Disruption of social foraging in turbid water

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INTRODUCTION

The ideal free distribution (IFD) theory (Fretwell and Lucas, 1970) predicts that the distributional ratio of foragers at two different patches will be equal the ratio of food resources available at the two patches. The theory assumes that foragers have ´perfect knowledge´ of the patch profitability, all foragers are equal competitors and free to enter each patch on an equal basis. Then patch choice maximizes fitness.

Today many costal aquatic environments faces sudden algal blooms due to eutrophication. Increased turbidity may hamper the ability of foragers to obtain 'perfect information'. We examine the effects of algal turbidity on the prediction of the IFD under a `continuous-input conditions` in which food resources were consumed immediately.

RESULTS

Fish in the turbid environment were unable to distribute themselves according to the IFD prediction, especially in the 2:1 food ratio treatment (Figure 2a). In the 5:1 ratio treatment there was no clear difference between fish in the clear and turbid water (Figure 2b).

METHODS

Water fleas (*Daphnia magna,* 3±1 mm) were supplied through continuous water flow into a tank (70X25X35 cm) from two opposite side maintaining two different reward ratios, 2:1 and 5:1 (Figure 1). A group of six hungry female three spined stickleback (*Gasterosteus aculeatus*), equal in size (6.0±0.2 cm) were released into the tank to forage there for 15 minutes. The distribution of sticklebacks between the two different food sources were observed in two different aquatic condition: clear (<1 NTU), and turbid (<10-12 NTU) water. Here we present the data for 4-9 Min.

Experiment Organisms

Female three spined stickleback (*Gasterosteus aculeatus*)

Water Flea (*Daphnia magna*)

Experiment Design
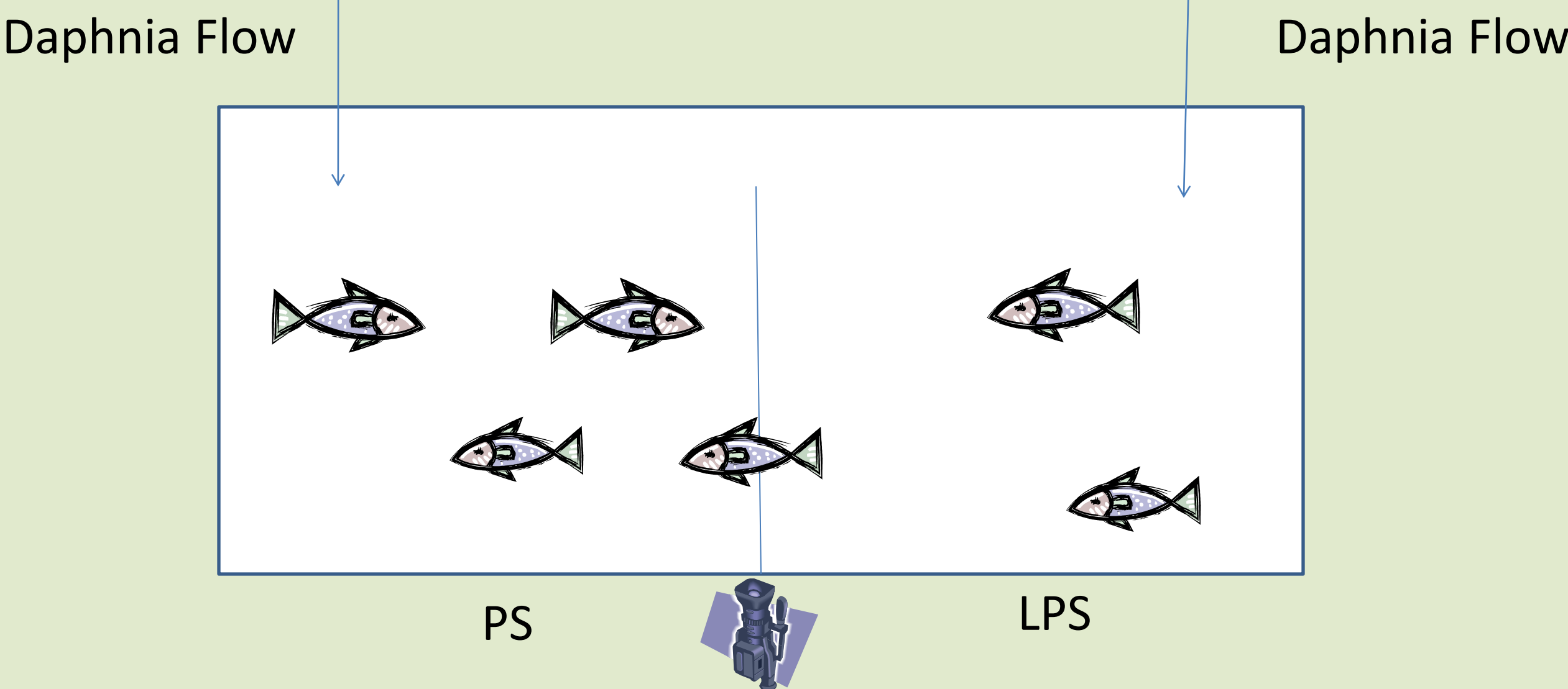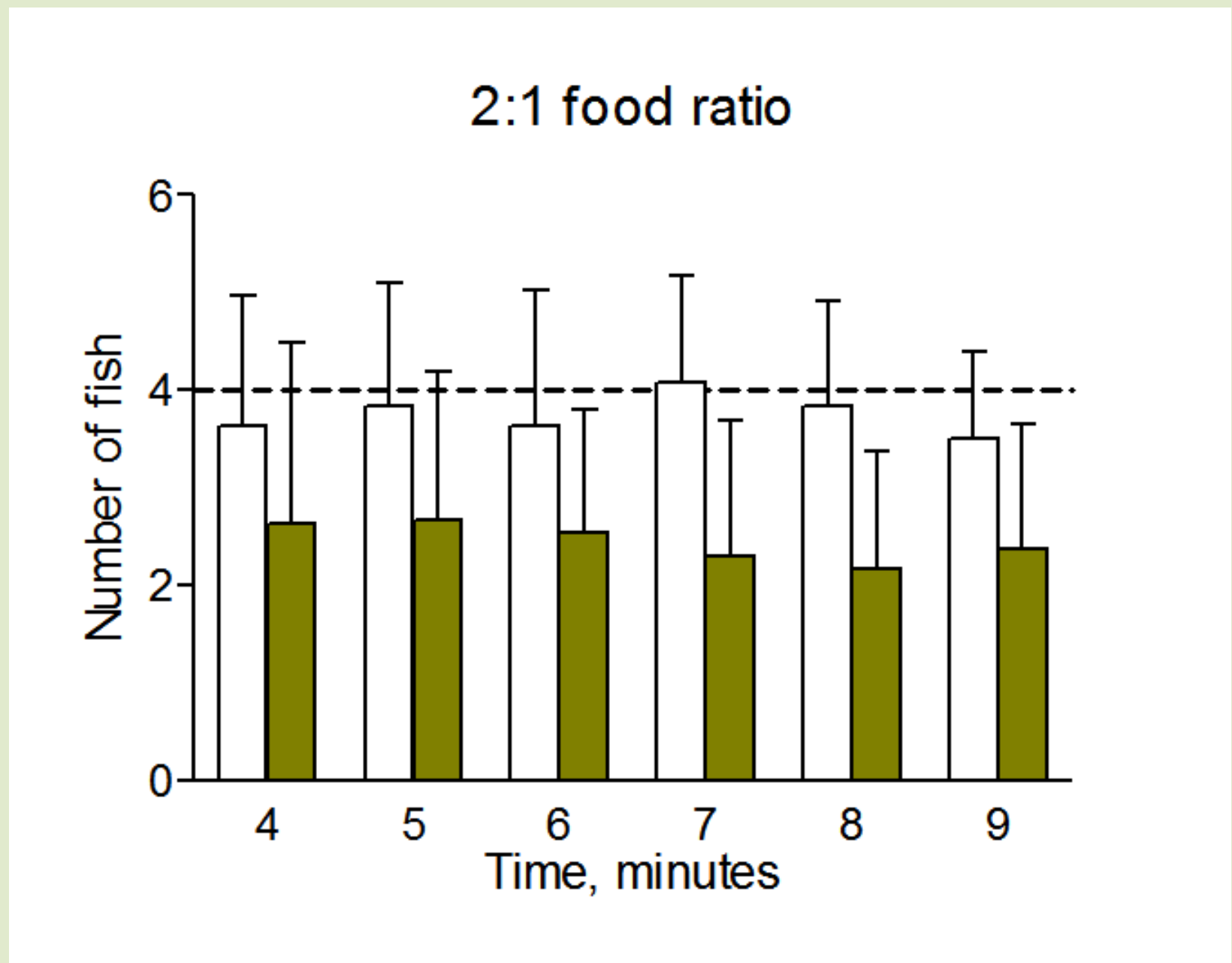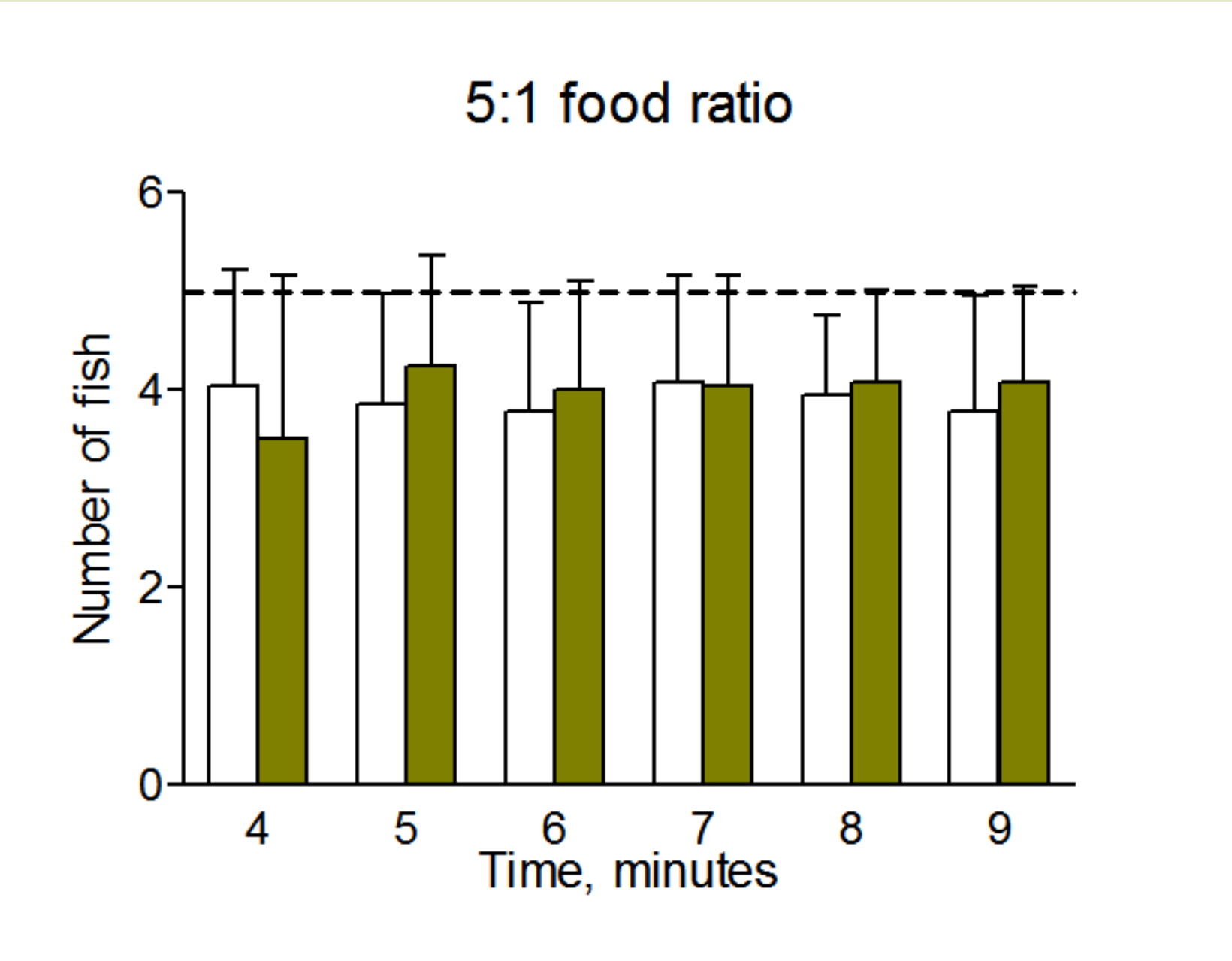

Figure 1. Fish roaming for food, PS: Profitable Side;LPS- Less Profitable Side, Middle line indicating the virtual dividation of the tank

2a

2b

Figure 2: Average number of fish present in profitable side in a) 2:1 ration; b) 5:1 ratio in 4-9th minutes.

Table 1: Repeated measures ANOVA of number of fish at the more profitable food patch. The result of the between subjects test are given

Source	SS	df	MS	F-ratio	p
Ratio	109.515	1	109.515	24.297	<0.001
Water treatment	56.171	1	56.171	12.462	<0.001
Interaction	71.562	1	71.562	15.876	<0.001
Error	432.711	96	4.507		

DISCUSSION AND CONCLUSIONS

This result suggests that sticklebacks rely on visual clues when foraging for food. In clear aquatic condition sticklebacks conformed closely to the IFD prediction, especially in the 2:1 ratio. It is easy for them to identify profitable food patches by either gathering personal information or by using public information. In comparison they were less successful at sorting themselves in the turbid condition, especially in the 2:1 ratio. Here the difference between the stations in reward rate was smaller so it is possible that personal information was harder to obtains and public information was not available due to turbidity. In 5:1 ratio reward rates were very different tand personal information readily available for decision making.

In the 5:1 the fish deviated from the IFD prediction. This could be due to aggressive among the individuals when excessive number of individuals gather in one patches.

Our study shows that increasing turbidity can have detrimental effects on foraging success in social foragers. This can lead to fitness reduction in terms of weaker condition of fish but it can also affect group behavior by making schooling a less profitable strategy.

Reference:
Fretwell SD, Lucas HL (1970) On territorial behaviour and other factors influencing habitat distribution in birds. I. Theoretical development. Acta Biotheoretica 19.16-36