Salmon eggs recovered from a natural redd near hatch time. When they die eggs become opaque.

**Why do salmon eggs die in redds?**

Salmon swim in rivers, releasing their eggs into a depression made in the gravel of the river bed to form a redd. It is known that many eggs die in redds, and this is usually attributed to an inadequate supply of oxygen, caused by infiltration of fine sediment into the streambed which reduces the flow of water to the eggs.

However, another factor may be involved since research shows that many eggs survive in the Newmills Burn, a degraded agricultural stream. Eggs were placed in the redds to monitor mortality and development. Several redds were monitored in a near-natural stream, the Girnock Burn, and in the Newmills Burn, a degraded agricultural stream.

These studies showed that:
- oxygen levels were lower in hyporheic water than in stream water;
- levels were lower at greater depth in the hyporheic zone;
- levels varied widely over the period of egg incubation.

**Tracking oxygen levels in redds**

As part of an FRS collaborative research project, groundwater and oxygen levels were tracked over the winter and spring in simulated redds in locations used by spawning salmon. Eggs were placed in the redds to monitor mortality and development. Several redds were monitored in a near-natural stream, the Girnock Burn, and in the Newmills Burn, a degraded agricultural stream.

Oxygen levels vary with time and depth beneath the stream bed. In the redd shown above, oxygen levels at 300mm depth approached zero during episodes of groundwater dominance associated with low stream flow. Hyporheic conditions were not noticeably worse in the degraded Newmills Burn than in the near-natural conditions of the Girnock Burn.

Oxygen levels in redds responded to the changing balance of groundwater and surface water in the hyporheic zone. Groundwater was dominant in the aftermath of floods or when surface water flow was reduced by severe frosts. During high flows, the contribution of surface water increased. However, even in redds that were only a metre apart, oxygen levels differed markedly in their response to all these types of change, emphasising the complexity of the mixing processes that occur in the hyporheic zone.

**Egg mortality caused by low-oxygen groundwater**

Low-oxygen groundwater kills salmon eggs. By hatching time, all the eggs in the most vulnerable redds had died. In redds where some eggs did survive, survival rate was dependent on the quality of the hyporheic environment. Survival rate was proportional to the average levels of oxygen that eggs experienced during their development.

As a general guide, no eggs survived in redds where average oxygen levels were less than 7 mg/l. 1

**Summary**

- the hyporheic zone is an unseen but important component of stream habitat that is used by salmon for spawning;
- intrusion of long-residence groundwater into the hyporheic zone can kill salmon eggs;
- even in the best spawning streams, the hyporheic environment is a potential constraint on the survival of eggs.

For further information see: