

## **Swimming performance of jack mackerel examined by EMG/ECG monitoring**

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**[Objective]** The physiological condition of jack mackerel, *Trachurus japonicus* was monitored using an electrocardiography (ECG) and electromyography (EMG) technique during swimming exercise, for determining the sustained and prolonged speed level, and during the recovery phase in relation to exhaustion level.

**[Method]** The white muscle and heart rate activity of jack mackerel (17.2-19.8 cm FL, n = 5) during swimming in a flume tank was monitored. The measurement of white muscle and heart rate activity was set together, by implanting each pair electrode of insulated stainless wires of 10 mm in length and 0.2 mm in diameter were connected with 3 insulated copper wire cables respectively at pericardial cavity and lateral muscle, and linked to digital oscilloscope via bio-amplifier. After the implantation of electrode and recovering for 180 min from anesthesia, ECG and EMG monitoring was started for 30 min in still waters as a control, and continued during swimming exercise at flow speed of 29 to 114 cm/s. The flow speed was increased every 10 min at 14.2 cm/s step up. After the fish terminated the swimming, the flow was stopped for monitoring the heart rate in recovery phase with same condition to the control.

**[Results]** EMG monitoring demonstrated that the activity of white muscle was firstly occurred at the swimming speed of 71.4-99.6 cm/s (3.7-5.3 FL/s), when the tail beat frequency was over 6 Hz. The result indicated that the threshold level for prolonged speed by muscle activity was around 4.0 FL/s. The power output of white muscle was increased from 0.8-1.0  $\mu\text{V/s}$  at speed of 3.3-4.0 FL/s to 5.0-5.8  $\mu\text{V/s}$  at 4.7-5.7 FL/s. The heart rate was not so much increased in the lower speed range of 1.6-3.2 FL/s against the control of 45.6-76.0 beats/min on average in still water. The higher heart rate was monitored as 96-143 beats/min on average at the higher speed of 4.1-5.0 FL/s. The recovery time monitored by ECG as the time required from the peak heart rate to the control level was 5 hours after terminating the swimming at prolonged speed.