2006 TAIWAN INTERNATIONAL SCIENCE FAIR

CATEGORY : Environmental Science

PROJECT : Development of a bio-monitoring system using behavioral pattern recognition of the medaka(Oryzias latipes)

AWARDS : Environmental Science Second Award

SCHOOL : Korean Minjok Leadership Academy

FINALISTS : Kim, Jee Hoon

Baek, Jae Yeon

COUNTRY : South Korea

APPENDIX 2

ABSTRACT OF EXHIBIT
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TITLE: Development of a bio-monitoring system using behavioral pattern recognition of the medaka (*Oryzias latipes*)

NAME: Kim, Jee Hoon & Baek, Jae Yeon

COUNTRY: Rep. of Korea

Water pollution is a severe problem for human beings. Sewage and hot water coming from homes and factories have changed the environment for aquatic animals. To manage a polluted environment, an accurately designed monitoring system is needed that will detect signs of toxic material or increase in temperature as fast as possible. A new and more accurate bio-monitoring system, which involves actual creatures, needs to be developed to save the aquatic environment from pollution.

This experiment focused on discovering a new way to monitor aquatic creatures by observing the behavioral patterns of the medaka and observing how they changed when exposed to external stress, especially an increase in temperature or exposure to insecticide. The behavioral patterns of the medaka were observed and measured by a tracking program called the Movement Viewer. In the transition period, that is, when the temperature was raised from 25°C to 35°C, the total moving distance of the medaka suddenly increased compared to that in 25°C. When the medaka was in a temperature of 35°C, it slowly adapted to the new environment and the total moving distance showed a similar value to that in 25°C. For section dominance, the medaka showed a sudden increase in the dominance of the top part of the tank, meaning that the medaka tended to swim on the surface of the experimental aquarium. Again, it slowly adapted when the temperature had completely changed to 35°C.

Empirical decision logic was developed to identify behavioral patterns using three factors: high-speed ratio, FFT (Fast Fourier transformation) to Angle Transition, and projection to x-y axis. If the high-speed ratio of the medaka was over 50, the pattern was considered as “active.” If below 50, “inactive.” If the FFT to Angle Transition was over 110, the pattern was considered “shaking,” and if below 110, “smooth.” The projection to x-y axis was used to confirm the logic of the decision tree for each pattern. The behavioral patterns could be classified into four

patterns: active-smooth, active-shaking, inactive-smooth, inactive-shaking. Using these four patterns, a computer program using MATLAB was made that could count the number of each pattern for a given period of time. For the experiment concerning an increase in temperature, the medaka showed a sudden increase in active-smooth patterns in the transition period. The number of active-smooth patterns slowly declined after. For the experiment concerning insecticide, there was a sudden increase in the active-smooth patterns, especially during the first hour after insecticide treatment. For the rest of the time, the medaka again, slowly decreased in active-smooth movement.

In conclusion, medaka showed sudden increase in active-smooth movement when the medaka receives external stress-increase in temperature or insecticide in this research. After some time, the medaka slowly adapts to the new environment, which can be shown by the slow decline of active-smooth patterns after the stress is received. If this characteristic of the medaka is used in natural bio-monitoring systems, we think that a more accurate, cheaper, and easier system can be developed for managing a healthy aquatic environment.

評語

本作品探討水溫改變與添加 diazinon 殺蟲劑，對 medaka 魚游移型態之改變情況，利用攝影機與電腦進行 statistical analysis 及 Empirical decision logic 分析，而將其游移型態分成 Active smooth，Inactive smooth，Active shaking 及 Inactive shaking 四類，用以發展水質污染之生物偵測系統。游移行爲可能受到影響之因子甚爲複雜，要歸納成爲可應用之生物偵測系統，以目前之成果來看，仍有很大的困難度。