Northwest Atlantic Fisheries Organization

Serial No. N5481 **NAFO SCR Doc. 07/90**

SCIENTIFIC COUNCIL MEETING – SEPTEMBER 2007

Analysis of Shrimp Fishing Effort Using VMS data

by

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ABSTRACT

Shrimp from 3L have a relatively higher catch rate, and are of higher quality, than shrimp caught in 3M. The difference is exacerbated by the higher operating costs involved in fishing shrimp in 3M. Shrimp in 3L are regulated by a catch quota whereas shrimp fishing in 3M is effort regulated by a total allowable number of fishing days per year. There are therefore strong incentives to erroneously report shrimp caught in 3L as being caught in 3M. The result is that actual catches in 3L are under-estimated and actual catches in 3M are over-estimated (NIPAG, 2006). Owing to the above, the NAFO FC have amended the reporting measures for 3LM shrimp in order to promote more accurate catch statistics (NAFO, 2006; CEM, 2007 Articles 6, 19 and 20).

NAFO SC requested the Secretariat to analysis the VMS data and supply SC with summary information on shrimp catches in 3L and 3M (SC, 2006, p. 223, Item V.4c).

METHODS

Area of coverage

This paper primarily covers the NRA, and it particular 3M and that portion of 3L outside the Canadian EEZ. There are particular definitions for 3M and 3L that specifically relate to the shrimp fishery and are defined in the CEM (2007, Annex 5). A rectangle at the southeast corner of 3L is regarded as 3M because of the shrimp stock in this rectangle is believed to be part of the 3M stock. This rectangle is closed to fishing from June to December, and does not appeared to be fished at other times of year. In this paper, this small rectangle was regarded as part of 3L, which is consistent with the finfish definition of the areas.

VMS data

The primary data source is the VMS database held at the NAFO Secretariat, with POS reports being matched to target species using COE/COX reports. Other trip and target species information submitted to the Secretariat was also used as a secondary data source. VMS transmissions are made by all vessels fishing within the NAFO Convention Area, but the Secretariat only receives information from those vessels in the NAFO Regulatory area. Therefore, only a portion of 3L east of 48°W can be monitored by the Secretariat; all of 3M lies within the NRA and so complete information is available for this area.

Time and position information is transmitted automatically at two-hourly intervals. Average vessel speed can only be calculated by reference to the distance traveled as detailed in Thompson and Campanis (2007), as vessel speed is not transmitted to the Secretariat. A vessel was said to be fishing when the average speed fell between 1 and 6 knots (Fig. 1). The data was filtered to include only fishing positions at depths down to 700 m.

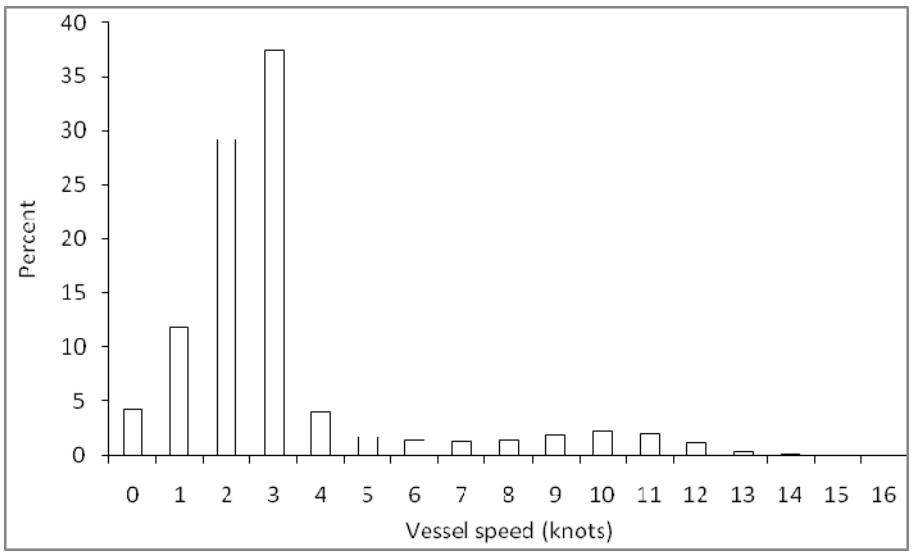

Fig. 1. Frequency distribution of calculated vessel speed for all NAFO VMS data.

Fishing effort is presented in terms of vessel time (hours-on-ground and hours-fished), and in terms of fishing power (kW hours-on-ground and kW hours-fished) taken as the days fished multiplied by the power of the individual vessels. The Ocean Data View software (ODV, 2007) was used to plot the latitude and longitude mid-points for each position pair on a chart containing depth contours.

Shrimp are mainly reported as Pink (*Pandalus*) shrimp (PAN) or Northern Prawn *Pandalus borealis* (PRA). These are assumed to represent the same species, *P. borealis*, that totally dominates the catch and are here referred to simply as shrimp.

STATLANT 21B

Effort data exists in the STATLANT 21B database (NAFO, 2007), although only Ukraine and Poland have to date submitted their 2006 catch and effort data. An analysis of 2005 data is possible from data submitted by Faroe Islands, Poland, Norway and Canada. Extractions were made using the main species classification for shrimp (PAN) with submissions current to 19 September 2007.

RESULTS

Data was only analyzed for 2006. The total shrimp fishing effort in 3M and the NRA portions of 3L was 10 557 and 5 244 hours on ground, respectively (Table 1). Fishing in 3N accounted for only 5% of the 3LNO effort, and no shrimp fishing was recorded in 3O. Since there should be no shrimp fishing in 3N, it is likely that the 5% value refers to some other fishery that has been erroneously included. Vessels were estimated to fish from 82–88% of their time on ground. Vessels were of a similar average size on the two grounds, and so the fishing effort is not skewed because of differences in the size of vessels fishing the two areas. No adjustment could be made with regard to single and twin trawls.

Little fishing was observed in less than 200 m of water, mainly because there is very seabed shallower than 200 m depth in 3LMNO. Most of the fishing occurred in the 250–550 m range, with a clear decrease in the 551–600 m interval (Fig. 2).

The spatial distribution of fishing effort on the eastern edge of the Grand Banks and on the Flemish Cap down to 600 m is shown in Fig. 3. Fishing is concentrated in two main areas within 3M and 3L, with some scattered fishing to the south of the Flemish Cap. The greatest concentration of shrimp fishing occurs in 3M from October to December (Table 2, Fig. 3D). Since, 2000, shrimp fishing in Divisions 3LNO is restricted to Division 3L. Division 3L is closed to shrimp fishing between April and June and top of the Flemish Cap is closed from June–December

TABLE 1. Shrimp fishing effort in NAFO Divisions 3M, 3L and 3N for the NAFO Regulatory Area in 2006 derived from an analysis of the VMS database.

Units of effort	3M	3L	3N
Hours on Ground	10 557	5 244	278
Hours Fishing	9 322	4 309	186
kW Hours - On Ground	13 899 000	27 827 200	204 700
kW Hours Fishing	11 388 700	24 895 200	136 900

TABLE 2. Quarterly comparison of fishing effort (hours-fished) for shrimp in 3L, 3M and 3N for 2006.

Quarter	3L	3M	3N
1 (Jan-Mar)	1 808	1 343	0
2 (Apr-Jun)	3	2515	0
3 (Jul-Sep)	1 094	848	186
4 (Oct-Dec)	1 404	4 616	0

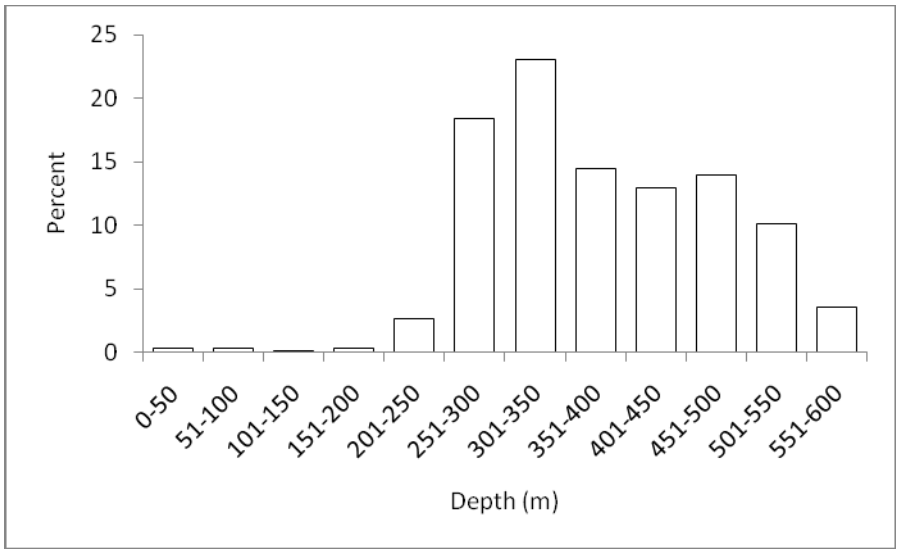

Fig. 2. Frequency distribution of estimated depth at which the vessels were recorded as fishing for shrimp in 3LMNO.

(Article 12 Fig. 1 in CEM 2007). However, shrimp do not appear to be fished on the top of the Flemish Cap during the first half of the year, and it is possible that good shrimp fishing grounds do not occur there.

Fishing effort was derived from the STATLANT 21B database for 2005 Total effort in 3M during 2005 was 5308 fishing hours by Poland (528 h), Faroe Islands (4 611 h) and Norway (169 h). Effort was greater in 3L at 14 475 h, mainly due to Canadian vessels (11 647 h) with less fishing undertaken by Faroe Islands (2 382 h), Poland (266 h) and Norway (180 h). There was a distinct peak in the June to August period in 3L and a shallow bi-modal pattern in 3M (Fig. 4).

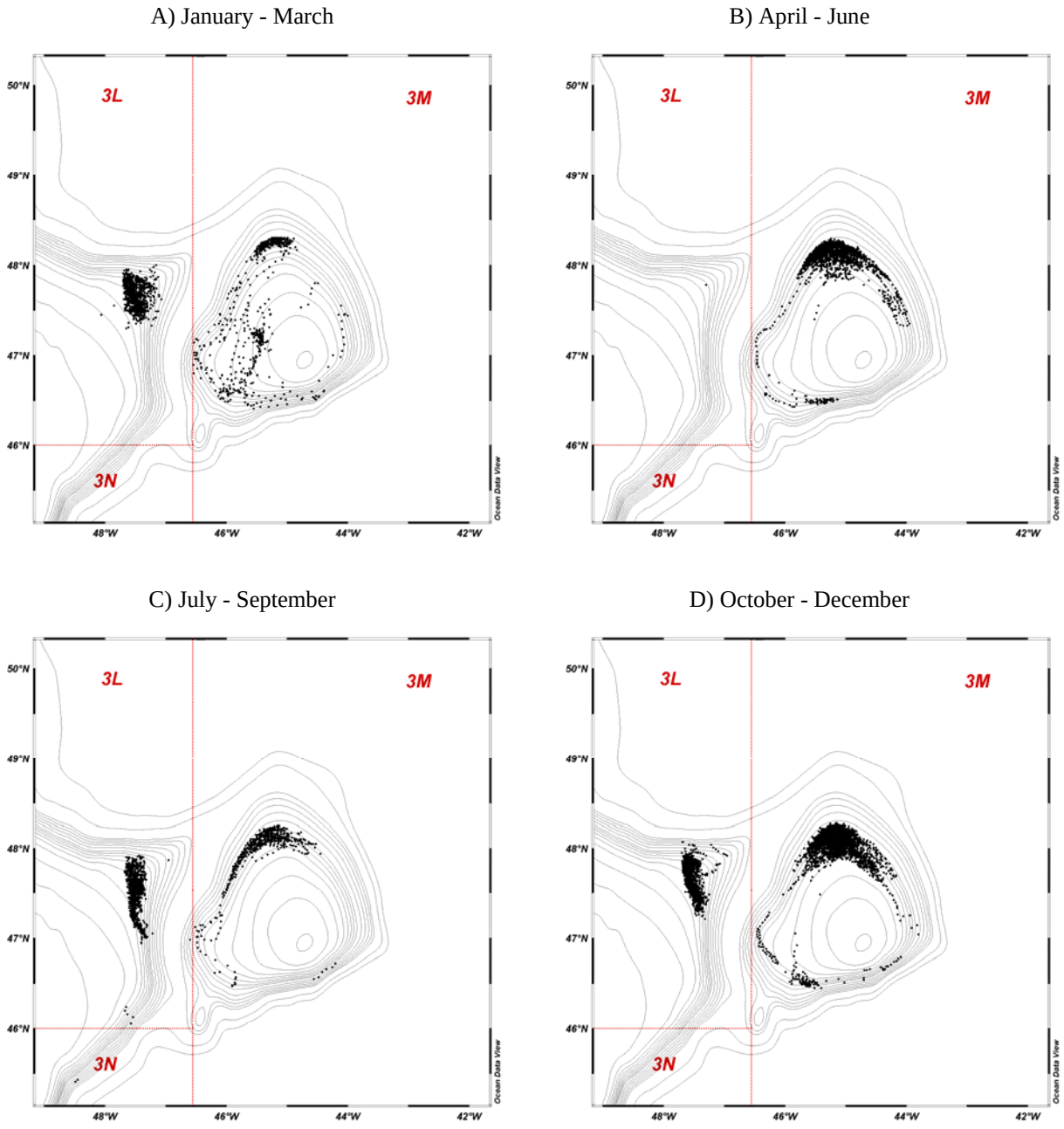

Fig. 3. Positions for vessels fishing for shrimp in Divisions 3L and 3M during each quarter of 2006.

DISCUSSION

At present, one of the central difficulties in the analysis of the VMS data is in assigning the target species fished by the vessel transmitting their positions. This is relatively easy, though still time consuming, for shrimp owing to the specific target species and gear deployed, and the limited number of vessels fishing for shrimp. Once the vessel has been identified as a shrimp fishing vessel, then determination of hours on ground can be achieved easily and with reasonable accuracy by simply recording the presence and absence of a particular vessel in a particular area. It should be realized that vessels enter and leave NAFO divisions fairly regularly and could easily be in two or three divisions in a single day. For this reason, this analysis has used hours on ground and this does not necessarily equate

easily to whole days on ground. The proportion of time actually fishing is a much harder to estimate from VMS transmission. A proxy for fishing must be used, and speed derived from successive transmission is the only real option. Trawling speeds are fairly consistent, however vessels often steam slowly when they are not fishing, or they change direction, and this could be erroneously recorded as fishing. In general, this form of error would over-estimate the hours fished. In addition, speed is not a point estimate, it is the average over a two hour interval. For this reason, a fairly wide range of speeds needs to be accepted as a proxy for fishing. This could cause over- or under-estimation of the time fishing, depending on the range of speeds used as a proxy.

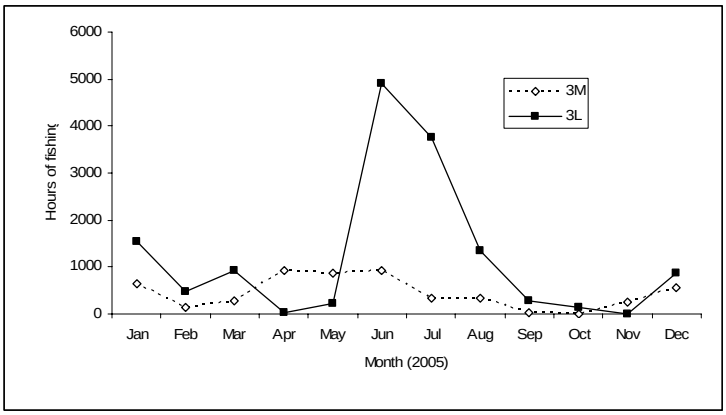

Fig. 4. Effort data for the 2005 shrimp fishery derived from STATLANT 21B.

In general, the assessment papers used at the NIPAG working group for 3L and 3M shrimp do not include details on fishing effort, although CPUE estimates are often given especially when this relates to research surveys. An exception exists for Greenland who used logbook information from commercial vessels (Siegstad, 2006). They record two vessels fishing in 3M (760 h in June and 110 h in July 2006) and one vessel fishing in 3L (76 h in July 2006), but note that the effective effort was twice this as twin trawls were used.

It is not really possible to compare the 2005 STATLANT 21B effort results with the 2006 VMS effort results, except in the most general way and by making some rather risky assumptions. In general, Canada does not fish for shrimp in the NRA, so if Canadian effort is removed from the STATLANT 21B results, we should at least be operating with comparable areas, albeit in different years. In both 3M and 3L, the effort derived from the VMS was around twice that obtained from STATLANT 21B, however, for a meaningful comparison we will need to wait until the STATLANT 21B data is available, but at least we are in the right order of magnitude.

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