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An Approach to Standardized Effort Statistics for U.S. Vessels  
Fishing in the ICNAF Convention Area

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## INTRODUCTION

The fish stocks of the ICNAF Convention Area are caught in significant amounts by such diverse fishing gears as shore-based traps, small hook and line vessels, dory schooners, pair trawlers, and otter trawlers of widely varying sizes. Attempts have been made from time to time to find some common ground for standardization of effort statistics reported by the member nations for their vessels fishing in the Convention Area. These have met with varying degrees of success, and at the 1959 Annual Meeting it was recommended by the Standing Committee on Research and Statistics that the United States attempt to calculate standard effort units from its extensive series of statistics from vessels of various sorts fishing for cod, haddock and redfish. The ultimate results desired would be that the member nations could either report effort statistics for their fleets in uniform fashion or furnish the Secretariat with conversion factors to reduce the effort to common units.

In other words, the effort of a stern trawler from the United Kingdom could be reported or converted into so many standard Portuguese trawler units, hence easily compared with the effort of a Spanish pair trawler team. Such data would go far to simplify the task of those who attempt to measure the results of exploitation.

## COMPARISON OF VARIOUS UNITS OF EFFORT

U.S. vessels of different sizes fishing in the same area.

One of the primary conditions for studying the comparative efficiency of different vessels is that they be fishing in the same place within as small units of space and time as possible. With this in mind, we sought a units of space and time where small (5 to 50 gross tons), medium (51-150 gross tons) and large (151 gross tons and over) otter trawlers were fishing together. (Because of the nature of the U.S. fleet, we were unable to take into account any vessels other than otter trawlers.)

The only place in which vessels of these diverse size groups fish at the same time is the west side of the South Channel (Statistical Subarea XXII G; Rounsefell 1948). This area of about 4000 square miles lies in the western portion of Subdivision 5Z and contains depths of water from the littoral to more than 100 fathoms.

In the past five years, 1955-1959, vessels of all three sizes hailing from Boston fished in the area simultaneously and caught some cod and haddock during the months of January, February, July, September, October and November of each year, Table 1 shows the catches and fishing efforts in days fished for these vessels, and Table 2 the summaries of these statistics for the five years.

Table 1. -- Catch and effort statistics for three sizes of Boston otter trawlers fishing the west side of the South Channel, 1955-1959. Catches are in thousands of pounds, effort in days fished.

Year	Month	Small Otter Trawlers			Medium Otter Trawlers			Large Otter Trawlers		
		Catch	Had-dock	Total effort	Catch	Had-dock	Total effort	Catch	Had-dock	Total effort
1955	Jan.	3	25	6.0	29	546	84.2	12	236	16.9
	Feb.	53	26	67.5	24	871	95.3	1	13	2.0
	July	74	256	38.2	623	248	200.1	16	114	20.0
	Sept.	26	252	42.0	363	2166	346.1	104	657	41.9
	Oct.	15	123	29.6	317	1406	262.2	98	322	45.4
	Nov.	3	15	6.2	110	1035	230.6	28	169	33.1
	Totals	174	697	189.5	1466	6272	1218.5	259	1511	159.3
1956	Jan.	7	1	26.0	42	589	95.5	12	50	3.6
	Feb.	1	32	1.7	47	1086	95.1	2	87	11.4
	July	70	191	42.9	356	927	183.2	65	94	16.0
	Sept.	14	144	19.9	301	2220	274.2	302	2609	158.4
	Oct.	6	77	13.3	128	1245	253.8	46	472	52.4
	Nov.	4	64	12.7	121	1282	247.9	24	314	49.3
	Totals	102	509	116.5	995	7349	1149.7	451	3626	291.1
1957	Jan.	4	1	1.9	52	1071	189.3	16	226	37.3
	Feb.	3	3	1.4	74	1743	230.5	11	87	15.9
	July	24	221	25.8	815	2010	257.9	243	750	73.1
	Sept.	1	10	2.4	263	957	158.7	15	37	8.0
	Oct.	2	47	10.9	326	1676	291.1	121	201	41.0
	Nov.	31	22	46.2	122	950	249.0	8	108	23.5
	Totals	65	304	88.6	1652	8407	1376.5	414	1409	198.8
1958	Jan.	2	31	4.4	82	1027	183.9	11	226	46.9
	Feb.	30	4	18.4	71	1449	218.1	13	258	38.7
	July	2	3	0.7	456	452	108.5	115	167	41.5
	Sept.	1	8	4.1	487	1802	347.5	110	271	38.3
	Oct.	157	27	33.2	203	944	249.6	106	137	27.7
	Nov.	10	21	4.5	201	750	231.6	211	231	57.3
	Totals	202	91	65.3	1500	6424	1339.2	566	1290	250.4
1959	Jan.	117	1	21.1	48	1011	169.1	29	547	87.1
	Feb.	109	4	18.0	45	1599	178.6	4	79	12.7
	July	13	36	8.8	124	344	80.8	82	98	17.0
	Sept.	14	2	3.7	458	2042	297.5	64	174	27.3
	Oct.	120	17	42.0	247	577	214.6	210	147	53.7
	Nov.	1	1	1.4	109	906	246.8	11	68	25.4
	Totals	374	61	95.0	1031	6479	1187.4	400	1113	223.2

Table 2.-- Summary of catch and effort statistics for three sizes of Boston otter trawlers fishing the west side of the South Channel, 1955-1959. Catches are in thousands of pounds, effort in days fished

Year	Small Otter Trawler			Medium Otter Trawlers			Large Otter Trawlers			
	Catch Had- dock	Total effort	Catch/effort Had- dock	Catch Had- dock	Total effort	Catch/effort Had- dock	Catch Had- dock	Total effort	Catch/effort Had- dock	
1955	174	189.5	0.9	1466	1218.5	1.2	1511	159.3	1.6	9.5
1956	102	116.5	0.9	995	1149.7	0.9	3626	291.1	1.5	12.5
1957	65	88.6	0.7	1652	1376.5	1.2	1409	198.8	2.1	7.1
1958	202	65.3	3.1	1500	1339.2	1.1	1290	250.4	2.3	5.2
1959	374	95.0	3.9	1031	1187.4	0.9	1113	223.2	1.8	5.0

The summary data are also shown in Figure 1. It is immediately apparent that the catches per unit effort for either cod or haddock do not reflect anything close to constant relationships for the three sizes of vessels in these years. Not until the catches of cod and haddock are combined do we get catches per unit effort in which smaller vessels are not shown as sometimes less efficient, sometimes more, than larger vessels.

However, even when the catches of cod and haddock are combined and catch per unit effort calculated for the two together, simple tests show no statistically significant relationship between the catch/effort figures for any two of the three--large, medium and small otter trawlers.

Some of the phenomena shown in Figure 1 can be explained:

1. The area under study is not physically homogenous, as mentioned above, and it is conceivable, even likely, that we are comparing the catch of large and medium vessels fishing as much as 60 miles offshore in deep water with the catch of small vessels fishing shallower waters within sight of land.

2. The division of vessels into size categories is crude; it is quite possible that vessels in each size category are not uniformly distributed in the category.

3. Changes in fish abundance have occurred during the period and it is obvious that the small otter trawlers turned their attention to cod rather than haddock. No correction has been made for effort directed toward either species at the expense of catches of the other.

4. A change has occurred in the fleet; at the beginning of the period there were about 30 large and 25 medium vessels fishing out of Boston, whereas at the end these proportions have reversed. At the same time, the number of small trawlers has been reduced by half, from 14 to 7.

Were the data more extensive it would be possible to take some of these considerations into account: the area might be subdivided, the vessels taken by smaller size groups, only the vessels with some definite percentage in the catch used for calculations of catch per day of either species, etc. But the data at times are so sparse that we do not believe any further fragmentation would be profitable.

Therefore, we can only offer this treatment as an example of the difficulties encountered in attempting to find quantitative relationships between abundance indices obtained by different sizes of vessels.

U.S. vessels fishing in different fisheries.

During the early 1950's a good many large otter trawlers were removed by their owners from the Georges Bank haddock fishery, transferred to Maine ports, and sent fishing for redfish. We are fortunate in having good catch and effort records for these vessels as haddock fishermen and as redfishermen, and were able to make a comparison of a selected group of boats before and after the change. Although the otter trawlers are all over 151 tons and therefore "large", there is some variation in size and horsepower (Table 3).

Table 3 - Sizes and horse powers of vessels used in comparison of redfish and haddock fisheries.

Boat	Gross tonnage	Horsepower
A	167	375
B	310	650
C	314	650
D	310	650
E	320	650
F	164	380
G	311	600
H	320	650
J	314	650
K	164	380

Table 4 shows the basic statistics used in the evaluation. Table 5 a summary of these statistics. We limited the data from the haddock fishery to trips made on Georges Bank in the year 1948 and 1949 and the redfish data to trips made on the Grand Bank in the year 1954 and 1955, after all of the boats under study had changed over.

Table 4 - Basic statistics used in comparison of haddock and redfish vessels. Catches are in thousands of pounds, effort in days fished.

Vessel	Haddock				Redfish								
	1948		1949		1954		1955						
	Catch	Effort C/E	Catch	Effort C/E	No. of trips	C/E	No. of trips	C/E					
A	758.8	90.8	8.4	12255	124.5	9.8	2	29.4	23.3	.69	.86	.76	.89
B	976.9	67.7	14.4	687.0	54.8	12.5	12	50.9	29.5	1.19	1.10	1.32	1.12
C	549.3	42.5	12.9	1212.4	106.2	11.4	10	56.1	24.0	1.07	1.00	1.45	.91
D	648.7	51.9	12.5	1446.3	106.6	13.6	11	46.6	27.5	1.03	1.19	1.21	1.05
E	551.1	58.8	9.4	411.6	41.4	9.9	15	43.6	23.0	.78	.87	1.13	.87
F	1496.5	133.6	11.2	1245.2	144.5	8.6	8	33.8	17.4	.93	.75	.88	.66
G	1090.7	79.5	13.7	289.6	30.0	9.7	6	56.5	23.2	1.13	.85	1.46	.88
H	468.4	47.8	9.8	394.7	39.3	10.0	13	40.9	31.5	.81	.88	1.06	1.20
J	62.6	8.4	7.5	133.3	88.9	12.1	12	47.7	33.6	.62	1.06	1.24	1.28
K	1114.7	142.8	7.8	1371.6	172.0	8.0	8	37.4	20.3	.64	.70	.97	.77

Notes.-- Scores computed for haddock fishing by comparing the catch per day of the vessel with the catch per day of "study boats" used to determine abundance of haddock. Scores computed for redfishing by comparing the catch per day of the vessel with the average catch per day for vessels redfishing in the same area.

Table 5.-- Summary of statistics used in comparison of haddock and redfish vessels.

Vessel	Mean haddock score	Mean redfish score
A	.78	.83
B	1.15	1.22
C	1.03	1.18
D	1.11	1.13
E	.83	1.00
F	.84	.77
G	.99	1.17
H	.85	1.13
J	.84	1.26
K	.67	.87

Note.-- Mean haddock score is the simple numerical average of the two years, 1948 and 1949, when the vessel was primarily a haddock fisherman. Mean redfish score is computed similarly for the years 1954 and 1955.

We compared the trawlers as haddock vessels to the "Boston Study Boats", a group of selected large trawlers of known efficiency which is used to derive our indices of abundance for Georges Bank haddock. (Some of the vessels used for this comparison were included in the study boat group when they were haddock fishermen.) This was done by taking all of the effort expended by each of the ten trawlers and the weight of haddock each caught, deriving a catch per day for each boat in each year, then dividing this catch per day by the study boat catch per day (12.1 in 1948 and 11.4 in 1949) to get a score. The scores for the two years were averaged to get the final score for the vessel.

We compared them as redfish boats by taking the catch per day for each trip made during the year to the Grand Bank and averaging these for the boat's yearly catch per day. The yearly catch per day was divided by the catch per day of all large U.S. otter trawlers fishing on the Grand Bank during that year (38.6 in 1954, 26.3 in 1955) for a score, and the scores for the two years averaged to get the final score for the vessel. It should be noted that U.S. redfish vessels ordinarily fish during daylight hours only, and that no adjustment has been made in these data for the difference between these and the haddock vessels which normally fish twenty-four hours per day while on the grounds.

Redfish data are commonly treated in our laboratory on a trip basis since in recent years each trip has involved a decision by the captain to go a shorter distance and fish longer on a lower abundance of fish, or to go a longer distance and fish for a shorter time on a higher abundance. Since all of these vessels sailed from Boston as haddock fishermen and had less than a day's steaming each trip to the grounds regardless of where on Georges Bank they fished, all of the days and all of the catch for the year were combined to calculate catch per day of haddock rather than doing it on a per trip basis as we did for redfish.

Figure 2 shows that there is a significant correlation between the scores of these vessels as haddock fishermen in 1948 and 1949 and their scores as redfishermen in 1954 and 1955.

We have not exploited these data to the fullest. The calculations outlined above have been on a selected group of vessels and only for four years, two of which they operated as "pure" haddock fishermen, two of which as "pure" redfishermen, for the sake of simplicity in our first approximations. If the Committee on Research and Statistics

think it worthwhile we can pursue the investigation further. Altogether about twenty vessels changed in the early 50's from one fishery to the other, and data on catch and effort for all of the years are available.

An additional consideration, which we have not been able to treat in this rather brief and cursory study, is that several of these vessels have subsequently been sold to Canadian fishing interests and are currently fishing out of Maritime ports, primarily we believe, for cod and haddock. A comparison of these boats fishing on different grounds, manned with Canadian crews, with their histories as U.S. haddock and redfish vessels might be useful in equating U.S. and Canadian effort statistics.

#### S U M M A R Y

Although we were unable to derive any standard effort units for U. S. otter trawlers of various sizes fishing the same are at the same time, a comparison of large otter trawlers fishing for haddock and redfish offers some promise that effort data for the two species can be related.

In addition, since some of these vessels have been fishing out of Canadian ports in recent years, probably for cod and haddock, there is a distinct possibility that their performances can be compared to relate U. S. and Canadian effort statistics. A joint study by scientists of the Woods Hole and St. Andrews laboratories, utilizing all of the data available for these vessels, is recommended.

#### LITERATURE CITED.

Rounsefell, G.A. 1948. Development of fishery statistics in the North Atlantic. U. S. Fish and Wildlife Service, Special Scientific Report No. 47, 27 pp.