Noldus
Information Technology

Using computer imaging to measure spontaneous locomotor activity in fish

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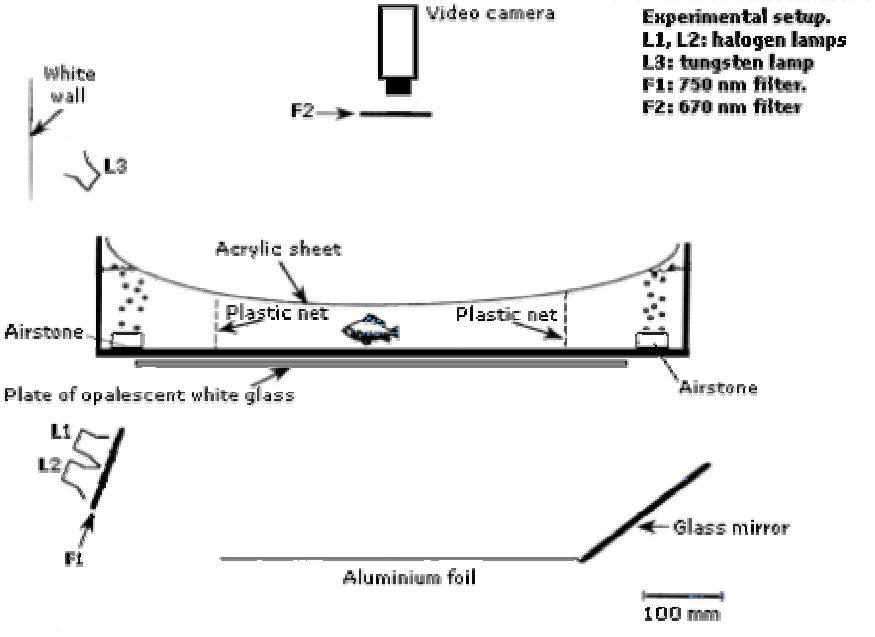
Using EthoVision for Animal Behavior Research

Experimental setup

In two studies, we have examined factors affecting spontaneous locomotor activity in fish. A similar setup was used in both studies. A Panasonic WV-BL200 video camera (4.8 mm lens, 0.5 lux light sensitivity) from which the IR-filter had been removed was placed above the test area (450 x 320 mm). Two 20 W halogen lamps equipped with red glass filters (RG 780, Melles Griot), with no transmission of wave lengths shorter than 750 nm, were used as the light source for the video camera. This infrared light was reflected by a glass mirror and a sheet of aluminum foil through a plate of opalescent white glass situated immediately below the bottom of the test area. On the video monitor this arrangement gave a light background, without reflections, against which the fish was readily detected. The visible light for the light/dark regime was provided by a 60 W tungsten lamp directed against a white wall 100 cm from the test area, hereby giving an indirect light in the test area. Disturbance of the video picture by reflections of visible light was prevented by a Kodak Wratten filter 89B (which has no transmission of wave lengths shorter than 670 nm) mounted in front of the camera lens. The video camera was connected to an IBM-compatible computer (386DX CPU, 20 MHz) equipped with a PC-VISIONplus video digitizer (Imaging Technology, Inc.). An early version of the EthoVision software was used for video tracking and motion analysis.



Role of brain serotonergic activity

The first study [2] was aimed at investigating the role of the brain serotonergic system in spontaneous locomotor activity of Arctic charr (*Salvelinus alpinus*), a fish that forms strong social hierarchies. Fish were put together in pairs. After one week the spontaneous locomotor activity of dominant and subordinate individuals from these pairs was recorded for 18 h (12 h dark, 6 h light). The subordinate individuals showed significantly lower locomotor activity than the dominant fish. Locomotor activity was also measured in fish where the serotonergic system was stimulated or inhibited pharmacologically. Fish treated with the serotonin (5-HT) synthesis inhibitor para-chlorophenylalanine

showed a significant increase in locomotor activity. By contrast, treating fish with the specific 5-HT re-uptake inhibitor zimeldine significantly reduced locomotor activity. Taken together these results suggest an inhibitory role of the serotonergic system on locomotor activity, and that this may underlie the reduced activity displayed by subordinate fish.

the Artic charr (*Salvelinus alpinus*)

Anoxic depression of locomotion

The second study [1] focussed on the crucian carp (*Carassius carassius*), one of the most anoxia-tolerant vertebrates. A major strategy used by the crucian carp to survive anoxia is to lower its rate of energy consumption. Anoxia-tolerant fish are known to simultaneously utilize two different strategies for reducing energy consumption during anoxia, the first being a reduction in locomotor activity and the second being a depression of cellular energy demands. Nevertheless, the reduction in locomotor activity during anoxia has never been measured quantitatively. This lack of information has apparently been caused by previous technical problems in measuring spontaneous locomotor activity in fish. Our study showed that crucian carp respond to anoxia (330 min at 9 EC) by rapidly decreasing locomotor activity (spontaneous swimming distance) to about 50% of that displayed during normoxia. Frequency diagrams of spontaneous swimming speed showed no bimodality and indicated a general decrease in swimming speed from a median value of 1.82 m/min during normoxia down to 0.82 m/min during anoxia. It was tentatively estimated that the anoxic depression of locomotor activity corresponds to a 35-40% reduction in total energy consumption.

References

1. Nilsson, G.E.; Rosén, P.; Johansson, D. (1993). Anoxic depression of spontaneous locomotor activity in crucian carp quantified by a computerized imaging technique. *J. Exp. Biol.*, **180**, 153-163.
2. Winberg, S.; Nilsson, G.E.; Spruijt, B.M.; Höglund, U. (1993). Spontaneous locomotor activity in Arctic charr measured by a computerized imaging technique: role of brain serotonergic activity. *J. Exp. Biol.*, **179**, 213-232

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