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Area Trawled on Georges Bank by the Canadian Groundfish Fishery

Superficie du banc Georges chalutée lors de la pêche canadienne du poisson de fond

Stratis Gavaris[1] and/et Jerry Black[2]

[1]Fisheries and Oceans Canada
531 Brandy Cove Road
St. Andrews, NB E5B 2L9

[2]Fisheries and Oceans Canada
P.O. Box 1006, 1 Challenger Drive
Dartmouth, NS B2Y 4A2

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ABSTRACT

Fishing activity may impact the ecosystem by disturbance of benthic communities and habitat. The area trawled by the Canadian groundfish bottom trawl fishery on Georges Bank was quantified using fishing log records and information captured by observers at sea. In 2001 and 2002, the footgear disturbed less than about 10% of the bottom while the bridles/warp swept less than about 30%. The doors impacted less than 1% of the bottom. The available data collected from fishery observations is not sufficient to provide anything but a rough estimate of the area trawled. Comprehensive monitoring of position during fishing operations is required if zoning within management units will be used to regulate ocean use activities.

RÉSUMÉ

Les activités de pêche peuvent avoir des effets néfastes sur l'écosystème parce qu'elles perturbent l'habitat et les communautés benthiques. Les données de journaux de bord et les renseignements recueillis par les observateurs en mer ont servi à quantifier la superficie du banc Georges chalutée dans le cadre de la pêche canadienne du poisson de fond au chalut à panneaux. En 2001 et 2002, le bourrelet a perturbé moins de 10 % du fond, les entremises et les funes en ont balayé moins de 30 %, tandis que les panneaux en ont déplacé moins de 1 %. Les données provenant de l'observation de la pêche suffisent seulement à donner des estimations très brutes de l'étendue de la zone de chalutage. Il faudrait surveiller et consigner la position des traits des activités de chalutage sur le fond si l'objectif est d'établir des zones dans les unités de gestion pour réglementer les activités océaniques.

INTRODUCTION

The primary impact of fishing is generally considered to be the direct mortality generated on the target species. Accordingly, considerable attention and importance has been given to regulating the fishing mortality. Fishing activity may also impact the ecosystem by disturbance of benthic communities and habitat. There is a growing awareness of these impacts and increasing acceptance towards adopting ethical codes of conduct for fishing that aim to reduce and minimize any unwanted effects. Disturbance of benthic communities and habitat may be caused by other ocean use activities (Wildish and Stewart *in prep*). This work only considers fishing activity.

Management approaches for mitigating the impacts of fishing on the benthic community and habitat include effort reduction, area restrictions and gear modifications (NMFS 2002). The development of effective management strategies for minimizing adverse effects on benthic communities and habitat requires classification of habitat, an understanding of the impacts by fishing on the various habitats and quantification of the bottom area affected by the fishing activities. A draft DFO work plan to address the impacts on ecosystem functioning and productivity caused by disturbance of the habitat and to develop reference points for unacceptable outcomes has been prepared (DFO 2002). The scope of this work is quantification of the bottom area affected by fishing.

Any fishing activity, regardless of gear employed, can have some impact on the habitat (NMFS 2002). Here, we are concerned with the groundfish fishery on eastern Georges Bank and do not consider gears employed in other fisheries, e.g. scallop, lobster, herring. Three principal gear types, otter trawl, longline and gillnet, are used in prosecuting the Canadian groundfish fishery. Of these three, otter trawl and longline are the most prevalent gears in use. Most concern about adverse effects on benthic communities and habitat have centered on the impacts caused by mobile bottom tending gear (Valdemarsen and Suuronen 2003). Accordingly, the objective of this study is to quantify the area of the seafloor on eastern Georges Bank that is fished by the Canadian bottom otter trawl fishery in a year. Results were summarized for 2001 and 2002. Otter trawlers in tonnage classes 1, 2 and 3 accounted for about 95% of the trawler effort hours. The analysis was only conducted for this fishing fleet sector.

DATA AND METHODS

The area fished by bottom otter trawl can be calculated as the product of the distance towed and the width of the gear. The width of the gear while in operation is not routinely monitored, therefore this measure must be obtained from opportunistic mensuration of trawl performance. Departures in the width of the gear from design characteristics are not expected to be significant under normal operation. It is generally recognized that bottom otter trawl gear is a complex piece of equipment and the impact to the bottom is a function of which part of the gear is in contact. The principle parts of bottom otter trawl gear that tend the bottom are the trawl doors, the bridles/groundwarp and the footgear of the net. The typical bottom otter trawl used by the Canadian Georges Bank fishery is a #300 Balloon (pers. com. J.G. d'Entremont). The wingspread, which represents the width swept by the footgear, for this net is about 20m and the doorspread is about 91m. Caddy (1973) reported

that the observed width of tracks made by doors ranged from 0.15m to 0.7m. We will use 0.5m for the width of bottom impacted by each door, therefore 1m for the width impacted by both doors in any tow. Subtracting the footgear and door tracks from the doorspread, the bridles/groundwarp sweep a combined width of about 70m.

The fishery catch effort statistics include only one position for each bottom otter trawl tow, therefore the tow distance and area towed cannot be obtained directly. The Canadian Georges Bank fishery has one of the highest coverage by at sea observers. The observer data includes considerable detail about fishing operations, including start and end positions for tows. However, since the observer data, while considered representative of the fishery, does not comprise complete coverage of the fishery, it also cannot be used to obtain total area towed in a year. Noting that the fishery catch effort statistics records hours towed, the two databases may be used together to derive an estimate of total distance towed by prorating the observed distance towed by the ratio of total hours fished to observed hours fished. The nominal area fished is the product of the total distance towed and the width of the gear.

It is known that towing over the same grounds is a common practice. This occurs because the contours, tides, and available prey for that piece of the bottom are some of the reasons that attract the fish to congregate in that particular area. Unlike for sedentary invertebrate species, for mobile finfish, these preferred habitats are occupied again after a trawl has passed through. We refer to the intersection of the area fished by all the tow tracks as the physical area fished, which is less than the nominal area fished. To get a measure of the physical area fished, it is necessary to account for the multiple tows over grounds and for the area when tracks cross over and overlap each other.

With only one position recorded in the fishery catch effort statistics, this database does not provide any information on overlap. The degree of overlap will depend on the fishing intensity in an area. Therefore, an accurate reflection of the degree of overlap cannot be obtained from the observed fishing in any one year because the observed fishing intensity is less than the actual fishing intensity. The relationship between fishing intensity, represented by hours per unit area, and overlap, represented by the ratio of physical area to nominal area, was established from observed fishing pooled over several years.

The physical distance towed for observed fishing was obtained by constructing rectangles defined by the start and end positions and the width (Figure 1). A mapping procedure to calculate the area enclosed by this multi-polygon was then applied. To calculate this physical distance, rectangle widths of 20m and 70m were used for the footgear and bridles/groundwarp respectively. It was assumed that the area disturbed by the doors is always unique even if tows had the same start and end positions, because the width of the doors is small. Therefore the area disturbed by the doors was obtained by multiplying the nominal distance by the width disturbed by the doors. The area fished by the footgear and the bridles/groundwarp was the nominal area adjusted by the ratio of physical to nominal area for the appropriate fishing intensity.

To account for possible differences in the degree of overlap and for possible variation in tow speed, eastern Georges Bank was partitioned into 5 zones and these calculations were done for each zone (Figure 2). The zones were defined to roughly delineate homogeneous areas with respect to bottom substrate, fish species composition and density of trawling.

The zones were also defined to accommodate the resolution of the catch effort statistics and to encompass, to the extent possible, the full length of the most typical tows observed. Only observed tows contained entirely within a zone were used in the analysis of physical area.

Zones B is classified as gravel pavement, while the remaining zones are classified as gravelly sand. Cod and haddock are the dominant species caught in Zone B while in Zone A, cod and haddock are caught along with pollock. Zone C is dominated by haddock and Zone D is the area where the directed yellowtail fishery is prosecuted.

RESULTS

Comparison of the ratio of physical area fished to nominal area fished from observed tows indicated that the percent of grounds towed more than once increased as a function of fishing intensity, expressed as hr/sq km, resulting in a decrease in the ratio (Figure 3). The ratio declines fairly rapidly as intensity increases to about 0.5 hr/sq km and stabilizes somewhat thereafter. The average annual fishing intensity was generally between 1 and 2.5 hr/sq km in all zones except D (Table 1). Accordingly, constant multipliers of 0.85 and 0.7 were used for the footgear and bridles/groundwarp respectively to convert nominal area fished to physical area fished. The appropriate multipliers for zone D are likely somewhat lower, but specific values could not be determined, therefore the physical area fished is designated as less than (indicated by < in Table 1) the calculated value. As noted earlier, the nominal area fished by the doors was not reduced for overlap because the width of the doors is narrow.

The area trawled, both in square kilometers and as a percentage of the bottom area, for the 2001 and 2002 Georges Bank groundfish fisheries is summarized by zone (Table 1). Zone D has the greatest amount of trawling effort, about half of the total trawling effort for Georges Bank. The area fished by the components of the otter trawl gear was highest in this zone. Zone B is the next most heavily fished area and shows the next highest area trawled. The results indicate that the doors generally disturb less than 1% of the bottom, except in zone D where the doors impact 2-3% of the bottom. Excepting Zone D, the percent of area swept by the footgear and the bridles/groundwarp ranged as high as 14% and 40% respectively.

DISCUSSION

The substantial reduction of effort by the Canadian fishery on eastern Georges Bank since the early 1990s should be recognized as an important positive contribution towards mitigation of fishing impacts on the benthic community and habitat. Nonetheless, it would be informative to monitor directly the area trawled by the fishery. The method employed assumes that tows are straight lines between the start and end positions. It is known that this is generally not the case. The effect of assuming straight lines between the start and end position of tows would result in an under-estimation of the area trawled. The impact of this effect on the estimate of area trawled cannot be determined with available data. The

calculation of area fished also assumes continuous bottom contact of the gear for the duration of the tow.

The method used to calculate nominal distance towed is equivalent to the product of total hours fished and observed speed over bottom. This suggests that an alternate general approach for calculating nominal area fished is to take the product of speed and hours towed and multiply by the width of the gear components. While hours towed is recorded as part of the fishery statistics, speed is not captured. Examination of speed recorded on observed trips indicated that speed was dependent on the vessel power, tides and the type of fishery being prosecuted. On Georges Bank, the average speed tended to be lower, about 1-1.5 n mi/hr in Zone D, characteristic of flounder fishing, and about 2 n mi/hr in other zones. The frequency distribution of speed shows a wide spread of speeds with 2 modes, characteristic of flounder and cod/haddock/pollock tow speeds (Figure 4). The observed variation in speed is high and a suitable average is difficult to predict. Without detailed information about the nature of the fisheries in an area, automatic application of this approach could produce misleading results.

The available data collected from fishery observations is not sufficient to provide anything but a rough estimate of the area trawled. The results may over-estimate area trawled due to inadequate accounting of the same grounds being towed and under-estimate area trawled due to assuming that tows are straight lines. Reliable estimates of area trawled will require monitoring and recording of position during tow operations from a large fraction, if not all, bottom trawling activity. Monitoring only observed trips would not be adequate because of low coverage. Recording of only start and end position on logbooks would not be adequate because tows are not straight lines. Monitoring of position by satellite telemetry during fishing operations is carried out for various fisheries now, including the scallop fishery on Georges Bank, and the associated costs have decreased in recent years. Comprehensive monitoring of position during fishing operations is required if zoning within management units will be used to regulate ocean use activities.

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Table 1. Area in square kilometers of the zones and of the bottom swept by the components of otter trawls for the 2001 and 2002 Georges Bank groundfish fisheries conducted by vessels in tonnage classes 1, 2 and 3.

		Zone					
		A	B	C	D	E	Total
	Zone area	2832	3101	1069	877	2544	10422
2001	***Effort***						
	observed (hr)	377	793	111	509	9	1799
	total (hr)	2412	7271	2008	13000	249	24940
	intensity (hr/sq km)	0.85	2.34	1.88	14.83	0.10	
	Fished area						
	footgear	154	384	81	498	13	1130
	bridles/warp	443	1107	234	1434	47	3265
	doors	9	23	5	29	1	66
	% of zone area fished						
	footgear	5%	12%	8%	<57%	1%	<11%
	bridles/warp	16%	36%	22%	<100% [1]	2%	<31%
	doors	0.3%	0.7%	0.4%	3.3%	0.0%	0.6%
2002	***Effort***						
	observed (hr)	418	533	129	534	0	1614
	total (hr)	3772	7105	1420	9909	50	22256
	intensity (hr/sq km)	1.33	2.29	1.33	11.3	0.02	
	Fished area						
	footgear	143	431	86	266		927
	bridles/warp	414	1241	249	767		2671
	doors	8	25	5	16		55
	% of zone area fished						
	footgear	5%	14%	8%	<30%		<9%
	bridles/warp	15%	40%	23%	<88%		<26%
	doors	0.3%	0.8%	0.5%	1.8%		0.5%

[1]calculated value was greater than 100%

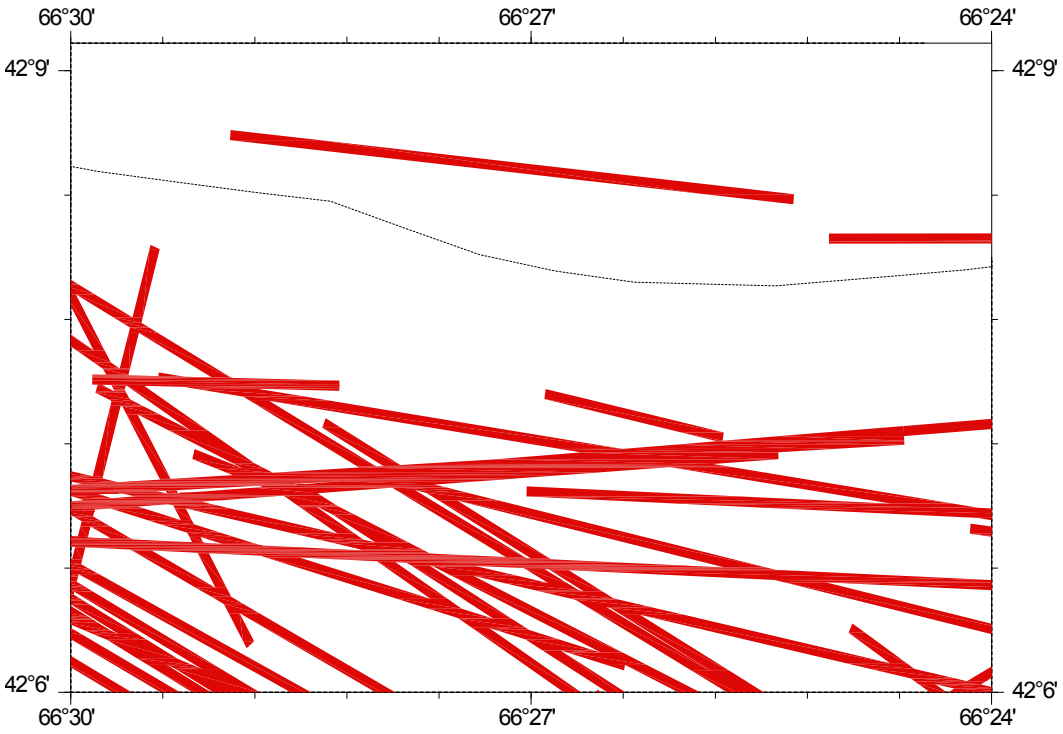

Figure 1. Section of the northern edge of Georges Bank showing overlap in trawl tracks during one year of observed trips. The illustrated width is scaled to reflect a 91m track width.

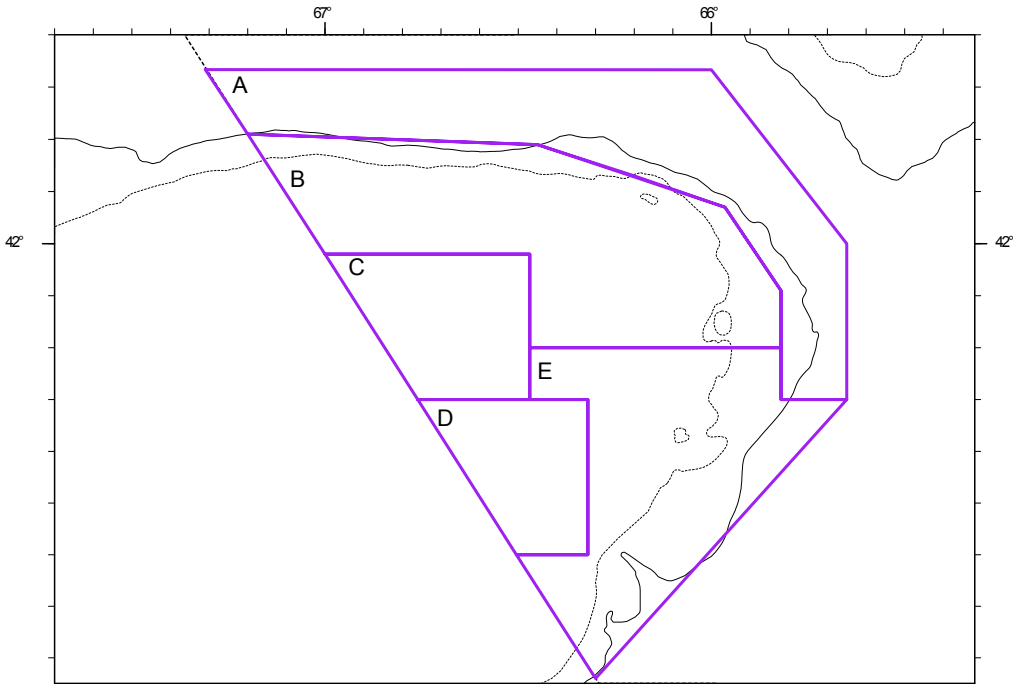

Figure 2. Zones used to summarize area trawled on Georges Bank.

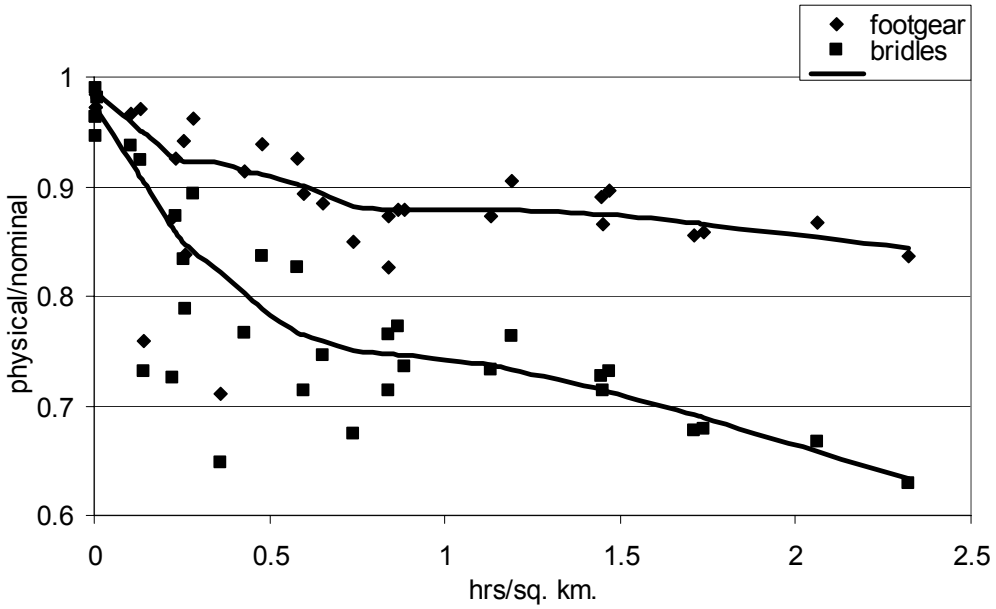

Figure 3. The degree of overlap in trawl tracks as a function of the fishing intensity is displayed as the ratio of physical area to nominal area. These results were obtained by pooling observed trips for several years.

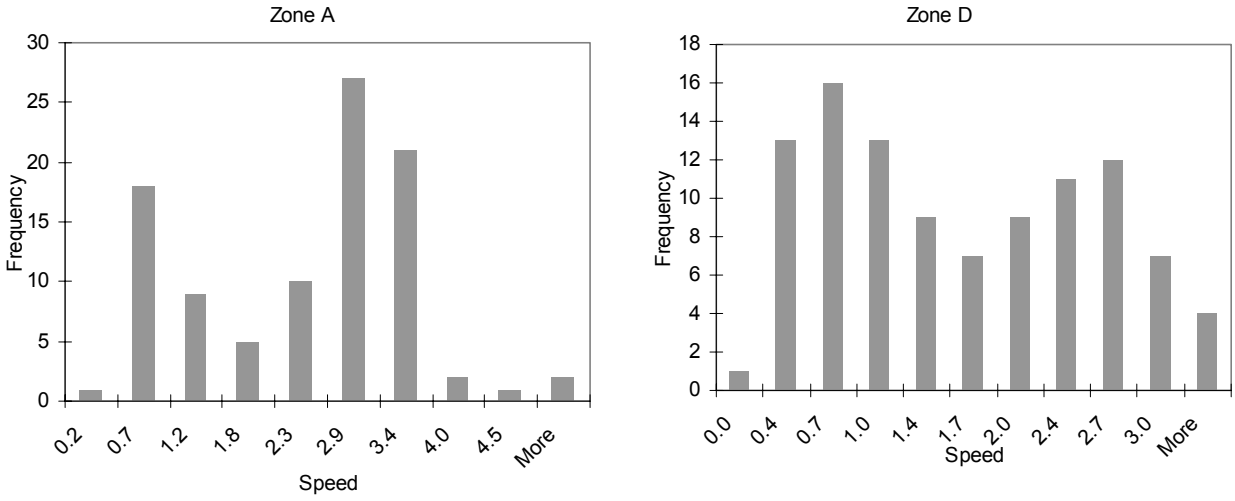

Figure 4. The frequency distribution of speed (n mi/hr) for tonnage classes 1-3 otter trawlers from observed trips in 2001 for two zones on Georges Bank displays two modes.