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Distribution of Yellowtail Flounder (*Limanda ferruginea*) on the Grand Bank of Newfoundland by the Data from Russian Surveys 1971-91

by

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ABSTRACT

It has been revealed that the northen boundary of yellowtail flounder area shifted much southwards from 1971 to 1991. Young fish (not larger than 25 cm) have been distributed lately only in the south of the Grand Bank (3 NO), though in 70's they occurred widely in the north of GNB (Div. 3 L).

It is shown, that yellowtail flounder occurrence in the northern outlying areas does not depend upon temperature variability in a bottom layer, but is determined by strength of yellowtail population in the Grand Bank area.

INTRODUCTION

As the yellowtail flounder stock in GNB has been at a low level in recent years, STACFIS pays much attention to prevent the catch of yellowtail flounder juveniles (NAFO, 1992).

Several papers concern yellowtail flounder juveniles distribution (Walsh, 1986; 1987;1990;1992 a,b).However,these papers deal with the data from autumn surveys of plaice juveniles carried out by Canada since 1985.Besides,emphasize in these works is made on yellowtail flounder juveniles distribution in the south and south-east of GNB,where yellowtail flounder densent concentrations are observed. The paper presented deals with yellowtail flounder juveniles distribution in the GNB area based on the data from PINRO spring-summer surveys for 1971-1991, with emphasize on variations in its distribution in the northern part of the area.

Recent years data determined,that yellowtail flounder both juveniles and adult specimens are widely tolerant to water temperatures (Walsh, 1992 a), i.e. their distribution depends more on other factors.Nevertheless, we consider the studying of yellowtail flounder distribution during such a long period just at the background of temperature variations of bottom waters layer, and especially, in abnormally warm and cold years to be very interesting.

Also we wanted to get clear wether the yellowtail flounder area borders in GNB had been changed because of essential decrease in its stock.

MATERIALS AND METHODS

To analyze distribution of yellowtail flounder in GNB on the basis of the annual Russian spring-summer surveys, 21 maps of yellowtail flounder catches distribution have been drawn up (per 1 haul/hour for 1971-1991).

When charting maps for juveniles distribution (1-4 years aged) ,and separately for adult fish (5+) for the period 1971-1990,fish abundance from each trawl has been calculated by two size groups (below 25 cm long and above 25cm long), which corresponded approximately to 1-4 and 5+ age respectively (Table 1, 2). The map of yellowtail flounder distribution in 1991 has been done using age-length key resulted from Subdivision 3 NO resulted from age reading by otholites in 262 spec. of yellowtail flounder.

RESULTS AND DISCUSSION

As the analysis showed,in 70's yellowtail flounder occurred over the Grand Bank shallows,expending northwads up to 48 N, and it was registered not only in the north-eastern areas,as the Canadian data had pretended in late 60's (Pitt,1970), but in the north-western areas also (Fig.1). Separate catches of yellowtail flounder were available along the Newfoundland coast up to the Belle Isle Strait (Bigelow,Schroeder, 1953; Leim,Scott, 1966).PINRO surveys indicate that in 70's separate catches of yellowtail flounder occured in the sea part of the shelf up to 51 N. In 1976 yellowtail flounder were caught even more northwads (51 24'N, 53 47'W).Those catches contained not only adult fish,but also young fish of 17-25 cm long.

In 70's yellowtail flounder juveniles occurred widely over the whole Div. 3 L (though in less quantities than in the south of GNB),(Fig.1).In 80's a gradual shifting of northern border of juveniles distribution to the southern direction has been observed (Fig.2).Analysis of length frequencies of yellowtail flounder for the period 70 - 80's shows ,that if in early 70's an essential amount of juveniles 13 - 25 cm long were available in catches, than no fish below 25 cm long were registered in catches since the mid-80's (Fig. 3). In 90's yellowtail flounder juveniles inhabited only the GNB southern area (Div. 3 NO), (Fig.1). The Canadian surveys for flat fishes juveniles carried out since the middle of 80's confirm that yellowtail flounder juveniles (aged 1-4) occur only in Div. 3 NO , and their main concentrations are registered in the Southeast Shoal (Walsh, 1986,1987,1990,1992 a,b).

During 20 years from 70 to 90's the yellowtail flounder spawning area has been reduced markedly. Thus, PINRO ichtyo-plankton surveys carried out in spring-summer 1959-70 showed that yellowtail flounder spawned across the whole GNB area, and also along the Newfoundland coast (North-East of Avalon peninsula),however, the most intensive spawning was observed in the southern part of the Bank under the temperatures in a bottom layer from 0.5 to 7.5 C (Nevinsky,1973).

Besides ,it has been noted that no transport of eggs and larvae has been registered off GNB far away from the spawning grounds and juveniles adapt to a bottom way of life immediately in the spawning areas.Taking this into account, and also the fact that general transport of water masses,and therefore,of eggs and larvae of yellowtail flounder is pronounced southwards (Evseenko,Nevinsky, 1980, 1981),one can suggest the yellowtail flounder stock off GNB in the northern outlying sections was recruited due to a spawning at the Avalon peninsula and in the north of the GNB shallows.Not only eggs at the 1st stage,i.e. eggs recently extruded (according to the Rass scale 1949),but also occurrence of prespawning and spawning specimens showed that spawning took place at the same time as the surveys (Nevinsky,1973). However, after 1971, yellowtail flounder distribution according to the data from spring-summer surveys indicates,no fish were practically registered at the Avalon peninsula on the sections which had been previously observed as spawning grounds. Yellowtail flounder seems to have continued to spawn for some time in the north of the GNB shallows.During last years yellowtail flounder spawning has been observed mainly within the Southeast Shoal and adjacent areas of the southern Bank (Walsh, 1992 a). Due to tagging, it was determined that adult yellowtail flounder migrated from the Southeast Shoal to the south of Div. 3 L(Walsh, 1987).Because of this,and also absence ofjuveniles in the northern areas,it can be supposed,that in recent years yellowtail flounder stock in the GNB northern areas has been recruited due to the spawning in the Southeast Shoal. As the yellowtail flounder stock in GNB has been markedly reduced since the middle of 80's according to both Canadian and PINRO surveys (Brodie et al.,1991; Brodie,Walsh 1992),a qantity of yellowtail flounder in the north of GNB has also been considerably reduced. Similar relationship between the populational abundance and spawning area size has been established for the Barents Sea plaice(Kovtcova, 1988).It has been found out that in the years when plaice abundance was high,the spawning area was vaster, irrespective of hydrographic situation.

In 1984-1985,after yellowtail flounder abundance and biomass have been markedly reduced in GNB, some attempts to connect these variations to hydrographic conditions have been undertaken (Borovkov et al.,1989). However simple comparison between mean catches and mean temperature variations in bottom layer did not show any relation.Analysis of yellowtail flounder distribution at the background of temperature variations in bottom layer for the period 1971-1991 did not elucidate any essential relatonship betwen these factors even in the abnormal years from the point of view of temperature either. Yellowtail distribution on GNB depends mainly on populational abundance.Thus in 1973, which is considered to be abnormally cold one (Fig.4), almost the whole Div. 3 L during spring-summer period was occupied by waters with negative bottom temperature (Fig.5). Nevertheless,relatively warmwater species of yellowtail flounder which in 1973

had a high abundance (Fig.4) extended widely over the whole Div. 3 L with both the adult and juvenile fish being available (Fig.5). In 1978, when the bottom layer temperature in Div. 3 L was observed to be highest for the 1971-1990 period, yellow tail flounder, the abundance of which was at a lower level in 1978 (Fig.4), occurred less in the Div. 3 L (Fig.5).

A comparison between the bottom layer mean temperatures (according to Brodie et al.,1992) and abundance by PINRO surveys in Div.3 L, revealed a certain opposite phase in these parameters variations (Fig.4). In the years of high temperatures in bottom layer low abundance of yellowtail flounder was observed and vice versa. However, it is known that abundance of any population is dependent on abiotic factors, firstly through recruitment value variations. So close relationship between abundance of the year class at age 5, survival ratio from eggs to age 5 and water heat content in 50 - 200 m layer has been determined for such a representative of flat fish as Greenland halibut from the North-West Atlantic (Serebryakov et al.,1989). Similar relationship, probably, exists for yellowtail flounder too. At least it is known, that a sharp rise in water temperature on the Jeorges Bank, where warm waters from the continental slope often enter, affects adversely boreal species, including yellowtail flounder (Colton, 1959). The opposite phase revealed in yellowtail flounder abundance variations and bottom temperatures in Div. 3 L was observed till the middle of 80's (Fig. 4). The opposite phase disturbance in subsequent years, has probably been connected to the fact, that after the middle of 80's, when yellow tail flounder abundance and biomass off GNB was markedly reduced (Fig.6), in northern areas yellowtail flounder started to be recruited completely on the basis of southern areas fish. At the same time, with yellowtail flounder stock sharp decrease, its catch increased much, and exceeded the TAC (Fig.6), which has led the stock to a complete decline.

CONCLUSIONS

1. During the period 1971 - 1991 the northern border of yellowtail flounder area in the North-West Atlantic has shifted much southwards.

2. Yellowtail flounder juveniles in GNB have been limited in recent years only in the south of the Bank, while in 70's it occurred widely in Div. 3 L.

3. Yellowtail flounder distribution in the northern outlying areas of the Bank is not dependent on the bottom layer temperature variations, but is determined by the abundance of its population on the Grand Newfoundland Bank.

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Table 1. Length - age key for yellowtail flounder males from Divisions 3 NO (sampled in April 1991)

Males: Length (cm)	Age (years) 3	4	5	6	7	8	9	Total amount
14	1							1
15	2							2
16	1							1
17								
18								
19		2						2
20								
21		2						2
22		2						2
23		3						3
24		2						2
25		2						2
26		2	3					5
27			7					7
28			4					4
29			6					6
30			4	1				5
31			2	3				5
32			1	4	1			6
33				7	1			8
34				4	1			5
35				2	3			5
36				1	4			5
37					3			3
38					6			6
39					3	2		5
40					2	3		5
41					4	1		5
42						3		3
43						2		2
44						1		1
45						1	1	2
Total amount	4	18	26	27	30	19	1	125

Table 2. Length - age key for yellowtail flounder females from Divisions 3 NO (sampled in April 1992)

Females: Length (cm)	Age (years) 3	4	5	6	7	8	9	10	Total amount
13	1								1
14									
15	1								1
16	1								1
17									
18	2								2
19	1								1
20									
21		2							2
22		2							2
23		6							6
24		3							3
25		2	3						5
26			5						5
27			6						6
28			5						5
29			4						4
30			4	1					5
31				1					1
32				2	1				3
33				3	1				4
34				1	1				2
35				3	4				7
36				3	3				6
37					6	1			7
38					3	1	1		5
39					2	4	1		7
40					2	4			6
41						4	3		7
42						4	2		6
43						4	1		5
44						4	2		6
45						1	4		5
46						1	3		4
47							1		1
48							2	2	4
49							2		2
50								1	1
Total amount	6	15	26	14	23	28	22	3	137

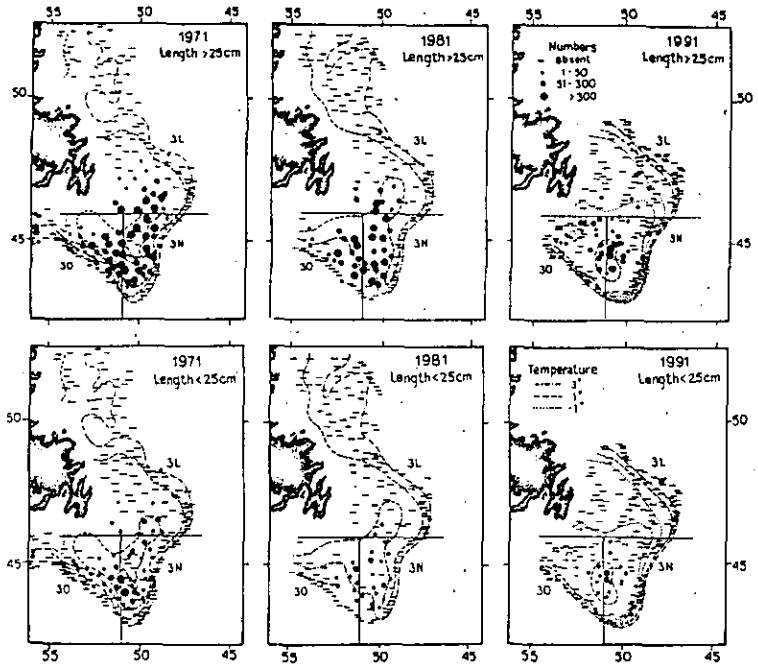

Fig. 1. Distribution of bottom layer temperature (Tevs, 1991) and of yellowtail flounder (both adult and juvenile fish) by data from PINRO spring-summer surveys on the Grand Bank of Newfoundland in 1971,1981,1991

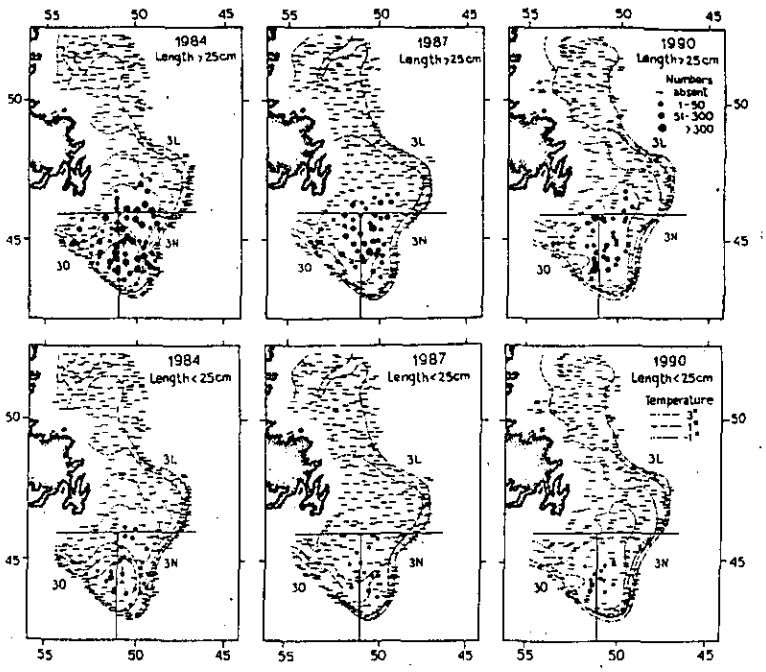

Fig. 2. Distribution of yellowtail flounder (both adult and juvenile fish) and of bottom layer temperature in the Grand Bank of Newfoundland by data from PINRO spring-summer surveys in 1984,1987 and 1990

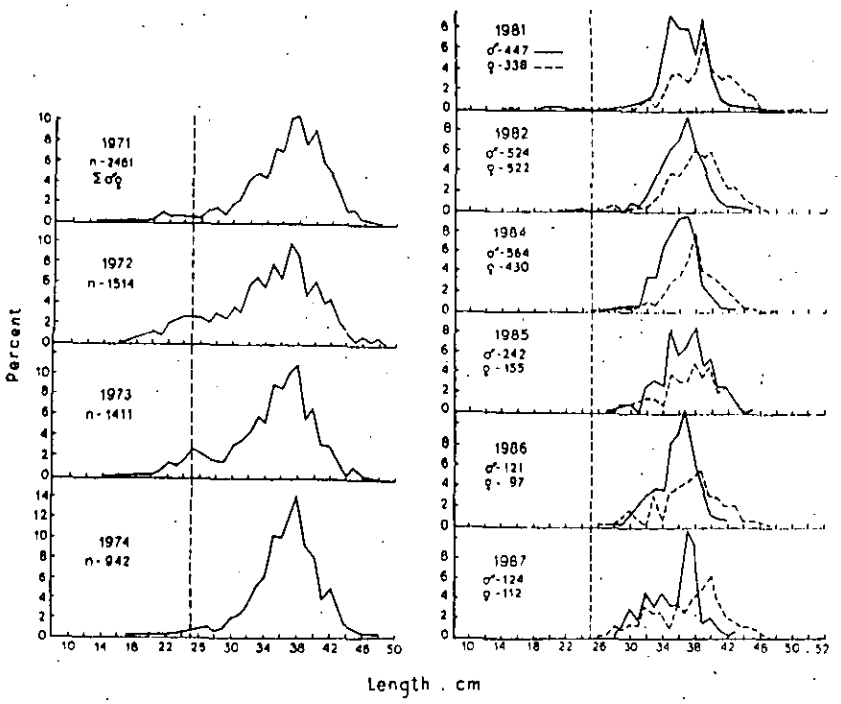

Fig. 3. Variations of length composition in yellowtail flounder catches in Div. 3 L in 70 and 80's by data from PINRO spring-summer surveys

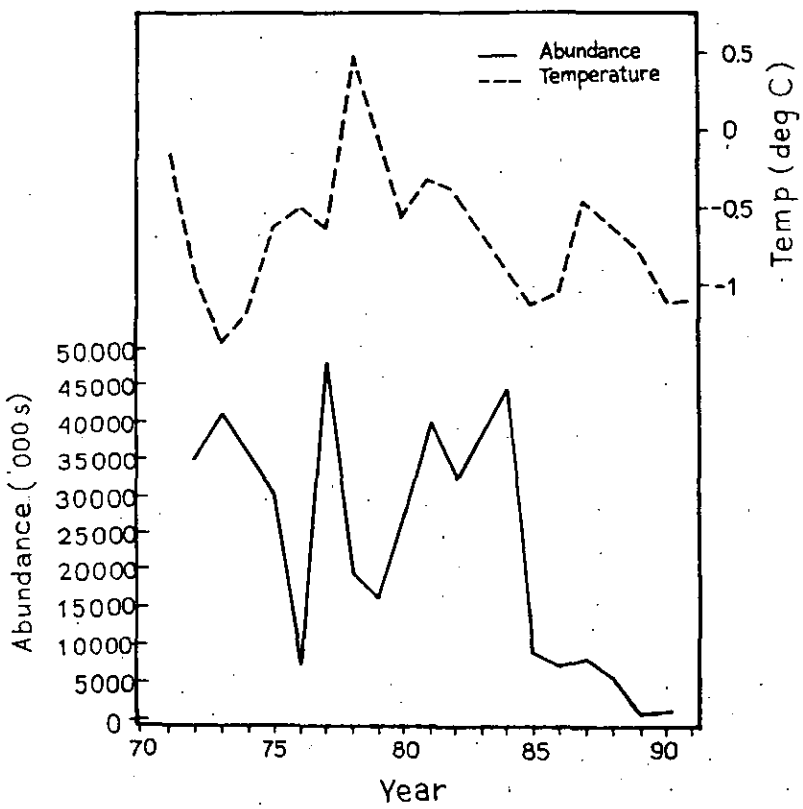

Fig. 4. Variations of yellowtail flounder strength by data from PINRO spring-summer surveys and variations of bottom layer mean temperatures by data from Canadian spring surveys in Div. 3 L (according to Brodie et al., 1992)

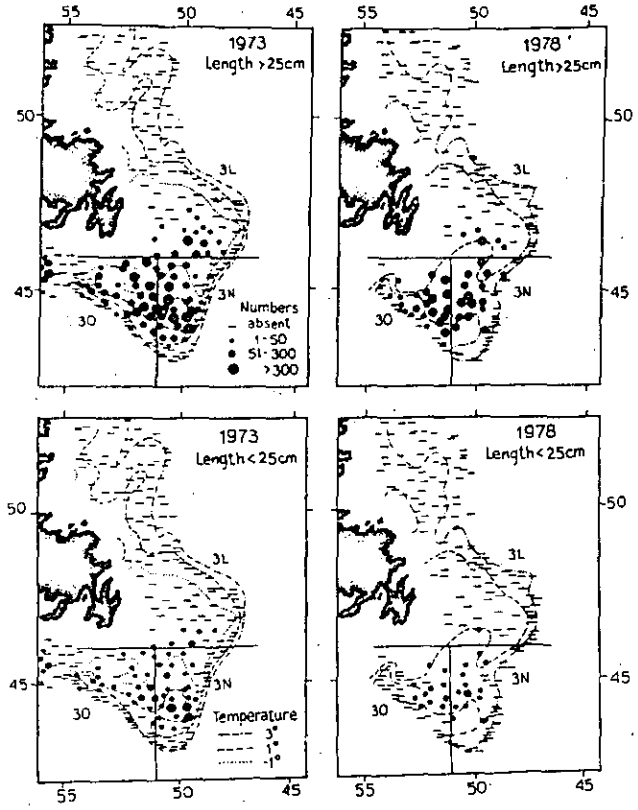

Fig. 5. Distribution of yellowtail flounder (both adult and juvenile fish) and distribution of bottom layer temperatures in the Grand Bank by data from PINRO spring-summer surveys in 1973,1978

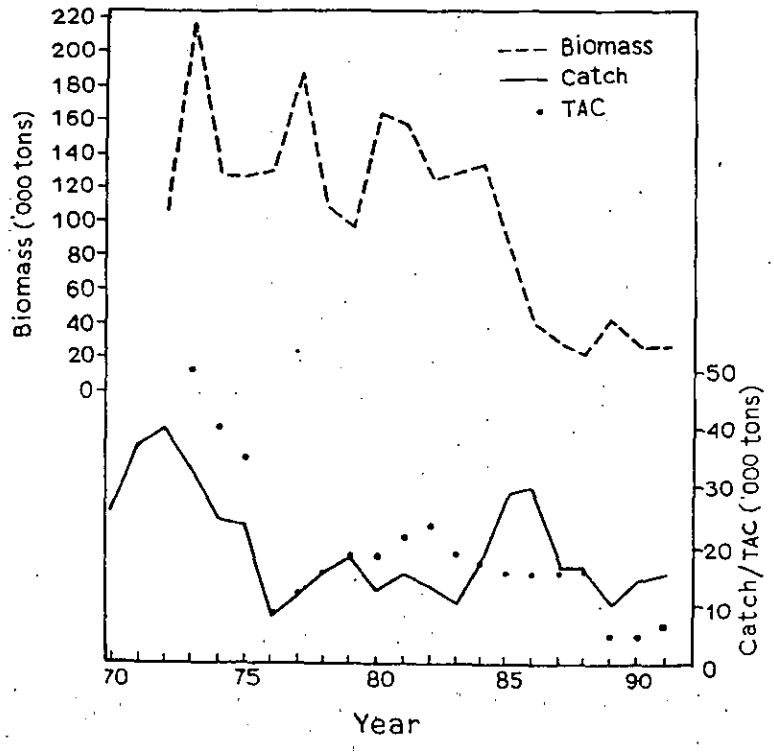

Fig. 6. Variations of yellowtail flounder biomass by data from PINRO spring-summer and variations of catches (by all countries) (NAFO, 1992)and TAC in Div. 3 LNO