UNDERWATER LENGTH ESTIMATION

Underwater fish length estimation is a necessary part of several kinds of comparative studies which require knowledge of the fish population size structure: environmental studies frequently require 'before' and 'after' assessments of fish populations to determine the effects of particular pollutants for example; many studies require comparisons to be made on a seasonal basis where changes in the size structures of the population may be evident; and investigations of the effects of fishing on populations require assessment of the size structures of populations. These and other reasons for the necessity for fish length estimation are discussed more fully in a paper by Pollard (in prep.)

However before undertaking studies involving length estimation it is essential that the accuracy of such estimations is known. To test the ability of divers to consistently estimate fish length underwater, a game (henceforth called 'fiddle sticks') was designed using lengths of orange 17 mm (O.D.) P.V.C. electrical conduit (the 'sticks') as simulated 'fish'. These sticks were cut into lengths of between 0 and 100 cm so that when grouped into five 20 cm length classes they formed a histogram approximating a normal curve with the parameters $\bar{x}$ = 50 cm and s.d. = 20 cm. The sticks were thus cut to the following lengths:

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0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm
6	22	41	61	82
12	24	42	62	88
18	26	43	63	94
	28	44	64	
(3)	30	45	66	(3)
	32	46	68	
	34	47	70	
	36	48	72	
	37	49	74	
	38	50	76	
	39	51	78	
	40	52	80	
	(12)	53	(12)	
		54		
		55		
		56		
		57		
		58		
		59		
		60		
		(20)		

To test the ability of divers to estimate lengths, several methods were used:

1. Underwater the sticks were selected randomly from a pile, held up by a diver approximately three metres away from the test subject divers who scored the lengths into size classes, and the sticks were placed in the second pile. On completion of the 50 sticks, they were transferred back to the first pile, repeating the process. The actual lengths of the sticks in cm. were estimated on several trials. In some trials, the sticks were held against a 'standard: an 80 cm stick marked into 10 cm intervals.
2. On land, a procedure identical to that above was conducted: with and without the standard. Additionally several attempts at actual length estimation in centimetres were made.

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3. Underwater the sticks were threaded in random order onto a 100 m rope. Each stick was separated from the next by at least its own length. The rope was laid out across the reef slope at a depth of between 9-12 m, depending on the location. The 'standard' stick was located at one end of the 'transect'. The divers swam along the 'stick transect' and recorded the sticks in size classes or made an actual length estimation recorded in centimetres.

The results of each diver were tested against the 'expected' distribution using the Kolmogorov-Smirnov test. The test statistic (Dmax) was compared with the critical value (Dcrit) for p = .05. The greater the difference between Dmax and Dcrit i.e. the smaller the difference between the two distributions, the better the length estimation.

In experiments in which actual length estimations were made, the mean deviation (in centimetres) and initially the mean negative and the mean positive deviations were calculated. The standard deviation and variance were also calculated.

Divers were informed of their results relative to the expected distribution or length estimations, and the various training exercises were repeated until a criterion developed over the course of the exercise was attained by all divers.

The results of a variety of trials of this technique are reported below.

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