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Inability of salamanderfish, *Lepidogalaxias salamandroides*, to tolerate hypoxic water

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The salamanderfish, *Lepidogalaxias salamandroides*, is the sole member of the Osmeriform family Lepidogalaxiidae and is only found in the southwest corner of Western Australia. The preferred habitat of this small (maximum SL 67 mm) fish includes freshwater pools that evaporate during the summer (Allen and Berra 1989). Salamanderfish survive the desiccation of their habitat by burrowing into the damp substrate and remaining moist as the groundwater retreats from the surface. The fishes emerge from the bottom within minutes after autumn rains partially fill the dry pools (Berra and Allen 1989).

A recent study demonstrated that salamanderfish have the ability to exchange O_2 and CO_2 through their skin while out of water as long as they remain moist. Martin et al. (1993) showed that during aerial respiration an average of 83% of the VO_2 and 69% of the VCO_2 exchange took place across the posterior cutaneous surfaces. This high level of cutaneous respiration confirms that the swimbladder is not used as an accessory aerial respiratory structure (Berra *et al.* 1989).

In order to determine if salamanderfish have any special ability to tolerate low O_2 conditions in water the following experiment was conducted at the Western Australian Museum in October 1988 with newly collected salamanderfish from Station 22 (Berra and Allen 1989) and other species from a nearby stream.

Nitrogen gas was bubbled through 1l of aquarium water at 19°C via an air stone at a pressure of less than 3 psi in order to remove dissolved oxygen. Four trials were run, in which *L. salamandroides* (N=6, $\bar{x}$SL = 30 mm) was compared with three other fish species (*Edelia vittata* (N=l, SL =34 mm), *Galaxias occidentalis* (N=3, $\bar{x}$SL=70 mm), and *Galaxiella nigrostriata* (N=6, $\bar{x}$SL=28)). A polarographic oxygen probe connected to an air-calibrated ICM type 30 oxygen meter (accuracy: ± 2%) was immersed in the water, and the dissolved oxygen levels were recorded. The reactions of the fishes were observed; when they exhibited signs of ataxia, they were removed to fresh oxygenated water.

Dissolved O_2 at the beginning of each experiment was 6–7 ppm. The fishes swam normally or sat on the bottom in the case of *Lepidogalaxias* until O_2 levels reached approximately 1.0 ppm. In most cases this occurred within 5 minutes. At 1 ppm, all fishes began leaping and gulping air at the surface. Approximately 2–3 minutes after the O_2 tension reached 0.8 ppm all species became ataxic. They lost the ability to right themselves and lay on their sides on the bottom. At this point the fishes were removed to fresh aerated water. All recovered and were swimming normally within a few minutes. There was no noticable difference in the reaction of *Lepidogalaxias* and the other species. The smallest fish of each species was the first to succumb; *Galaxiella* appeared to tolerate the low pO_2 slightly longer than the other 3 species.

We conclude that salamanderfish have no special ability to tolerate hypoxic water. The ability to survive in their ephemeral habitat depends upon burrowing into the substrate and remaining damp on the water table below the surface during times of drought. During this time the fish presumably enter a lowered metabolic state and respire cutaneously. The nature of this aestivation and what environmental cues trigger it remain to be determined.

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