
(Puntius barbuis)

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(Puntius barbuis)

Z Y X

PMP

)

(

Z Y X

PMP

.(P<0.05)

(P<0.05)

...

)

LeMorvan-Rocher *et al.*, 1995; Franklin *et al.*,
1990).

Tanck *et al.*, 2000.

(Duarte *et al.*, 2008)

(Barton and Iwama, 1991)

(Kramer *et al.*, 1982)

(Israeli and Kimmel, 1996)

(Kristiansen *et al.*,

2004; Mcfarlane, *et al.*, 2004).

(Stradmeyer, 1989; Brannas and

Alanara, 1993; Reig *et al.*, 2003).

(Nogita *et al.*, 1998; Kane *et al.*, 2004)

(Askarian and Kousha, 2006)

(Kondaiah and Murty, 1994)

(Elliot, 1981)

(Xu *et al.*, 2006)

CCD
Sony, DSC- W35, MPEG movie, Kodak, C743,
MPEG movie

(*Puntius barbuis*)

x x

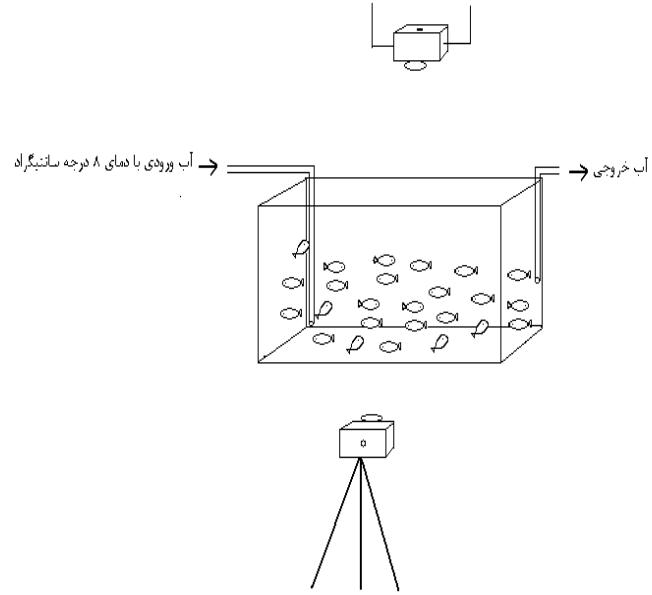
PRG

l) Ph () :
(l l) (l

³ charge coupled devices

² Schooling

...



t

SPSS

.()

()

I= image 0
 B= Back ground image
 Binary image = [I- B]

()

PBS

X ,

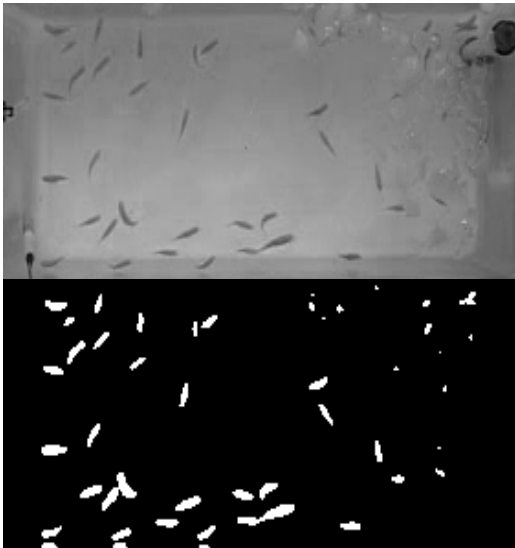
Y, Z

(Israeli and Kimmel, 1996) .

()

ELISA

$$CX = \frac{1}{N} \sum_{i=1}^n Ai Xi$$



Binary

Borland)

C++

Grabber

(International

1.0.0.1

Delphi

IBM PRG

0.1

Ai

CX

N X

Xi

project

X

⁴ Phosphate Buffered Saline

⁵ Binarization

...

X

X

Y

Z

X

)

/

PMP

$$(j=1, 60) = F_j$$

(P<0.05)

()

/

Israeli and) .

Y

(Kimmel, 1996

()

$$PMP = \frac{1}{8} \sum_{j=2}^{60} |F_j - F_{j-1}|$$

× F_j

PMP⁶

()

(P<0.05)

Z

()

(P<0.05)

:X,Y,Z

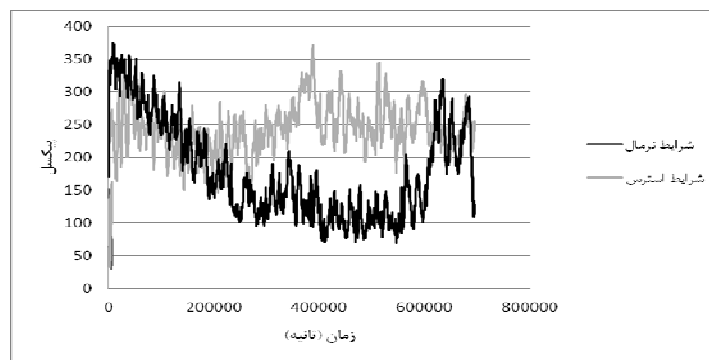
X,Y,Z

⁶ projected mobility picture
⁷ mobility

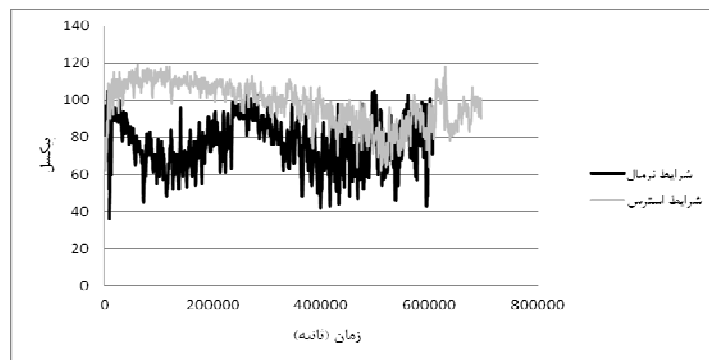
PMP

PMP

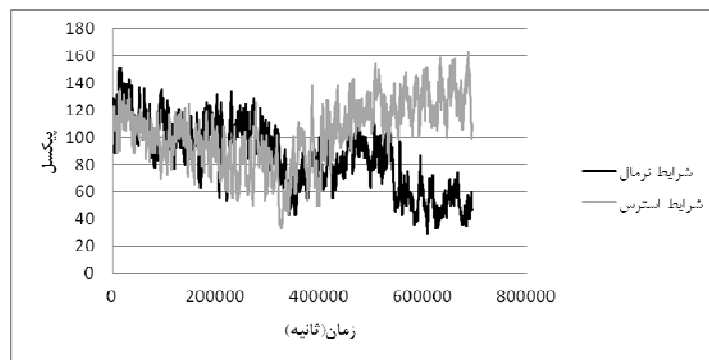
PMP



X

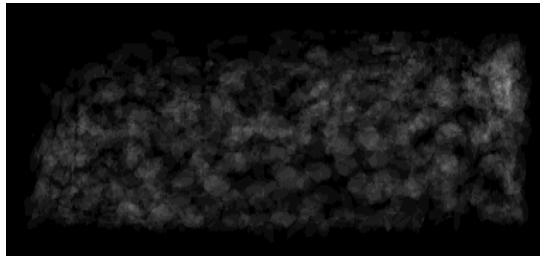
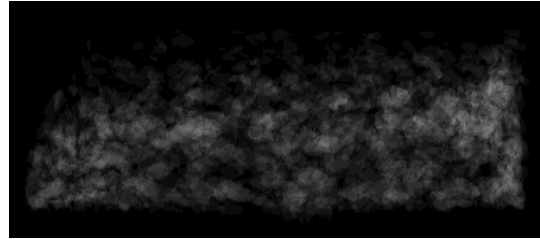
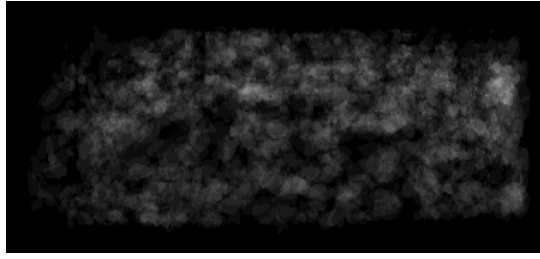


Y



Z

...

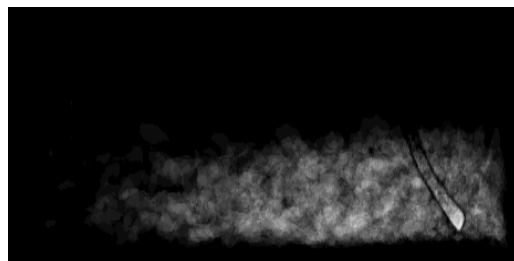
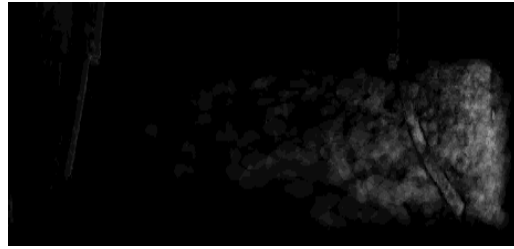


PMP

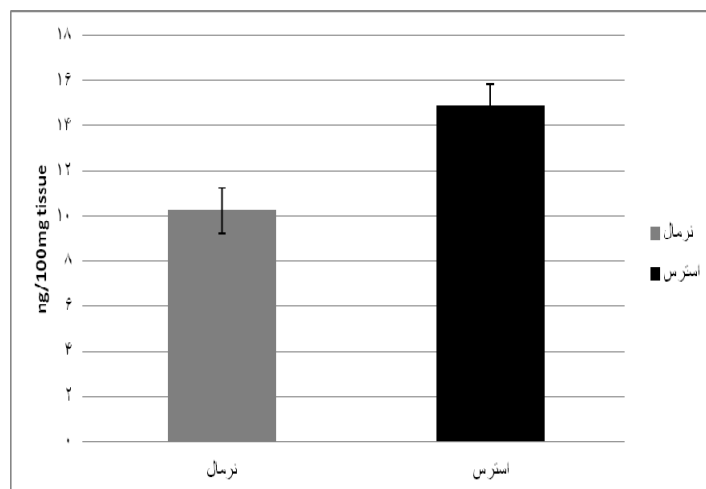
PMP

() (P<0.05)

()



PMP



($P < 0.05$)

...

.Xu *et al.*, 2006)

.(Schwan and Lamberti, 1986;

PMP

.()

Israeli

and Kimmel, 1996

(Xu *et al.*, 2006)

PMP

Matlab 6.5

Delphi

PMP

PMP

/

Matlab

Hubbs *et al.*, 1967; Cichocki, 1977; Metcalfe

.(and Butler, 1984)

Matlab

PMP

Israeli &)

(Kimmel, 1996

(*Carassius auratus*)

X,Y,Z

(Strange, 1980; Davis *et al.*, 1984)

HPI

Barton and Wendelaar Bonga, 1997)

(Iwama, 1991;

(Tanck *et al.*, 2000)

(*Ictalurus punctatus*)

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Quantification of Schooling Behavioral Responses of Rosy Barb (*Puntius barb*) to Acute Decrease Temperature Fluctuations Using Computer Vision

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Abstract

In order to quantify of schooling behavioral responses of Rosy barb (*Puntius barb*) subjected to acute decreasing temperature stress monitored by computer- vision system. Four aquaria as duplicate with a density of 30 fish per unit were used for rearing of fish in normal and stress conditions. Some geometric schooling parameters such as average location of center gravity school and distance of coordinate axels X, Y, Z and average of swim speed were used for calculating. Additionally mobility and density of fish school were evaluated by the 'Projected Mobility Picture' (PMP) index. Expressed indices for normal temperature condition were compared with acute stress of low temperature. Cortisol was measured from whole body with sampling 6 fish before and after stress. The results showed that schooling behavioral was changed by entering, 8°C water, and expressed indices were different significantly. While average location of center gravity school and distance of coordinate axels X, Y , Z showed intensity fluctuations in all three directions was correlated with spreading and contracting of the school. PMP index showed an accumulation of the school in the outlet area. The average of swim speed of fish school decreased under stress conditions compared to normal conditions ($P < 0.05$). Cortisol levels increased significantly after stress which support behavior parameters ($P < 0.05$).

Keywords: Fish schooling behavior, Image processing, Cortisol hormone, Rosy barb