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Calculated and Measured Trawl Drag Comparison

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Drags of a 2.06 m model net and 31 and 17 m two panel demersal trawls were estimated using two methods of calculation and compared with measured tension at towing point. Calculated drag with the first method (Kowalski & Giannotti 1974 a, b) were 0.68, 2080 and 557 kgf as against the measured tension of 0.62, 1634 and 482 kgf, respectively for 2.06, 31 and 17 m nets. Using the second method (Dickson, 1979) results obtained appeared to be unreliable indicating need for further refinement

Key words : Trawl drag estimation.

Techniques of measurement and calculation for gear performance evaluation have been used by Crewe (1964), Fridman (1969), Anon (1974), Kowalski & Giannotti (1974 a, b) and Dickson (1979). In this paper, results of drag estimation of two demersal trawls and one model net using two methods of calculation and direct measurement are compared.

A 31 m two seam manila trawl, its scale model using nylon netting with 2.06 m headline (Perumal *et al.*, 1973) and a 17 m two seam PE trawl (Kunjipalu, K.K., pers. comm.) were selected for the study as operational and design parameters of these nets were available. Design details and field test results of 31 m trawl operated from 28 m LOA, 600 hp vessel and 2.06 m model net tested in a towing tank are described by Perumal *et al.* (1973). Operational parameters of 17 m trawl tested from 9.75 m LOA, 52 hp vessel were worked out by Mukundan & Hameed (1994). The drag of three trawls were worked out following the methods of Kowalski & Giannotti (1974 a, b) and Dickson (1979).

Drags calculated based on Kowalski & Giannotti (1974 a, b) are presented along with operational parameters in Table 1. Combined drag of codend, cone, ropes and floats for 2.06, 31 and 17 m nets worked out to be 0.32, 1040.9 and 383.4 kgf respectively, and drags for each otter door were 0.13, 397.9 and 76.8 kgf. Percentage contribution of door to total drag were 38.8, 38.1 and 27.5, respectively. Percentage contribution of door drag of 2.06 and 31 m nets were very near the value obtained by Kowaslki & Giannotti (1974) while it was less for 17 m net, possibly due to camber of the doors used. The drag of the warp and tension at the end of the warp were estimated using drag of one door and half the net, following Pode (1951). The warp drag obtained were 0.11, 89.8 and 7.2 kgf, respectively. Calculated tension at the towing points were 0.68, 2079.8 and 556.9 kgf while the mean measured tension were 0.62, 1634 and 481.5 kgf (Perumal *et al.*, 1973; Mukundan & Hameed, 1994), respectively for 2.06, 31 and 17 m trawls. Calculated drag values were 9 and 14% less than the measured values in the case of 2.04 and 17 m nets, while the variance was greater for 31 m net. Calculated drag for 31 m net was, however, close to the drag predicted through model testing (1988 kgf) (Perumal *et al.*, 1973).

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Table 1. Operational and design parameters of nets used and drag estimates after Kowalski & Giannotti (1974 a, b)

	2.06 m model trawl	31 m demersal trawl	17 m demersal trawl
Headline length, m	2.06	31.00	17.00
Net mouth circumference, m	3.60	53.92	20.00
Mean horizontal spread, m	1.05	15.54	8.50
Mean vertical opening, m	0.12	1.80	1.50
Mean towing speed, $m.s^{-1}$	0.38	1.47	1.27
Depth of operation, m	2.53	36.00	10.00
Otter board			
Type	Rect. flat	Rect. flat	Rect cambered
Length, m	0.14	2.20	1.20
Height, m	0.08	1.23	0.60
Mean measured tension at towing point, kgf	0.62	1634.00	481.50
Calculated drag estimates; kgf			
Cone	0.31	962.86	367.32
Codend	0.00	4.08	0.52
Ropes	0.01	53.20	12.00
Floats	0.00	20.73	3.57
Total for net and appendages	0.32	1040.87	383.41
Door (one)	0.13	397.85	76.79
Warp	0.11	89.81	7.20
Total calculated drag at towing point	0.68	2079.81	556.90

Following the method of Dickson (1979) solidity coefficients of different netting panels and total drag area were worked out as a part of the drag calculation (Table 2). Other operational parameters are as in Table 1. It can be seen that 2.06 and 31 m nets have higher solidity values compared to 17 m net. The calculated drags for net and appendages alone were 0.66, 2187 and 285 kgf, respectively for 2.06 and 31 and 17 m nets. For net and appendages alone, these values were very high as it exceeded the measured total tension at towing point for 2.06 and 31 m nets which have high solidity values, while it was quite low for the 17 m net having low solidity value. Dickson (1979) observed similar condition with respect to high and low solidity nets.

Table 2. Solidity values, total drag area and calculated drag estimates after Dickson (1979)

	2.06 m model trawl	31 m demersal trawl	17 m demersal trawl
Solidity values :			
Wing	0.14	0.14	0.10
Belly	0.18	0.18	0.10
Codend	0.58	0.62	0.26
Total drag area, m^2	0.89	18.60	2.66
Calculated drag estimates; kgf :			
Cone	0.636	2085.87	266.01
Codend	0.023	57.52	7.08
Float	-	20.47	3.54
Sinker	0.004	8.97	9.15
Line	0.001	15.05	-
Total for net and appendages	0.664	2187.88	285.78

The study indicated that while the method of Dickson (1979) may need further refinement as it has given unrealistic results, that of Kowalski & Giannotti (1974) may be useful for getting rough estimates of trawl drag.

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