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Fundamental study on the behavior of milkfish fry for the evaluation of the efficiency of traditional fry collecting gears in the Philippines

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The response of the fry to moving and stationary net of different mesh size and color in the experimental tank, underwater visibility of the net and water filtration were observed. Black nylon twine of 0.53 mm diameter was stretched vertically on a blue-painted wooden frame at intervals of 0.5, 1.0, and 2.0 cm; and white nylon twine of the same diameter, at 0.5 and 2.0 cm. In the following discussion, these will be referred to as black 0.5, black 1, black 2, white 0.5, and white 2. In addition, nylon-monofilament white, blue and black mosquito net with filament diameter of 0.24 mm and mesh of 0.8, 0.8 and 1.4 mm respectively, were also attached to the wooden frame.

When the fry were introduced into the experimental tank, they swam continuously, forming one or two schools and showed no preference for any particular area in the tank. They could easily be driven by shaking a hand in the air. When the fry were blocked by the stationary frame without the net, all schooling companions passed through the frame at once and no response to the frame could be recognized. But when the frame was moved, the fry were sometimes driven up to the opposite wall. The driving was almost perfect when the fry were distributed at the bottom, and imperfect when they were in the mid-layer or surface of the water.

When the fry driven to one end of the tank were blocked by a stationary net, they rotated forming one or two schools in the compartment inside the net. When a school approached the net, a small part of the school escaped through the black 0.5, and the majority of the school escaped through the black 1 and 2 and through white 0.5 and 2. This shows that black and white twine have different effects on the fry: the fry readily and quickly escaped through the white twine, but were retained for a much longer time in the black. In the pairs black 0.5-black 1 and black 0.5-black 2, the tendency of change for either and both black 1 and 2 is steeper than for black 0.5. There was no remarkable difference between black 1 and black 2 neither between white 0.5 and white 2. From these results it can be concluded that milkfish fry easily escape through the mesh of white twine and mesh larger than 1 cm of black twine. The retaining efficiency of the twine and mesh used could be arranged in descending order as follows: black 0.5, black 1 and black 2, white 0.5 and white 2.

The response of the milkfish fry to the moving net varied slightly with the mesh and color of the twine. The fry swam forward in a relatively dense school keeping a distance of about 10-45 cm from the moving black twine; they formed a looses school keeping a distance of about 3-45 cm from the moving white twine. The number of fry that passed through the net at different points in the tank are given in Table 1. Remarkable differences in the number of escaped fry, according to mesh and/or color, could be seen at the 30 cm and 15 cm positions (from the oppo-

Table 1. Number of fry that passed through the mesh of the moving twine at different points in the tank.

Color Mesh	Distance of moving net from the opposite wall in cm 210	195	180	165	150	135	120	105	90	75	60	45	30	15	Number of fry finally retained
	5		13						5	5				172	0
White												50		100	50
									1					100	100
5 mm														100	100
	4	20	50	30											100
															200
Black															200
														100	100
5 mm														100	100
															200
													100		100
Black												50	100	50	0
												50		150	0
2 cm											8	60	30	100	0
													150	150	0
														10	190
Black													3	14	183
													20	100	80
5 mm													80		120
													30	10	160
		30	3		10							2	2	70	80
Black		20			2				1			2	1	100	75
	70	10				3				3	3		10	30	70
1 cm	30	2	1							4		5	10	100	50
	5	30		3			1				10		10	100	40
	1	1	10						3				20	70	100
Black													2	30	170
	5	3	2		3							1	3	60	120
5 mm	8												30	70	90
	10	20	1			3	2	3			7	3	1	30	120
	1										3		120	80	0
White		1	1					2	1			80	100	20	0
	1	1	10			1		1			1		30	150	10
2 cm									1		3		100	20	80
						1			1	7	50		30	100	10
												30	4	90	100
White													50	20	130
	4	2	1								2		30		100
5 mm													30	20	150
	5										5		40	50	100

site walls); so also in the number of fry finally retained. In the first pair, all fry were retained by black 0.5 in three of five trials, with less than half retained by white 0.5. Both black 0.5 and black 2 (second pair) effectively drove the fry, but no fry was finally retained by black 2 in four of five trials. In the third pair, the fry escaped through both black 0.5 and black 1 at positions close to the starting point, although more fry were retained by the former. In the fourth pair, white 0.5 retained more than half of the fry while only a few were retained by white 2. Driving efficiency in descending order as follows: black 0.5, black 1, black 2, white 0.5, white 2.

The response of milkfish fry to the moving mosquito net is indicated as the distance between the net and the last member of the school moving forward away from the net (Figure 1). When the fry was pressed to the net by water pressure, the distance was recorded as zero. When the fry encountered the net moving against the light, they turned about and kept a good distance ahead of it. Results indicate that the underwater visibility of the net probably varies with the lighting condition: surface lighting when the net was move against the incoming light, and contour lighting when the net was moved in the same direction as the incoming light. The white mosquito net (and the white twine) under the contour lighting condition might be almost invisible to the fry. This speculation is partly supported by the fact that when the condition switched from surface to contour lighting, the underwater visibility for human eyes decreased by 19% for the white net, 9% for blue, and 2% for black (Table 2). The waters in the fry collection grounds is relatively turbid because of the repeated operations of many fry collectors and the rough sea condition. The underwater visibility measured at noon in Table 2 may be regarded as the representative value for the fry collection grounds. It can be said that they fry respond feebly to a white net operated in a usually turbid fry collection ground, that a white net does not have a good driving effect under such condition. Fry also respond feebly to a moving white mosquito net in surface lighting.

Table 2. Underwater visibility of the mosquito net in a fry collection ground measured under different conditions.

Color of net	Condition		
	At noon. Windy and sea rough	In the morning. Contour light	Calm and sea smooth Surface light
Blue	209 cm	238 cm	262 cm
Black	170	277	282
White	157	263	324

While the young milkfish have color sense (Kawamura and Nishimura, 1980) it is still unknown whether the fry have color sense or not. At this stage though, it can be concluded that the invisible material does not have a good driving effect.

Whether the fry collecting gear is a driving or a filtering one, the water filtering efficiency of the moving net is a very important factor in efficient capture. The fry sweeper is constructed of bamboo frames and of mosquito nets commonly white and or blue. The underwater depth of the

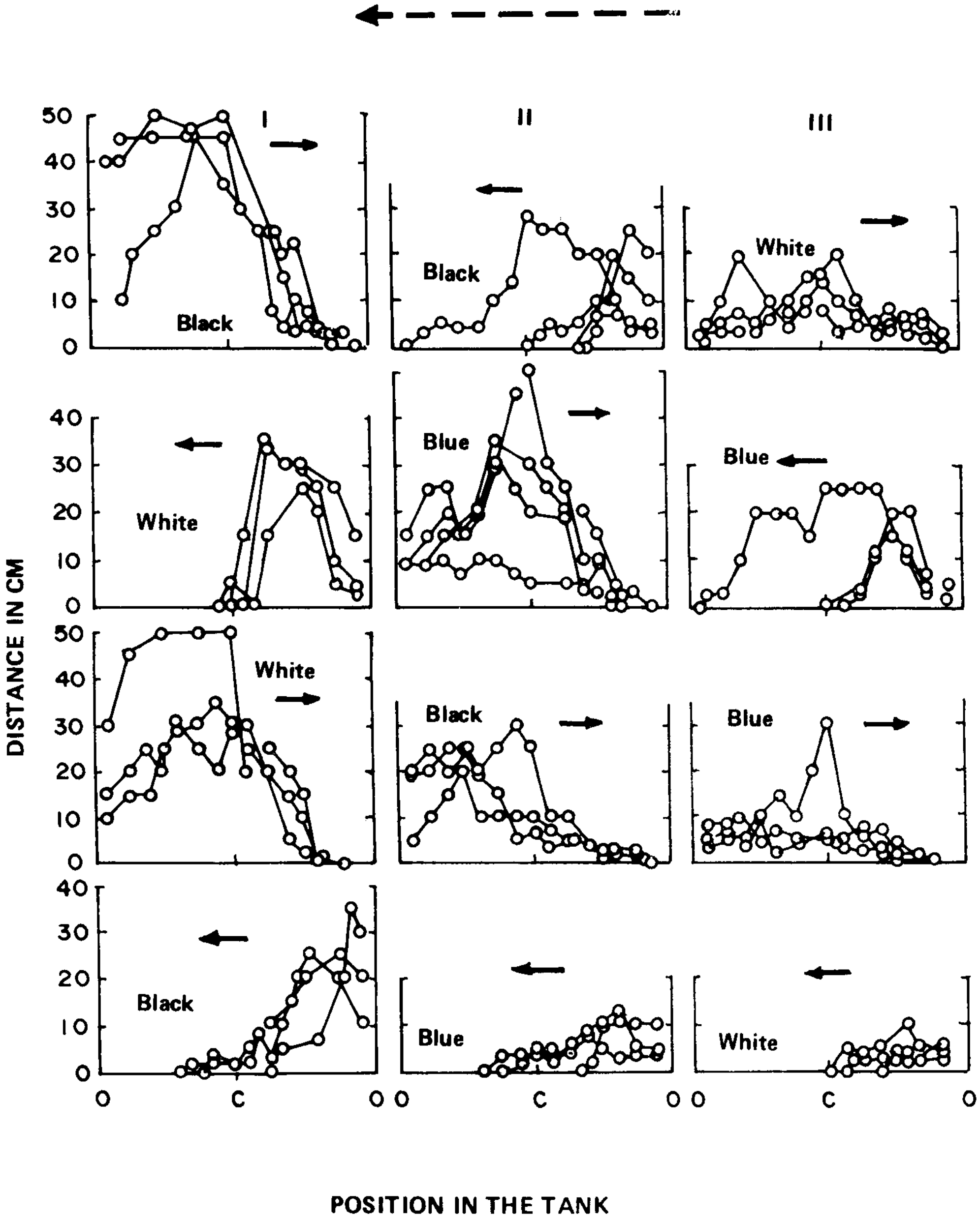

Figure 1. Response of the milkfish fry to the mosquito net at each position in the tank. Ordinate shows the distance between the last member of the school swimming forward the moving mosquito net. C on the abscissa shows the central position of the tank and O shows the starting or final point of the moving net. Arrows in the figure show the moving direction of the net. Uppermost arrow shows the direction of incoming light from the open side of the shed.

wing is about 15 cm and that of the belly, less than 40 cm. The probable stream line in and just behind the net is shown in Figure 2. It was observed that the water smoothly passed through the wings with very little moving along the net. The water in the cone was smoothly filtered while it was slightly retained at the cone end and a little moved along the belly and sides. The stream line drawn by the milk was disturbed behind the wing and cone; the disturbance followed the net for a long distance and was most noticeable behind the cone end. From these observations, it can be said that filtration is the fry-sweeper is almost perfect. It can also be concluded that fry are not caught by filtering but by driving.

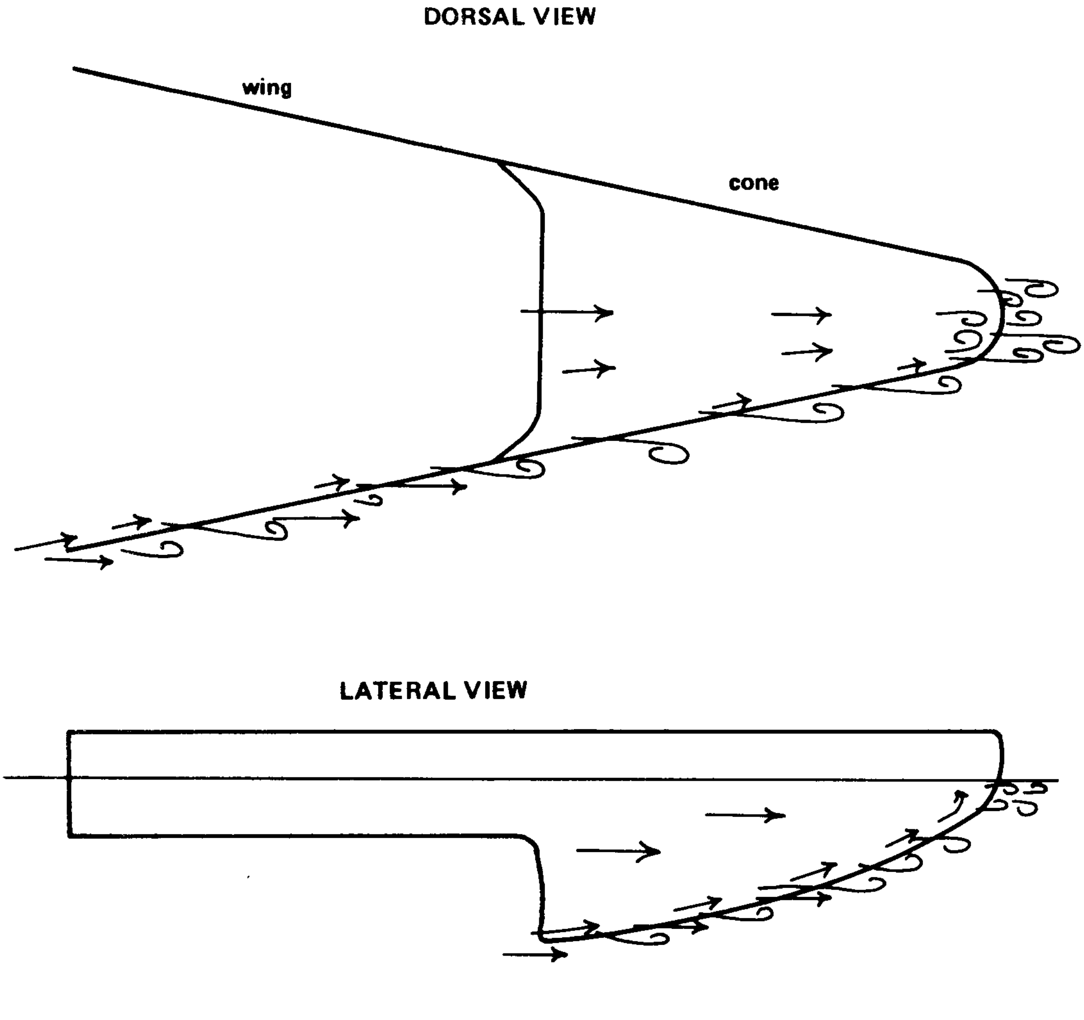

Figure 2. Probable stream-line in operating the fry sweeper.

From the experiment it can be induced that milkfish fry could also be driven by nets of larger mesh size than those presently used. Larger mesh decreases the net resistance in the water and collectors can easily move the gear. The net at the wings and at the mouth of the belly can be replaced with one of larger mesh; this will also increase the depth of the sweeper. The large mesh nets should be of dark color, preferably black for effective driving. However, white mosquito net is best for the cone, especially for the cone end, because the fry are more easily visible on a white background to the collectors during scooping.

Literature Cited

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