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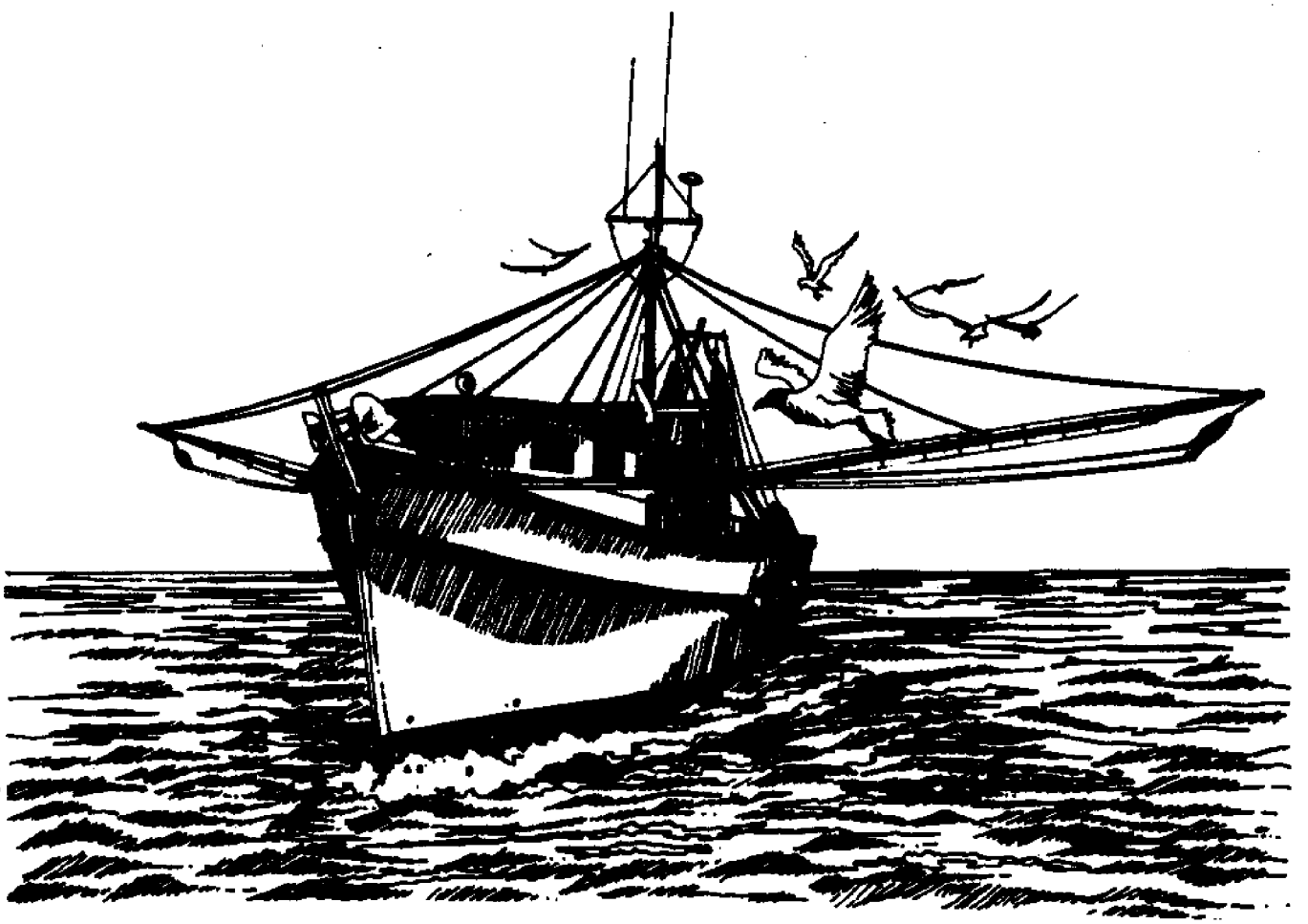
SHRIMP TRAWLS - PERFORMANCE & EFFICIENCY



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The National Marine Fisheries Service (NMFS) movie, "Shrimp Trawls Design and Performance," contains much information on shrimp trawl performance under different operating conditions. This information might be useful to you in increasing the efficiency of your fishing operation and in reducing your fuel bill. Rick Wallace, marine fisheries specialist with Alabama Sea Grant Advisory Service, compiled a bulletin containing much of the information in the movie. Much of this publication is taken directly from Wallace's. Supplementary information resulting from conversation with John Watson of NMFS is also included.

Significant Factors in Fuel Efficiency

At trawling speed, most of the developed engine horsepower is used to overcome the drag of the fishing gear. (The drag of the boat is nearly insignificant compared to the drag of the gear.) The amount of power needed is directly proportional to the product of the drag and speed. If towing tension doubles while speed remains the same, the power required also doubles. If this towing tension stays the same and the speed doubles, the power required doubles. If both speed and tension are doubled, the power required is four times as much.

If the opening of the net stays the same, the amount of ground covered also changes directly with the speed. Therefore, the amount of power used per amount of ground covered changes directly with the towing tension, if the net opening remains the same. If the speed and tension double and the net opening remains the same, the power required for covering a given amount of ground doubles. Fuel consumption is related to power used. If the efficiency of the propulsion system does not change, fuel consumption varies directly as power consumed. If you double the power, you double the fuel consumed. Towing tension divided by net opening can be thought of as a measurement of fuel used per ground covered.

Towing Conditions

Towing was done with the Georgia Bulldog, a 72-foot Desco wooden shrimp trawl powered by a D-343 Caterpillar engine with a 6 to 1 reduction gear and a 60-inch diameter, 50-inch pitch propeller. Standard towing speed was 2½ knots in water depths from 20 to 30 feet. The tows were performed over a set course with essentially no tide or current.

Net Performance

Table 1 compares the performance of eight trawls. Remember: the twine area is the total square feet of material in the net, and towing tension refers to the actual tension in the towing cable caused by the drag of the net, doors and bridles.

Table 1

Trawl performance summary for a twin 35' trawl and seven 50' trawls with 7' X 36" doors (no floats) 1 7/8" #15 webbing

Trawl	Spread (Ft.)	Headrope Height-Center (Ft.)	Spread Ratio (%)	Twine Area (Sq. Ft.)	Footrope Height-Center (In.)	Towing Tension (Lbs.)	Towing Tension Spread (Lbs./Ft.)
Flat	37.0	3.0	74	213	3	1,350	36.5
Two-Seam Semiballoon	38.5	2.75	77	201	0	1,350	35.1
Four-Seam Semiballoon	37.0	4.0	74	248	3	1,550	41.9
Western Jib	39.0	2.5	78	233	3	1,700	43.6
Twin	56.0	3.0	78	267	2-3	1,750	31.3
Mongoose[b]	39.0	3.5	78	266	4	1,800	46.2
Three-wing Tongue[a]	42.5	3.5	85	271	0	2,100	49.4
Scorpion[b]	41.5	3.5	83	226	3	1,750	42.2

[a] Top middle bridle wing extension, 9 feet; bottom middle bridle wing extension, 10 feet (5 ft. bullet + 5 ft. chain)

[b] Middle bridle extension 9 feet

Bib Trawls

Bib trawls are standard trawls such as the flat or semiballoon to which a bib has been added. Table 2 demonstrates the effect of adding a bib to a flat net.

Table 2

Comparative measurements of a 50' flat net, with and without bib or tongue (Spread 2.5 knots, door size 7' X 36") (6 floats)

	Spread (Ft.)	Headrope Height (Ft.)	Footrope Height (Inches)		Towing Tension (Lbs.)	Towing Tension Spread (Lbs./Ft.)
			Wings	Center		
Bib	39	8.5	8-10	2-3	1,650	42.3
No Bib	33	6.5	10-12	4	1,500	45.5

Floatation

Floatation can dramatically change the shape of a net. Table 3 compares three nets with three different float arrangements. Note that the Mongoose net with six floats gives the widest spread and still has a very high opening.

Table 3
Effect on floatation

Trawl Type (50')	No. of 6" X 8" Spongex Floats	Spread (Ft.)	Vertical Opening (Ft.)	Spread Ratio (%)	Towing Tension (Lbs.)
Semiballoon	18	31	8	62	1,700
	12	32	7	64	1,500
	6	33	5	66	1,450
Flat	18	31	10	62	1,650
	12	31	8.5	62	1,700
	6	33	6.5	66	1,500
Mongoose	18	30	13	60	2,150
	12	34	11	68	2,100
	6	37	7.5	74	2,000

Tickler Chains

The standard practice of attaching the tickler chain to the heel of the trawl boards results in the tickler chain fishing very close to the footrope in the wings of the net. If the tickler chain is shortened to bring it further forward, the horizontal spread of the net is reduced. Attaching the tickler chain approximately 21 inches ahead of the heel of the door resulted in the tickler chain fishing further ahead of the footrope and the wings without reducing net spread. See Table 4.

Table 4

Observations of 1/4" tickler chain profiles using various settings (50' flat net, 7' x 36" doors)

Inches Shorter Than Footrope	Net Spread	Distance Tickler Chain Ahead of Footrope	
		Center	Wing
24"	37' 6"	18"	8" - 10"
36"	38'	24"	15"
48"	35' 6"	32"	18"
Super 36"*	37' 6"	24"	20" - 24"

*Super 36" - Chain attached on inside face of door and 21" ahead of heel of door.

Twine size can affect net performance quite a bit. Table 5 compares identical nets but with different twine sizes.

Table 5

Comparative efficiency of 50' flat trawls constructed of No. 15 and No. 18 twine

	No. 15 Twine	No. 18 Twine
Twine area	213 sq. ft.	245 sq. ft.
Drag or tension	1,350 lbs.	1,511 lbs.
Vertical opening	3' 0"	3' 3"
Spread	37'	35'

Trawl Door Size

Trawl door size is an important factor in net performance and fuel consumption. Table 6 summarizes this information for several trawl types and door sizes.

Table 6

Door Chain Settings for Wooden Doors Used

Trawl Systems	Door Size Length (ft)	Door Size Height (inches)	Chain Size (inches)	Links Front Top	Links Front Bottom	Links Back Top	Links Back Bottom
All	6	36	3/8	20	19	35	34
All	7	36	3/8	21	20	41	40
Twin	8	40	1/2	19	18	37	36
All except twin	9	40	1/2	17	16	43	42

Table 6a

Performance Comparisons Among Trawl Types
With Different Size Trawl Doors

Trawl Type (50')	Door Size (Feet x Inches)	Spread (Ft.)	Spread Ratio (%)	Headrope Height-Center (Ft.)	Footrope Height-Center (In.)	Towing Tension (Lbs.)
Flat	6 x 36	33	66	3	2	1,250
	7 x 36	37	74	3	3	1,350
	9 x 40	42.5	85	3.3	4-6	2,100
Semi-Balloon	6 x 36	34	68	3.5	0	1,350
	7 x 36	37	74	4	3	1,550
	9 x 40	42	84	3.5	6	2,400
Twin (2-35 Ft. Flat)	6 x 36	52	73	3	1-2	1,700
	7 x 36	56	78	3	2-3	1,750
	*8 x 40	61	85	3	2-3	2,400
Mongoose	6 x 36	35	70	2.5	2	1,500
	7 x 36	39	78	3.5	4	1,800
	9 x 40	43	86	3.5	3	2,350

* 9 x 40 doors were too large for this net

The angle of attack (AOA) of the doors can be changed by changing the chain setting. The effects of three different settings are shown in Table 7. Optimum angle of attack is usually considered to be about 30° to 35°. Increasing the angle of attack more does not increase spread, but it does increase drag and fuel consumption.

Table 7

Effects of Different Door Chain Settings and AOA on Trawl Performance

Number of Links						Fuel	
Front Top Chain	Front Bottom Chain	Back Top Chain	Back Bottom Chain	AOA	Tilt	Spread (ft)	Consumption (gph)
15	14	40	39	27°	5°	37.0	3.0
20	19	40	39	37°	7°	37.5	3.2
22	21	40	39	40°	4°	37.0	3.5

Cable Length

Tongue and bib trawls appear to have some advantages over standard trawls. However, these trawls require greater warp ratios (more scope), especially in deeper water. The middle bridle also often needs to be lengthened for best performance.

Towing Speed

The best towing speed was 2.5 to 3.0 knots. Higher speeds resulted in less horizontal spread and increased fuel consumption. At 4.0 knots, the nets and doors were completely off the bottom.

Table 8

Effects of Towing Speed on Performance and Fuel Efficiency

Speed (knots)	Net Spread (ft)	Spread Ratio (%)	Headrope Height (ft)	Footrope Height (inches) Center	Footrope Height (inches) Wing	Towing Tension (lbs)	Towing Tension / Speed x Spread (lbs/knot-ft)
2.0	33	66	3.0	0	4	1,100	16.7
2.5	35	70	3.5	3	4	1,500	17.1
3.0	37	74	3.5	3-4	6	2,300	20.7
3.5	35	70	4.0	6-8	8-12	3,000	24.5
4.0	Gear off bottom			--	--	3,500	---
5.0	Gear off bottom			--	--	4,700	---

If you have questions about this material, please contact the Louisiana Cooperative Extension Service at 388-2229.