole at the bottom of the bucket.
33. Screw the male end of the outer plumbing into the female end of the inner plumbing (make sure holes in part 1 are faced down)
34. Screw the male end of the inlet pipe into the female end of the outer plumbing.
35. Insert the egg basket into the bucket.
36. Add bio-saddles into the egg basket.
37. Attach lid.



Image 7: RSI setup properly in a small stream, water flowing from right to left.

Deployment:

1. Set RSI in a stream with the bucket downstream.
2. Make sure that the bottle at the end of the pipe is higher than the top of the bucket or the water will not flow correctly.
3. If necessary, make a small dam in the creek to create a collecting pool and to gain needed head pressure.
4. Use rocks to stabilize and level the bucket and hold down piping.
5. Once water is flowing correctly, allow RSI to run for a few minutes to flush out debris.
6. Remove the eggs basket. Fill basket with a 1'' layer of small spawning size gravel.
7. Rinse gravel repeated, until all loose debris is removed.
8. Place egg basket w/ gravel back in the bucket.
9. Add a 6'' layer of bio-media into the eggs basket.
10. Let RSI run for several minutes or until water is flowing clear.
11. Remove bio-media.
12. Turn off valve.
13. Lift egg basket until gravel is just under the surface of the water, then gently wash eggs onto the gravel layer.
14. Lower basket so that the eggs "swirl" and evenly distribute on the gravel.
15. Place bio-media on top of eggs.
16. Turn on valve.
17. Place lid on bucket.



Image 8: A) Looking upstream at a RSI, notice the amount of drop from the straining bottle to the bucket. B) Eggs on the gravel layer before the addition of the bio-media.

Monitoring and Maintenance:

After eggs are introduced into the RSI, it may take several weeks before the all fish have exited. During this period conditions will change, which may require alterations to the RSI's setup. The most important factor in the monitoring of the RSI is making sure they maintain water movement. If water stops flowing the eggs and fry will die. Water can stop flowing correctly for several reasons. If the stream flow drops considerably water may drop below the intake pipe, stopping flow. Similarly, if the small dam, built to increase the size of the collecting pool and gain head pressure, fails it may cause the inlet pipe to no longer properly gather water. Also, if the stream is high in debris, partials may plug the holes in the straining bottle slowing or stopping flow. It is important to regularly check the RSI to catch and fix any problems that may occur.

Acknowledgements:

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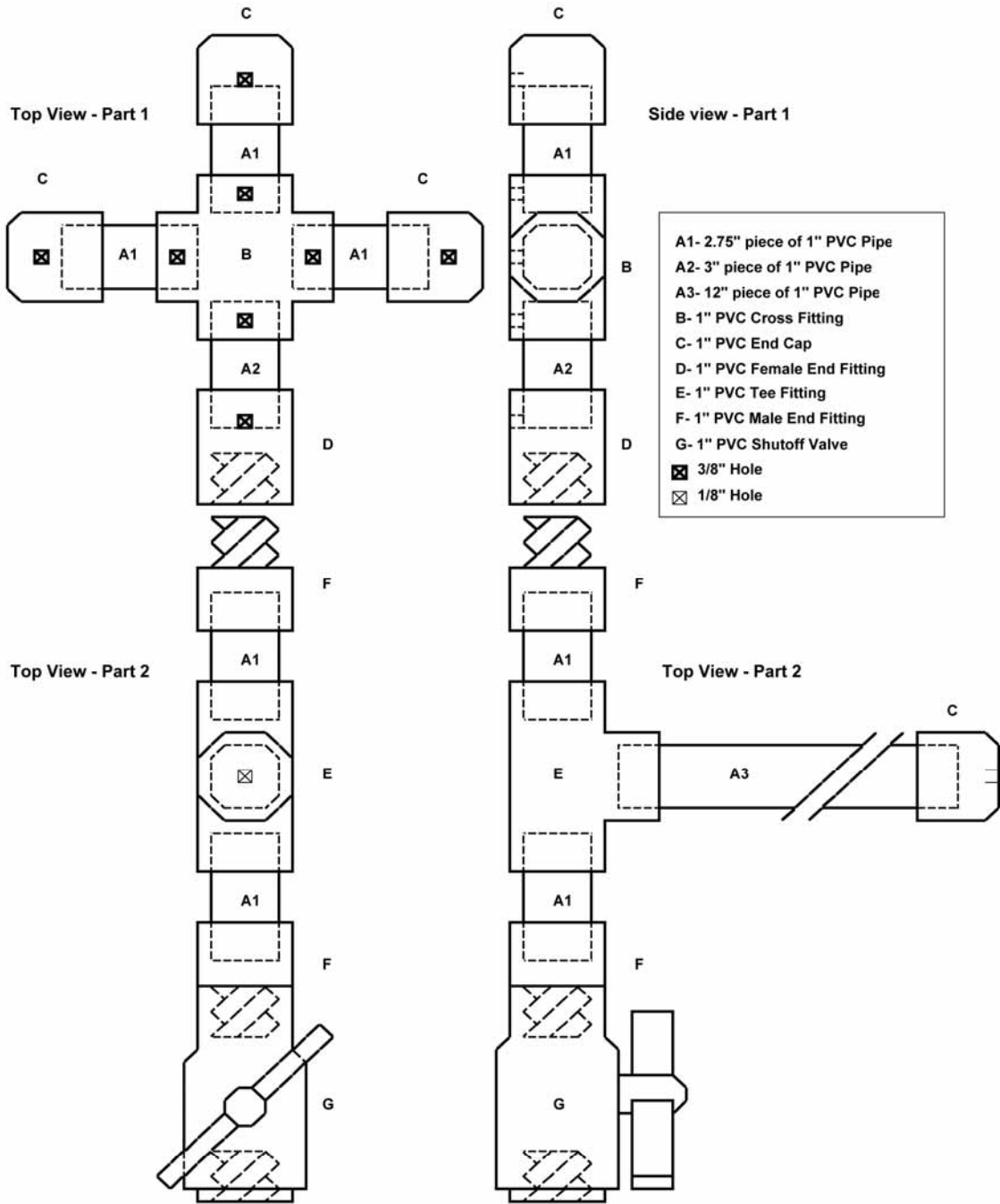


Figure 1: Part 1 (inner plumbing) and Part 2 (outer plumbing). Not to scale.

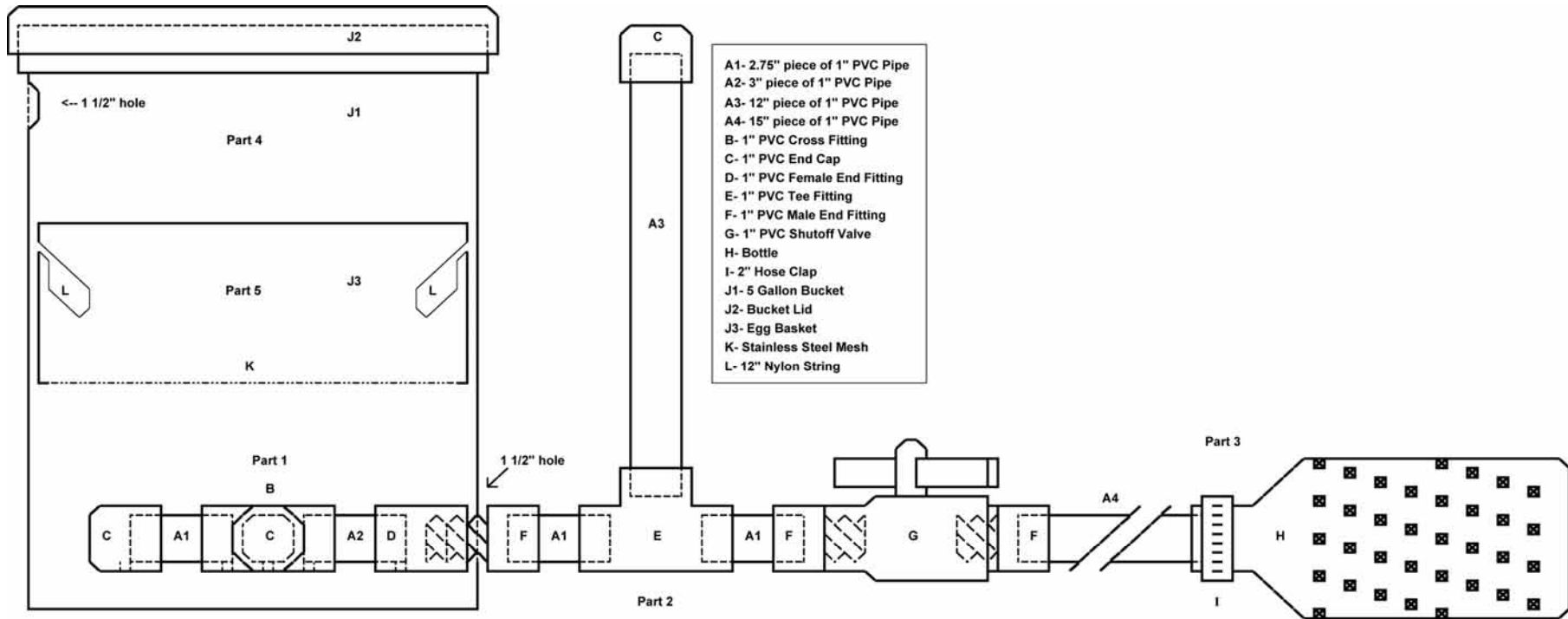


Figure 2: Final assembly side view- Parts 1 (inner plumbing), 2 (outer plumbing), 3 (inlet pipe), 4 (bucket w/ lid), 5 (egg basket). Not to scale.

Specific RSI instructions for Cherry Creek project

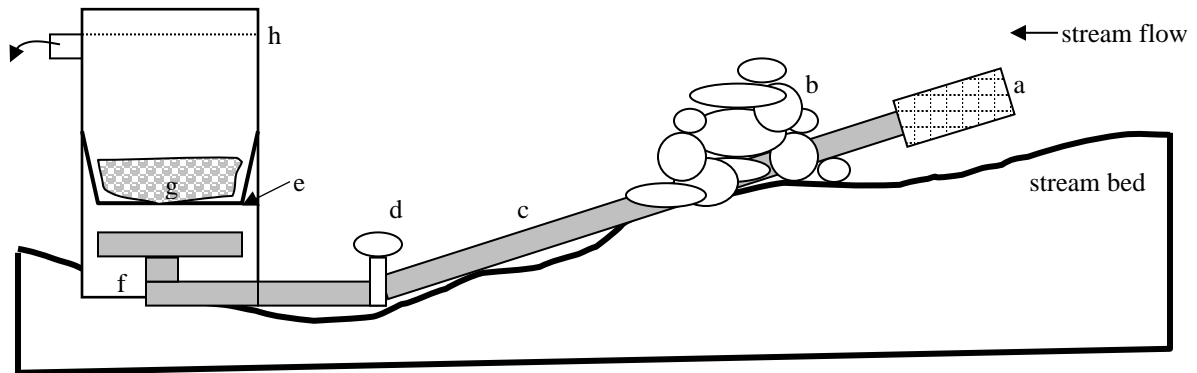


Figure 1. Diagram of RSI used to incubate eggs and fry. Letters designate (a) filter, (b) rock and plastic dam to control stream depth, (c) water supply pipe, (d) flow regulator, (e) gravel substrate and screen, (f) diffuser, (g) bio-saddle basket, and (h) water level maintained in RSI.

1. Placing embryos in RSI's
 - a. Do not mix egg lots from wild streams into same RSI
 - b. Keep eggs cool / cold...perhaps cool them down. Add fresh water (50%) once you hit the stream.
 - c. Try not to add more than 500 eggs per RSI
 - d. Release similar age embryos (only a few days apart)
 - e. When placing eggs in RSI's
 - i. Turn water off before you put eggs in. Don't forget to turn water back on.
 - ii. Do not expose embryos to direct sun light.
 - iii. Note number dead eggs (white) prior to placing in RSI. Don't try to remove them.
2. RSI maintenance
 - a. Only remove lid from RSI when necessary. Lid can be lifted slightly to see if fine sediment has accumulated in RSI and check water level.
 - b. When the lid is removed from the RSI, try to prevent direct sunlight from entering the incubator by placing yourself between the incubator and sun.
 - c. After most eggs have hatched (2 – 3 days after initial fry observed), the lid should be partially removed (1/8 to 1/4 covered and stabilized with a rock) for 7 - 10 days to allow fry to adjust to sunlight. After 7 –10 days the lid can be completely removed.
 - d. If fine sediment accumulates within the incubator, it can be dislodged and flushed by gently swirling water in the incubator by hand, or by gently lifting and dropping the egg basket (e) within the water column. If basket is lifted, make sure it settles against the edge of the bucket. Cleaning

should not be necessary if sediment is negligible. Be careful to not flush eggs out of the incubator.

- e. Clean pipe screen, if needed
 - f. Maintain dams at water inflows to maintain 28 cm of head (water in RSI bucket up to outlet pipe to fry capture-bucket but does not overflow RSI bucket).
 - g. Can use plastic sheeting to seal dams and raise head.
3. Fry capture buckets
- a. If no fry are seen in capture bucket for a week or more, remove RSI lid and check egg basket or, where "egg baskets" are used, gently remove some bio-saddles to reveal egg/ fry on the gravel to check their development. Unless there are large differences in water temperatures between incubators, it should only be necessary to look at egg development in a small sample of the incubators.
 - b. Adjust fry capture-buckets so current into bucket from stream is very low velocity to avoid impinging fry
 - c. Period of fry dispersal is usually 7 to 10 days, but may have stragglers
4. Record keeping
- a. Record number of fry released each day from each RSI
 - b. Note if any problems with any RSI and adjustments made to RSIs
 - c. Note if dead fry are seen in capture-buckets
 - d. Note if any RSI has evidence it has been disturbed by animals