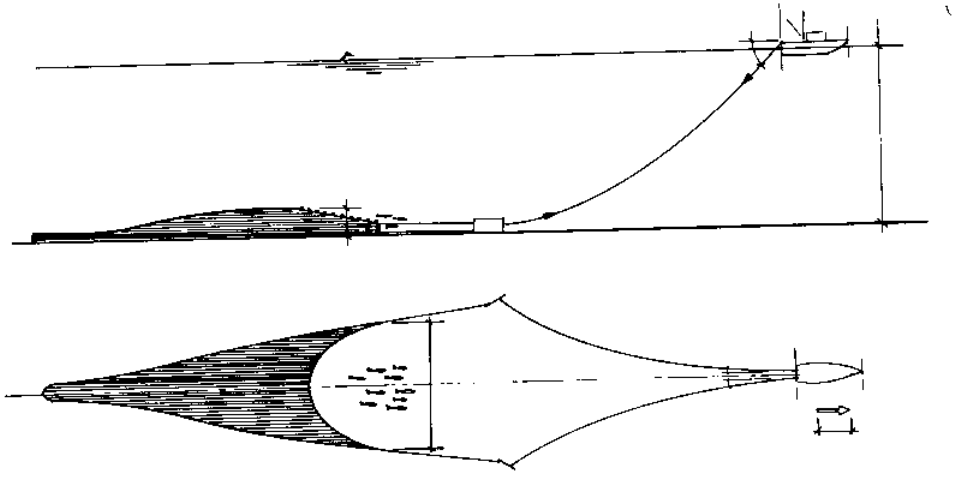
Bottom Trawl Measurement Trials Report

G. A. Motte, A. J. Hillier, R. D. Beckwith



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Professors Motte and Hillier are members of the Department of Fisheries and Marine Technology, University of Rhode Island, where Mr. Beckwith is a graduate student in ocean engineering. *This Sea Grant publication is also contribution no. 1516 of the Rhode Island Agricultural Experiment Station. Kingston 1973.*

This report summarizes results of various Yankee 35 bottom trawl trials, which were conducted in Narragansett Bay by the University of Rhode Island (URI) research vessel, *Gail Ann*. The trials were somewhat limited by vessel size, but produced information of interest to persons fishing from smaller inshore draggers. The *Gail Ann*, a stern trawler, is 47 feet long and is powered by a GM 471 engine, which yields 96 horsepower.

Opinions differ about how the shape of the mouth of a trawl is affected by changes in such factors as vessel speed, number of headline floats or mesh size. The purpose of these trials was to gain insight into how the Yankee 35 bottom trawl reacted to such changes. However, some of the results may be applied to the entire Yankee series of trawls, and some may, after adaptations in scale, apply to the larger 41 trawl.

This report contains information we hope will be helpful to working fishermen. A more theoretical approach to the trials is contained in the publication, *Bottom Trawl Performance Study*, Marine Technical Report 7, available for $1.50 from the Marine Advisory Service, University of Rhode Island, Narragansett Bay Campus, Narragansett, Rhode Island 02881.

The project leading to the trials was divided into three main parts. The first examined a series of Canadian full-scale trawl tests to determine which parts of the trawl gear changed in that study were most important in affecting drag, headline height and wingspread. The second consisted of full-scale tests on a series of Yankee 35 trawls in which the important trawl gear parts from the Canadian tests as well as additional parts were changed and the headline height and wingspread measured. The third part examined the URI test results to determine which changes in trawl gear were most important in affecting headline height and wingspread.

Canadian Study Results

The results of a Canadian bottom trawl study were examined for those trawls of the Yankee series commonly used by the United States East Coast fishing fleet. A computer program determined which of the gear changes were important to the headline height, wingspread and drag.

The parts of the trawl which were changed were:

Headline length — from 52 feet to 79 feet
Footrope — from disc to roller
Seabed — from sand to mud and gravel
Twine type — from polypropylene to nylon
Seabed (for disc footrope only) — sand to mud and gravel
Seabed (for roller footrope only) — sand to mud and gravel
Twine type (for 52-foot headline only) — polypropylene to nylon

Headline Height. The headline height was affected the most by changes in footrope type, twine type (both headline lengths), and twine type (52-foot headline only).

The remainder of the changes did *not* affect the headline height. It is interesting to note that the change in headline length did *not* affect headline height.

Wingspread. All of the changes were effective in varying the wingspread except a change in seabed for the roller footrope only.

Drag. Drag was affected the most by the changes in headline length and footrope type.

The other changes, including seabed and twine type, did not affect the drag.

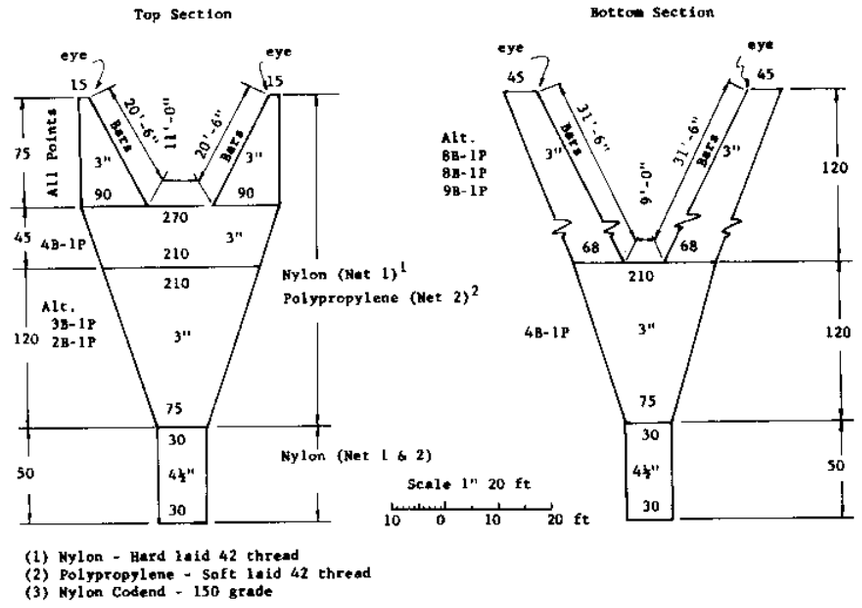
The parts of the trawl to be changed in our tests were then chosen from those trawl parts considered important in the Canadian test results. A single Yankee 35 design was selected in order to reduce the size differences. This eliminated the changes in headline length and footrope type. Similar sites were chosen to keep the type of seabed unchanged. The change in twine type was kept since it affected both the headline and wingspread.

URI Full-Scale Tests

The Yankee 35 bottom trawl used in the test is shown in figure 1 and described in table 1. This trawl was chosen since it is a typical design used in East Coast fishing grounds and was suitable for the *Gail Ann*.

Table 1. Yankee 35 trawl (see fig. 1).

Line	Length x Diameter	Material	Attachments
Headline	52 ft	Combination	Floats: 8 or 19 x 8-in
Bosom	12 ft x 5/8 in		diameter — plastic
Each Wing	20 ft x 5/8 in		
Footrope	72 ft	Chain	Bobbin Gear: 4-in dia-
Bosom	10 ft x 3/8 in		meter — rubber discs,
Each Wing	31 ft x 3/8 in		full length footrope
Hanging Line	89 ft x 5/8 in	Polypropylene-Dacron	
Wing Lines	6 ft x 5/8 in	Polypropylene-Dacron	
Wing Bridles			
Upper	60 ft x 3/8 in	Steel Wire	
Lower	60 ft x3/8 in	Chain	
Door Legs			Doors: Standard Rectangular
Upper	7 ft x 5/16 in	Chain	3 ft x 6 ft x 1½ in 236 lb
Lower	7 ft x 5/16 in	Chain	2.5 ft x 5 ft x 1½ in 262 lb
Towing Warps	7/16 in — 6/19 in	Steel Wire	



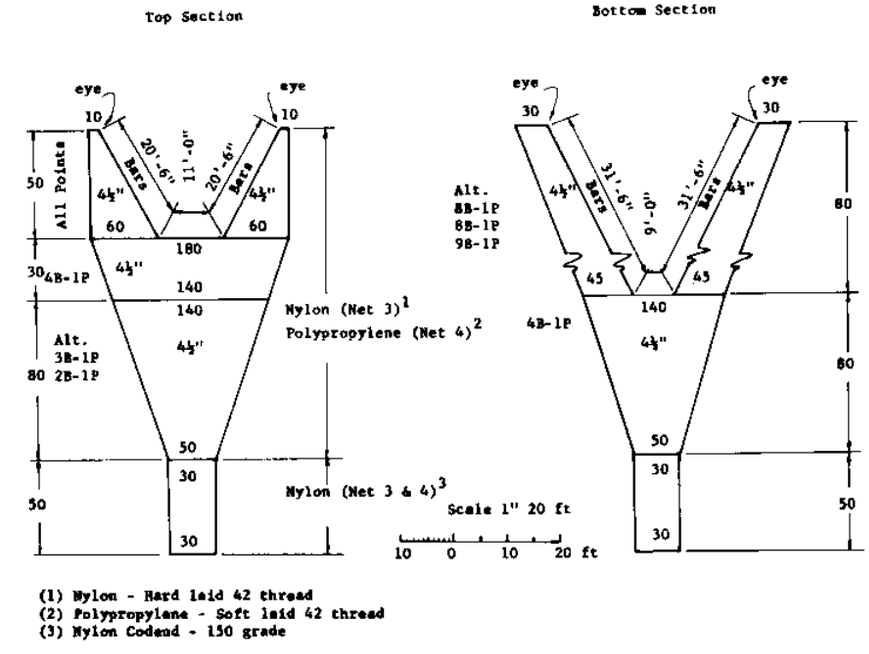
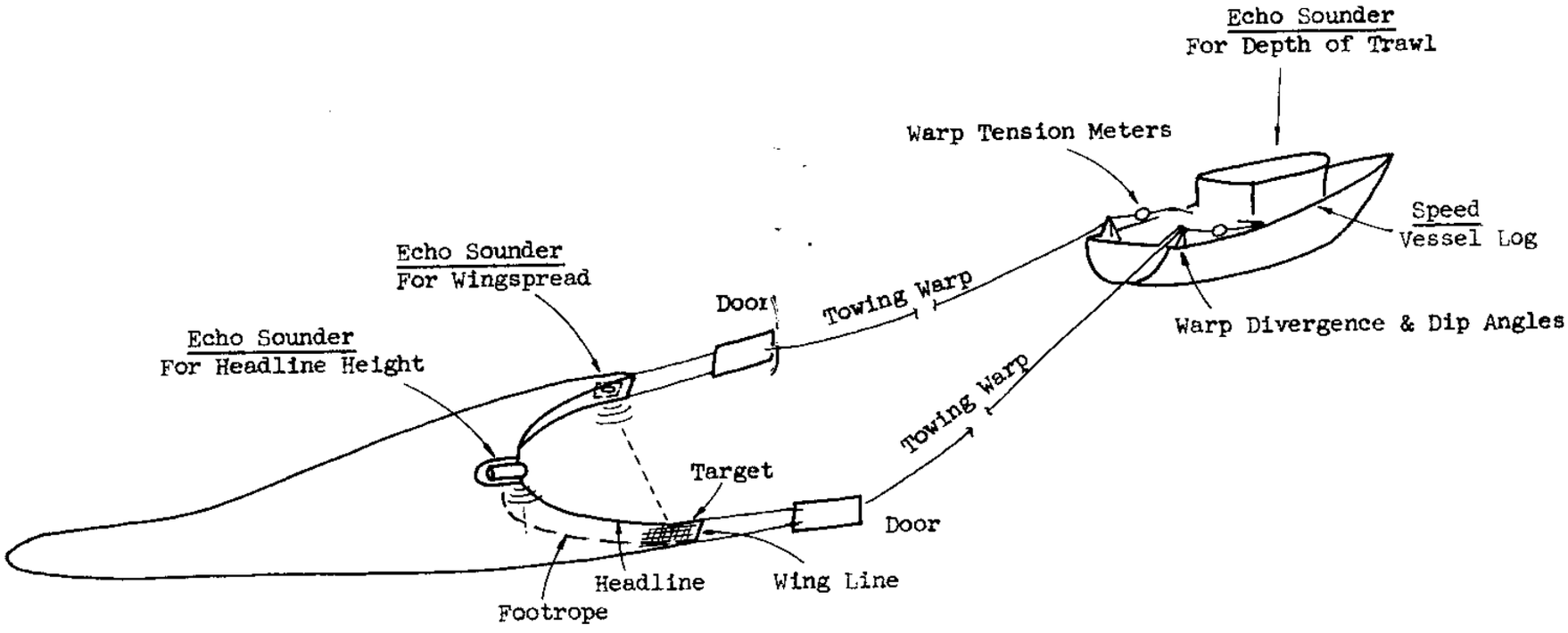


Figure 1. Yankee 35 bottom trawl.

Figure 2. Instrumentation for bottom trawl study.



The parts of the trawl which were changed were:

Twine type — from nylon to polypropylene
Mesh size — from 3-inch to 4½-inch
Number of headline floats — from 8 to 19
Door area — from 12.5 square feet to 18.0 square feet

The other important features measured were warp tension, warp length and depth of trawl.

A series of tows were made in which the vessel's speed was varied over a fixed range, and changes were made to the trawl one at a time until all of the combinations of changes were included. The two towing sites were located in Narragansett Bay at similar depths and on similar-type bottoms.

Instruments. The instruments and their locations on the trawl tests are shown in figure 2. The echo sounder used for the measurement of headline height and wingspread was a remote unit with no wires to the boat. It was battery-operated and recorded the measurements on a continuous chart paper inside the unit. The wing echo sounder was connected by a wire along the headrope to the combination headline echo sounder-recorder unit which is shown in the photograph.

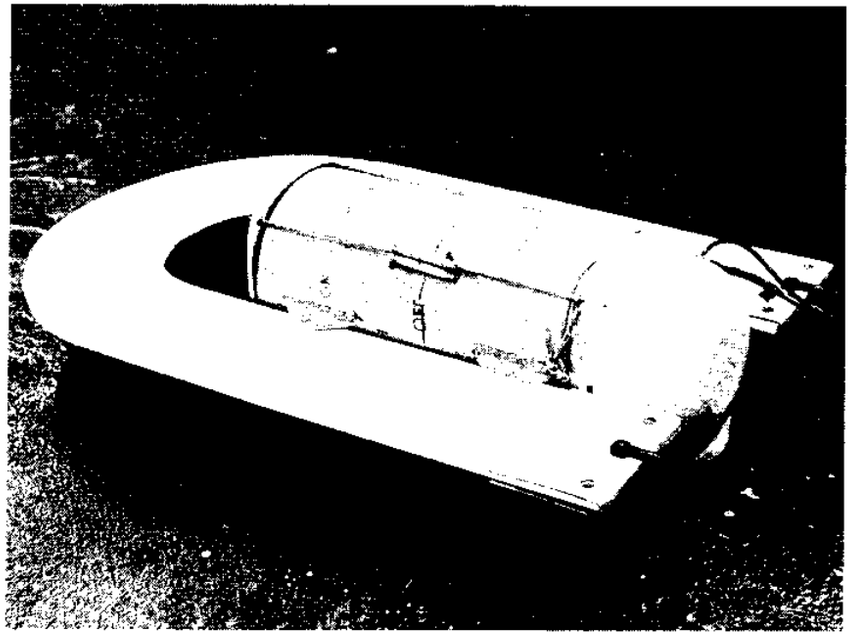
URI Bottom Trawl Results

The results of the URI study were analyzed by a computer which examined each of the gear changes one at a time and in various combinations. The results indicate which of the changes had an important effect on headline height and wingspread. The effects of warp tension (drag), trawl depth and warp length also were included.

Headline Height. The most effective change, which was expected, in headline height was caused by an increase in the number of headline floats. A typical example is shown in figure 3.

The changes in mesh size and door area were both important in affecting headline height. A comparison of test results showed that in every case an increase in mesh size caused a decrease in headline height. An example is shown in figure 4. Test results in which the door area changed were not conclusive. However, it was noted that with nylon twine the headline remained the same with a change in door area. The polypropylene with 3-inch mesh increased headline height with an increase in door area; whereas, the polypropylene with 4½-inch mesh decreased headline height and increased door area.

Twine type was not important in relation to headline height.



Combination headline height transducer and recorder unit

The remainder of the important combinations all contained a change in number of headline floats, and the combined effect seemed to be caused mainly by the floats.

Wingspread. The most important gear change was the mesh size. This result seems reasonable since an increase in mesh size causes less drag, thus enabling the doors to spread the net further. Typical results are shown in figure 4.

Although a change in door area had an important effect, it was not as important as a change in mesh size. The result — that the doors were not as effective in increasing the wingspread as was the increase in mesh size for our trawls — suggests that increasing mesh size alone could provide a method for increasing wingspread with a savings in horsepower. This would depend, of course, on the mesh requirements for the fish being caught. The changes in wingspread as affected by a change in mesh size and in door area are shown in figure 5.

The number of headline floats was important to wingspread. A decrease in the number of floats lowered the headline and allowed an increase in wingspread as shown in figure 6.

The twine type had no effect on wingspread. Some of the remaining combinations affecting wingspread were changes in twine type-mesh size and in floats-mesh size.

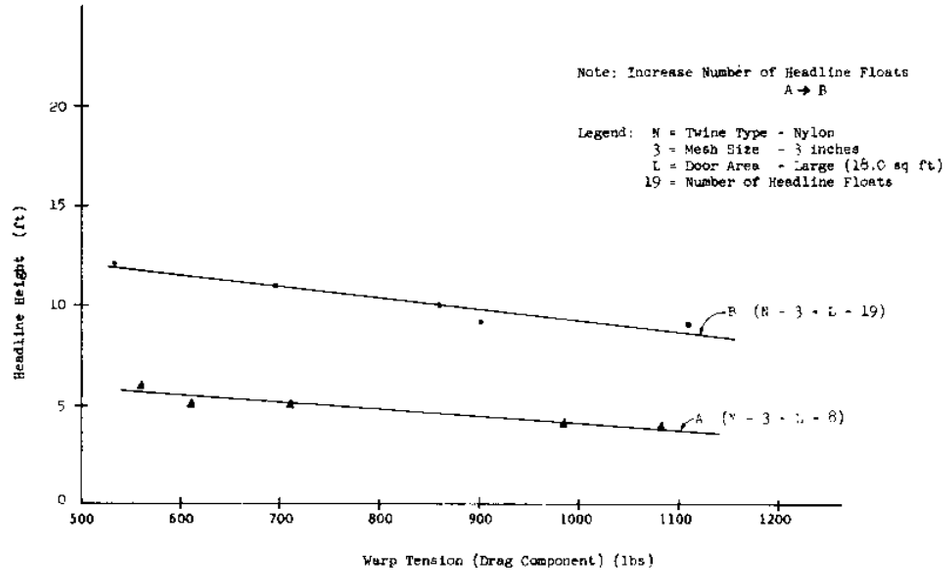


Figure 3. Headline height with increase in number of headline floats.

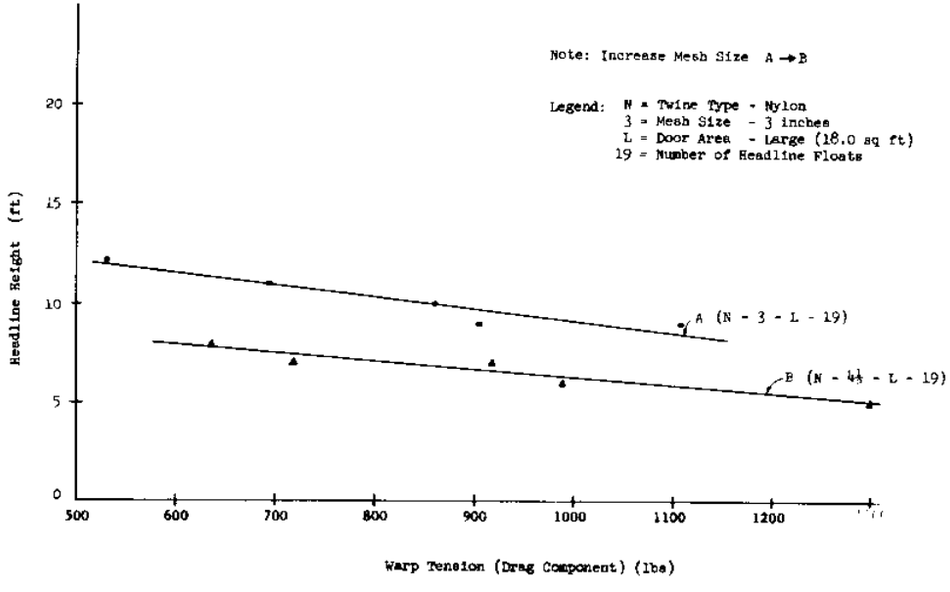


Figure 4. Headline height with increase in mesh size.

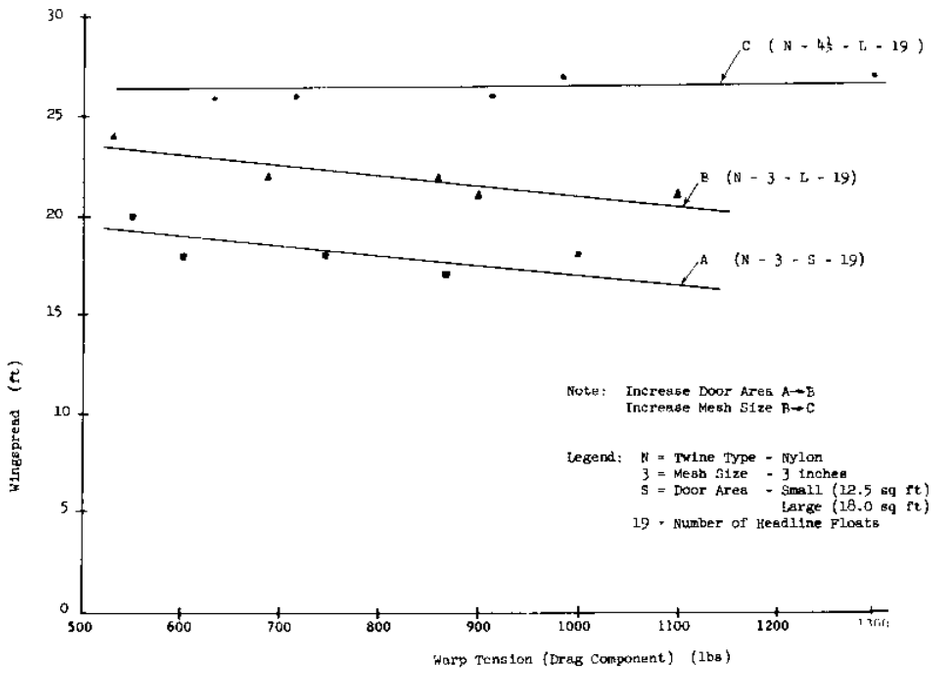


Figure 5. Wingspread with increase in door area and increase in mesh size.

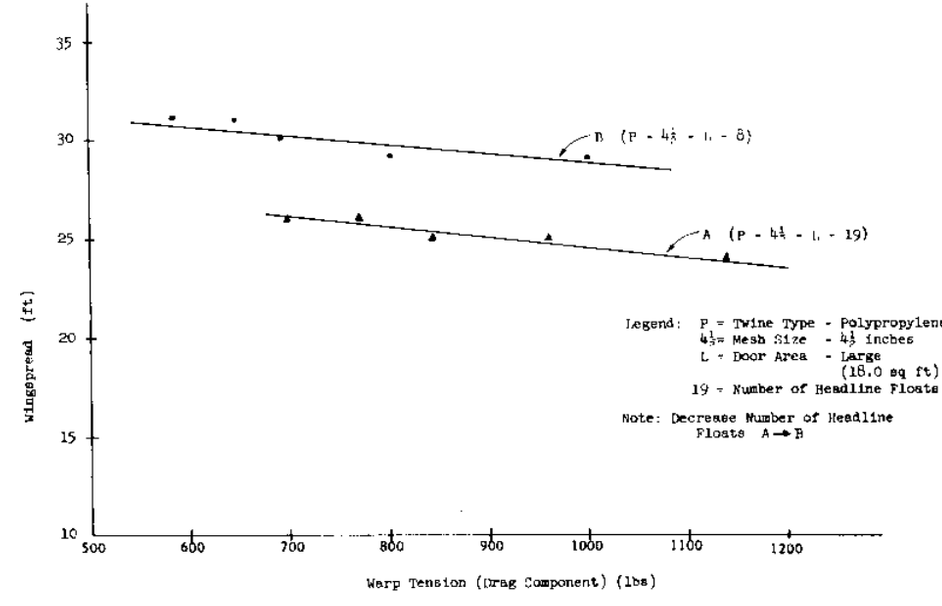


Figure 6. Wingspread with decrese in number of headline floats.

Table 2. Summary of trawl gear most important to headline height and wingspread.

Canadian Bottom Trawl Results: Yankee Series

	Important changes	Unimportant changes
Drag		
	1. Headline length — 52′ to 79′	1. Seabed — sand to mud and gravel
	2. Footrope — disc to roller	2. Twine type — poly to nylon
Headline height		
	1. Footrope — disc to roller	1. Headline length — 52′ to 79′
	2. Twine type — poly to nylon	2. Seabed — sand to mud and gravel
Wingspread		
	1. Headline length — 52′ to 79′	
	2. Footrope — roller to disc	
	3. Seabed — sand to mud and gravel	
	4. Twine type — poly to nylon	

URI Bottom Trawl Results: Yankee 35

	Important changes	Unimportant changes
Headline Height		
	1. Number of headline floats — 8 to 19	1. Twine type — poly to nylon
	2. Mesh size — 3″ to 4½″	2. Twine type *and* door area
	3. Door area — 12.5 to 18.0 sq. ft.	3. Twine type *and* mesh size
	4. Twine type *and* floats	4. Door area *and* mesh size
	5. Door area *and* floats	
	6. Door area *and* floats	
Wingspread		
	1. Number of headline floats — 8 to 19	1. Twine type — poly to nylon
	2. Mesh size — 3″ to 4½″	2. Twine type *and* door area
	3. Door area — 12.5 to 18.0 sq. ft.	3. Twine type *and* floats
	4. Twine type *and* mesh size	4. Door area *and* mesh size
	5. Door area *and* floats	5. Mesh size *and* floats

References

1. Carrothers, P. J. G.; Foulkes, T. J.; Connor, M. P.; Walker, A. G. 1969. *Data on the Engineering Performance of Canadian East Coast Groundfish Otter Trawls.* Technical Report No. 125, Fisheries Research Board of Canada, St. Andrews, New Brunswick.
2. Motte, G. A.; Hillier, A. J.; and Beckwith, R. D. 1973. *Bottom Trawl Performance Study.* University of Rhode Island. Marine Technical Report Series Number 7, Kingston, Rhode Island.