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# Spanish Skate (*Raja radiata* Donovan, 1808) Fishery in the Grand Bank (NAFO Division 3N): 1997-2000.

by

J. L. del Río and S. Junquera

Instituto Español de Oceanografía, Vigo, Spain

## ABSTRACT

The Spanish skate fishery in NAFO Regulatory Area is performed from August to November in a quite restricted area of Div. 3N at depths between 51 and 100 m. Fishing effort, unstandardized catch rates, length composition, sexual maturity, by-catch, discards and sex-ratios are presented in this paper.

The length range of thorny skate in the catches is mainly between 30 and 85 cm, with a mode of 50-51 cm. Both sexes appeared equally represented in the catches. The main by-catch in this fishery is American plaice and yellowtail flounder. A large proportion of mature males are observed.

## INTRODUCTION

As a result of the increase in fishing effort towards non-regulated species added to the decline in the traditional groundfish resources in the area of the Grand Bank, in recent years the catches of non-traditional resources in NAFO area have been increasingly important (Durán *et al*., 1997; Junquera and Paz, 1998).

Thorny skate distribute widely on the Grand Bank region, though it is most highly aggregated on the Southern part (Simon and Frank, 1996). The pattern of aggregation observed shows seasonal differences in distribution, with a period of concentration mainly in fall in shallow waters on the southern Grand Bank (del Río and Junquera, 2000; Kulka and Mowbray, 1998).

The skate fishery in the Grand Bank and the Scotian Shelf within Canadian waters is regulated since 1994, through quota control (Simon and Frank, 1996), but the fishery in the Regulatory Area is currently unregulated. Since 1996, part of Spanish fleet formerly targeting exclusively on Greenland halibut, started to undertake occasionally the skate fishery on the southern Grand Bank Regulatory Area in shallow waters. The estimated catches of thorny skate by the Spanish fleet in NAFO Div. 3N in 1999 were 4 700 tons (Junquera *et al.*, 2000) and increased to about 10 700 tons in 2000.

In 1997-2000 biological sampling on three of the trawlers targeting skate have been performed by Spanish national scientific observers. Besides, data on fishing effort provided by NAFO observers are analysed to obtain further evidences on the seasonality of this resource.

## MATERIAL AND METHODS

Two sources of information have been used in this study:

(I) Three scientific observers from the Spanish sampling program have been on board three trawlers involved in the skate fishery in Div. 3N in the second half of the year (September and October in 1997; August to December in 2000). Those observers provided data on fishing activity and carried out biological sampling of this species. Skates were sexed, weighed to the nearest 10 g and measured to total length (LT), taken as the distance between the tip of snout to terminal point of the caudal fin, to the lower centimetre. Sexual maturity was assessed macroscopically.

(II) Data from the NAFO observers (100% coverage of the fleet) have been used to obtain the proportion of fishing effort directed to this species. Those observers report on hours fishing, hauls position, catches, discards and mesh size, in a year round haul basis. The fishing time targeting skate is identified as the vessels change to a trawl with a codend mesh size of about 220 mm, instead of the usual 130 mm used when targeting for others species.

## Results and Discussion

### Fishing effort and CPUE

In Table 1 the monthly distribution of the Spanish fleet effort targeting skate in Div.3N by depth, as reported by the NAFO observers is presented. The majority of these hauls (98.7%) were realised in Div. 3N and the presence in Div. 3O is only occasional. The results show that the 65% of fishing effort is performed at depths between 51 and 100 m.

The unstandardized catch rates (kg/hour fishing) by depth strata in 1997 and 2000 appear in Table 2. The highest catch rates occurred at depths less than 100 m. In 2000 the best catch rates were 1079.3 Kg/hour obtained in August at depths less than 50 m.

The present results confirm the previous evidences regarding the seasonality of the fishing effort distribution in this fishery obtained in 1997, 1998 and 1999 (del Río and Junquera, 2000). The pattern of the fleet activity indicate that this species form seasonal dense concentrations from August to November in shallow waters, between 51 to 100 m, in a quite restricted area in Div. 3N.

### By-catches and discards.

The main by-catch species in the skate fishery are presented in Fig. 1. In 1997 and 2000 the main by-catches are American plaice and yellowtail flounder and secondarily cod and juvenile Greenland halibut. The discarded proportions (%) of those by-catches are shown in Fig. 2.

### Biological information

Table 3 and Figure 3 shows the length composition (0/00) by sex of thorny skate Spanish trawl catches in Div. 3N in 1997 and 2000. The length range is mainly between 30 and 85 cm and is approximately similar in the two years analysed. Modal length coincides in males and females in 48-49 cm in 1997. In 2000 the modal length is 50-51 cm and 46-47 cm for males and females respectively. Length classes between 42-59 cm are dominant in the catches (61.9%).

Figure 4 present the sex ratio in 1997-2000. Both sexes appeared equally represented in the catches. A total of 1977 and 8704 skates have been sampled in 1997 and 2000 respectively. Female ratio is 52% in year 1997 and 51% in year 2000. Female proportions at length are shown in Fig. 5. In the first length-classes (24-40 cm), females are more abundant than males. Between 40-72 cm sex ratio fluctuates around 50%. In larger length-classes (72-94 cm), females proportion decreased very fast (72 cm 50% and 78 cm 25%) and at length-classes over 88 cm the 100% are males.

A total of 2 629 males ranging from 21 cm total length to 95 cm total length and 2 284 females from 28 cm total length to 88 cm total length were examined from August to December 2000 (Table 4). A 70% of the males and 47% of the females sampled were mature (adults). Similar proportions have been observed in previous years (Junquera and Paz, 1998; del Río and Junquera, 2000). Thus in the autumn concentrations the proportion of mature males is

consistently higher than that of females, and besides, the majority of males were ripe whereas females were at earlier maturity stages. It could mean that the fishing activity is probably targeting on a mating concentration.

Length-weight relationship for males and females in year 2000 are illustrated in Fig. 6. The relationship between LT (cm) and weight (g) was assumed to be adequately expresses by the exponential function. Relationship for males is $W(g) = 0.0169*LT(cm)^{2.8698}$ and for females $W(g) = 0.0141*LT(cm)^{2.9165}$. Differences between sexes are not significant. The sexes combined relationship is $W(g) = 0.0158*LT(cm)^{2.8878}$.

## Acknowledgements

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Table 1.- Fishing effort (%) in hours in the Spanish skate fishery in Div. 3N, 2000.

| Div. 3N | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (meters) | JAN. | FEB. | MAR. | APRIL | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | TOTAL |
| 0 - 50 | | | | | | (0) | (1) | (8) | (11) | (6) | (3) | (0) | (30) |
| | 0 | 0 | 0 | 0 | 0 | 17 | 33 | 485 | 646 | 364 | 196 | 11 | 1752 |
| 51 - 100 | | | | | | (1) | (5) | (7) | (10) | (16) | (24) | (1) | (65) |
| | 0 | 0 | 0 | 0 | 0 | 80 | 314 | 426 | 590 | 919 | 1397 | 30 | 3756 |
| 101 - 150 | | | | | | (0) | (0) | (0) | (1) | (0) | (0) | | (2) |
| | 0 | 0 | 0 | 0 | 0 | 10 | 13 | 10 | 69 | 10 | 8 | 0 | 120 |
| 151 - 200 | | | | | | | (0) | | (1) | (1) | | | (2) |
| | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 0 | 63 | 31 | 0 | 0 | 117 |
| 201 - 250 | | | | | | | | | (0) | | | | (0) |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 21 |
| TOTAL | | | | | | (2) | (7) | (16) | (24) | (23) | (28) | (1) | (100) |
| | 0 | 0 | 0 | 0 | 0 | 107 | 383 | 921 | 1389 | 1324 | 1601 | 41 | 5766 |

Table 2.- CPUE (kg/h) by month in the skate fishery in Div. 3N, 1997 and 2000.

| 1997 | | | | | | |
|---|---|---|---|---|---|---|
| DEPTH (meters) | AUG. | SEPT. | OCT. | NOV. | DEC. | TOTAL |
| 0- 50 | - | 355,7 | 576,2 | - | - | 527,3 |
| 51- 100 | - | 508,5 | 582,1 | - | - | 541,9 |
| 101- 150 | - | 3,3 | - | - | - | 6,7 |
| 151- 200 | - | 22,3 | 1,9 | - | - | 15,4 |
| 201-250 | - | - | - | - | - | - |
| TOTAL | - | 457,4 | 573,9 | - | - | 519,1 |

| 2000 | | | | | | |
|---|---|---|---|---|---|---|
| DEPTH (meters) | AUG. | SEPT. | OCT. | NOV. | DEC. | TOTAL |
| 0- 50 | 1079,3 | 592,4 | - | 640,2 | 937,5 | 801,9 |
| 51- 100 | 768,9 | 729,9 | 897,1 | 663,8 | 275,3 | 686,9 |
| 101- 150 | - | - | - | 13,9 | 11,4 | 10,9 |
| 151- 200 | - | 485,9 | - | - | - | 489,1 |
| 201-250 | - | 234,7 | - | - | - | 663,5 |
| TOTAL | 995,9 | 626,3 | 897,1 | 628,4 | 298,8 | 690,6 |

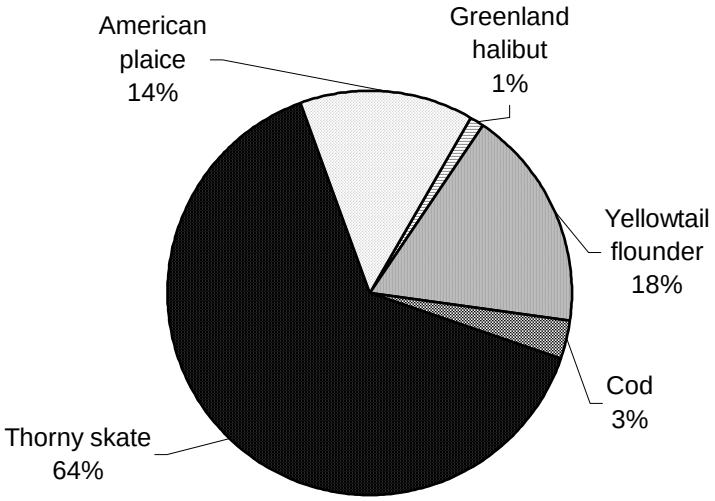
Table 3.- Thorny skate length composition (0/00) by sex in the Spanish commercial catches in Div. 3N: 1997-2000.

| LENGTH | 1997 | | | 2000 | | |
|---|---|---|---|---|---|---|
| (cm) | MALES | FEMALES | TOTAL | MALES | FEMALES | TOTAL |
| 24 - 25 | 0 | 1 | 1 | 0 | 0 | 0 |
| 26 - 27 | 1 | 2 | 1 | 3 | 3 | 3 |
| 28 - 29 | 0 | 5 | 3 | 18 | 5 | 11 |
| 30 - 31 | 5 | 6 | 6 | 16 | 16 | 16 |
| 32 - 33 | 6 | 13 | 10 | 20 | 18 | 19 |
| 34 - 35 | 11 | 23 | 18 | 19 | 28 | 23 |
| 36 - 37 | 31 | 25 | 28 | 16 | 31 | 23 |
| 38 - 39 | 63 | 57 | 60 | 28 | 29 | 28 |
| 40 - 41 | 69 | 78 | 74 | 34 | 43 | 38 |
| 42 - 43 | 65 | 82 | 74 | 41 | 59 | 50 |
| 44 - 45 | 76 | 66 | 71 | 68 | 79 | 73 |
| 46 - 47 | 70 | 85 | 78 | 75 | 82 | 79 |
| 48 - 49 | 88 | 90 | 89 | 86 | 74 | 80 |
| 50 - 51 | 57 | 66 | 62 | 87 | 74 | 80 |
| 52 - 53 | 60 | 67 | 63 | 70 | 71 | 70 |
| 54 - 55 | 57 | 74 | 66 | 65 | 66 | 65 |
| 56 - 57 | 53 | 38 | 45 | 61 | 50 | 55 |
| 58 - 59 | 44 | 42 | 43 | 46 | 46 | 46 |
| 60 - 61 | 32 | 35 | 34 | 37 | 40 | 38 |
| 62 - 63 | 24 | 35 | 30 | 28 | 32 | 31 |
| 64 - 65 | 31 | 20 | 25 | 26 | 35 | 30 |
| 66 - 67 | 26 | 31 | 28 | 21 | 28 | 25 |
| 68 - 69 | 22 | 13 | 17 | 22 | 24 | 24 |
| 70 - 71 | 19 | 11 | 15 | 19 | 22 | 21 |
| 72 - 73 | 16 | 9 | 12 | 15 | 18 | 16 |
| 74 - 75 | 15 | 10 | 12 | 19 | 10 | 15 |
| 76 - 77 | 13 | 6 | 9 | 16 | 8 | 12 |
| 78 - 79 | 13 | 6 | 9 | 15 | 6 | 10 |
| 80 - 81 | 14 | 0 | 7 | 9 | 2 | 6 |
| 82 - 83 | 12 | 2 | 7 | 8 | 0 | 4 |
| 84 - 85 | 5 | 1 | 2 | 5 | 0 | 2 |
| 86 - 87 | 1 | 0 | 0 | 2 | 0 | 2 |
| 88 - 89 | 0 | 0 | 0 | 1 | 0 | 1 |
| 90 - 91 | 3 | 0 | 2 | 2 | 0 | 0 |
| Total | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Fish measured | 936 | 1041 | 1977 | 4325 | 4379 | 8704 |
| Nº samples | | 12 | | | 56 | |
| Sample weight (kg) | | 3150 | | | 13612 | |
| Depth range (m) | | 40-250 | | | 40-250 | |

Table 4.- Number of adult and immature individuals by length in 2000.

| | MALES | | | | FEMALES | | | |
|---|---|---|---|---|---|---|---|---|
| Length (cm) | Immature | Mature | Total | % | Immature | Mature | Total | % |
| <25 | 1 | 0 | 1 | 0 | - | - | - | - |
| 26 - 27 | 1 | 0 | 1 | 0 | - | - | - | - |
| 28 - 29 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 |
| 30 - 31 | 1 | 0 | 1 | 0 | 3 | 0 | 3 | 0 |
| 32 - 33 | 6 | 0 | 6 | 0 | 4 | 0 | 4 | 0 |
| 34 - 35 | 14 | 0 | 14 | 0 | 15 | 0 | 15 | 0 |
| 36 - 37 | 23 | 0 | 23 | 0 | 28 | 0 | 28 | 0 |
| 38 - 39 | 54 | 0 | 54 | 0 | 43 | 0 | 43 | 0 |
| 40 - 41 | 70 | 1 | 71 | 1 | 78 | 3 | 81 | 4 |
| 42 - 43 | 97 | 6 | 103 | 6 | 106 | 2 | 108 | 2 |
| 44 - 45 | 131 | 12 | 143 | 8 | 152 | 4 | 156 | 3 |
| 46 - 47 | 139 | 42 | 181 | 23 | 196 | 8 | 204 | 4 |
| 48 - 49 | 131 | 99 | 230 | 43 | 181 | 20 | 201 | 10 |
| 50 - 51 | 72 | 166 | 238 | 70 | 127 | 38 | 165 | 23 |
| 52 - 53 | 33 | 171 | 204 | 84 | 123 | 52 | 175 | 30 |
| 54 - 55 | 17 | 148 | 165 | 90 | 87 | 67 | 154 | 44 |
| 56 - 57 | 3 | 156 | 159 | 98 | 34 | 92 | 126 | 73 |
| 58 - 59 | 0 | 103 | 103 | 100 | 17 | 93 | 110 | 85 |
| 60 - 61 | 0 | 118 | 118 | 100 | 7 | 82 | 89 | 92 |
| 62 - 63 | 1 | 88 | 89 | 99 | 3 | 93 | 96 | 97 |
| 64 - 65 | 0 | 85 | 85 | 100 | 3 | 86 | 89 | 97 |
| 66 - 67 | 0 | 75 | 75 | 100 | 0 | 68 | 68 | 100 |
| 68 - 69 | 0 | 70 | 70 | 100 | 0 | 91 | 91 | 100 |
| 70 - 71 | 0 | 73 | 73 | 100 | 0 | 80 | 80 | 100 |
| 72 - 73 | 0 | 80 | 80 | 100 | 0 | 67 | 67 | 100 |
| 74 - 75 | 0 | 81 | 81 | 100 | 0 | 55 | 55 | 100 |
| 76 - 77 | 0 | 64 | 64 | 100 | 0 | 24 | 24 | 100 |
| 78 - 79 | 0 | 48 | 48 | 100 | 0 | 28 | 28 | 100 |
| 80 - 81 | 0 | 55 | 55 | 100 | 0 | 12 | 12 | 100 |
| 82 - 83 | 0 | 35 | 35 | 100 | 0 | 5 | 5 | 100 |
| 84 - 85 | 0 | 26 | 26 | 100 | 0 | 4 | 4 | 100 |
| 86 - 87 | 0 | 17 | 17 | 100 | - | - | - | - |
| 88 - 89 | 0 | 7 | 7 | 100 | 0 | 1 | 1 | 100 |
| >90 | 0 | 7 | 7 | 100 | - | - | - | - |
| TOTAL | 796 | 1833 | 2629 | 70 | 1209 | 1075 | 2284 | 47 |

**1997**




**2000**

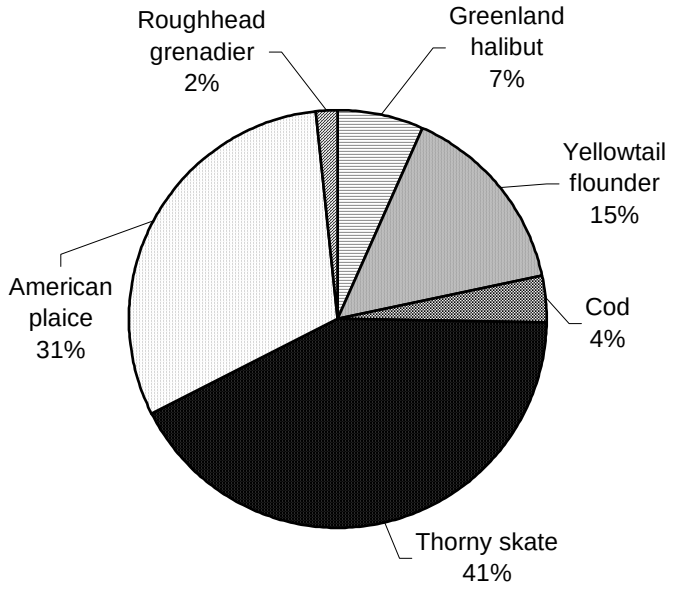



Fig. 1.- By-catch species in the skate fishery in Div. 3N, 1997 and 2000.

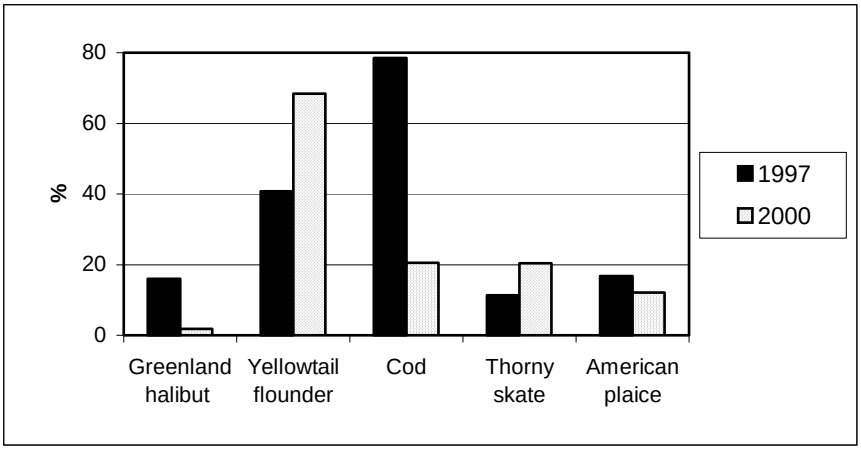



Fig. 2. Proportion discarded of the by-catches species in the skate fishery in Div. 3N, 1997 and 2000.

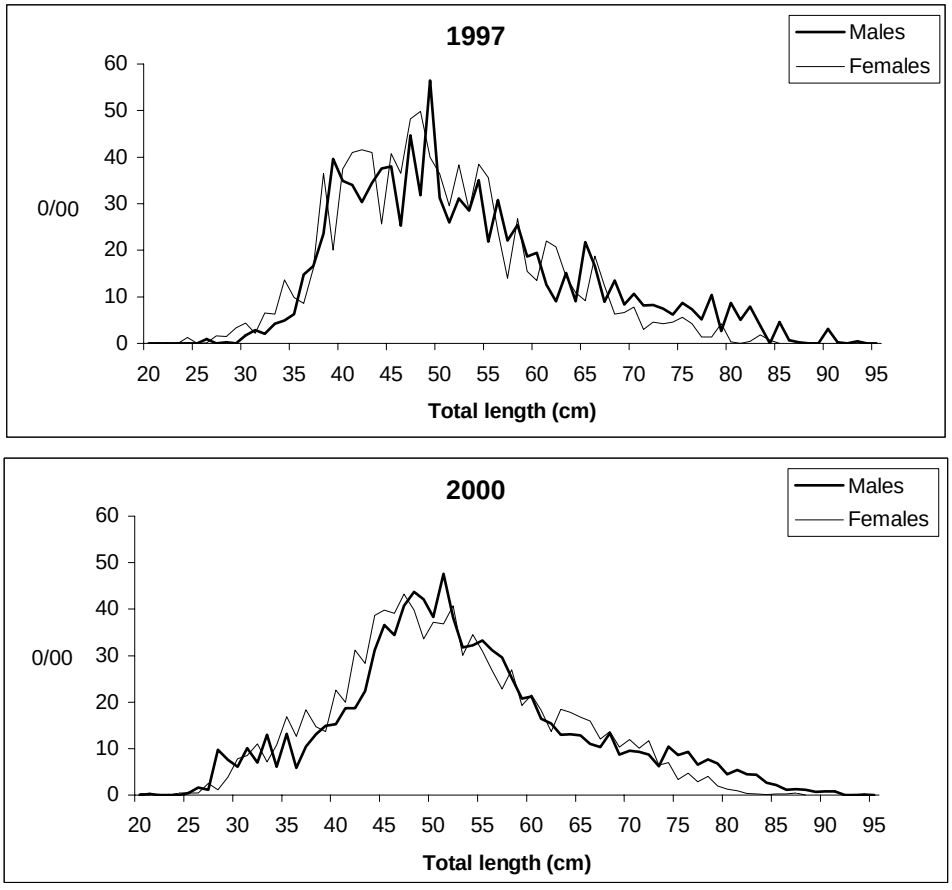



Fig. 3.- Length composition (0/00) by sex of the thorny skate in the Spanish commercial catches (NAFO Div. 3N): 1997 and 2000.

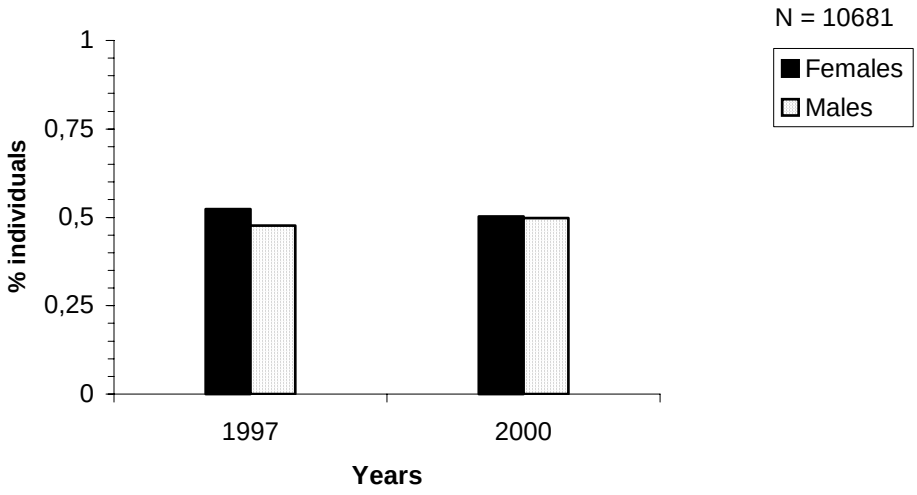



Fig. 4.- Thorny skate sex-ratio (%) by year.

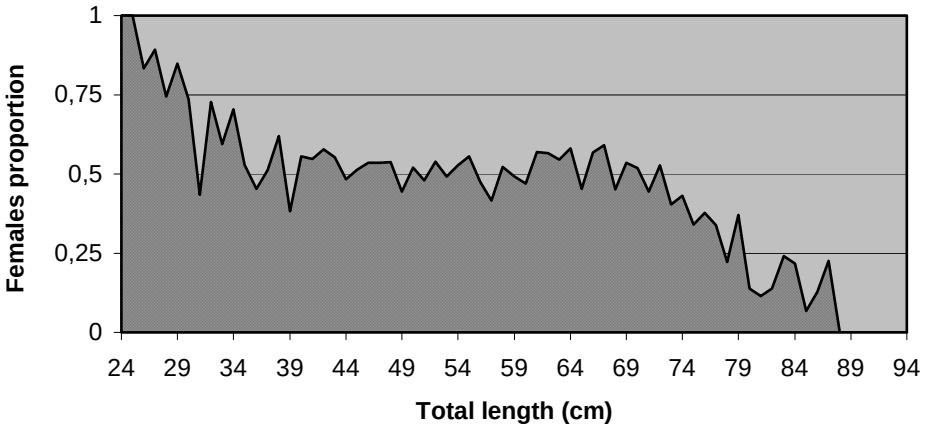



Fig. 5.- Female ratio by length in 1997 and 2000 (NAFO Div. 3N).

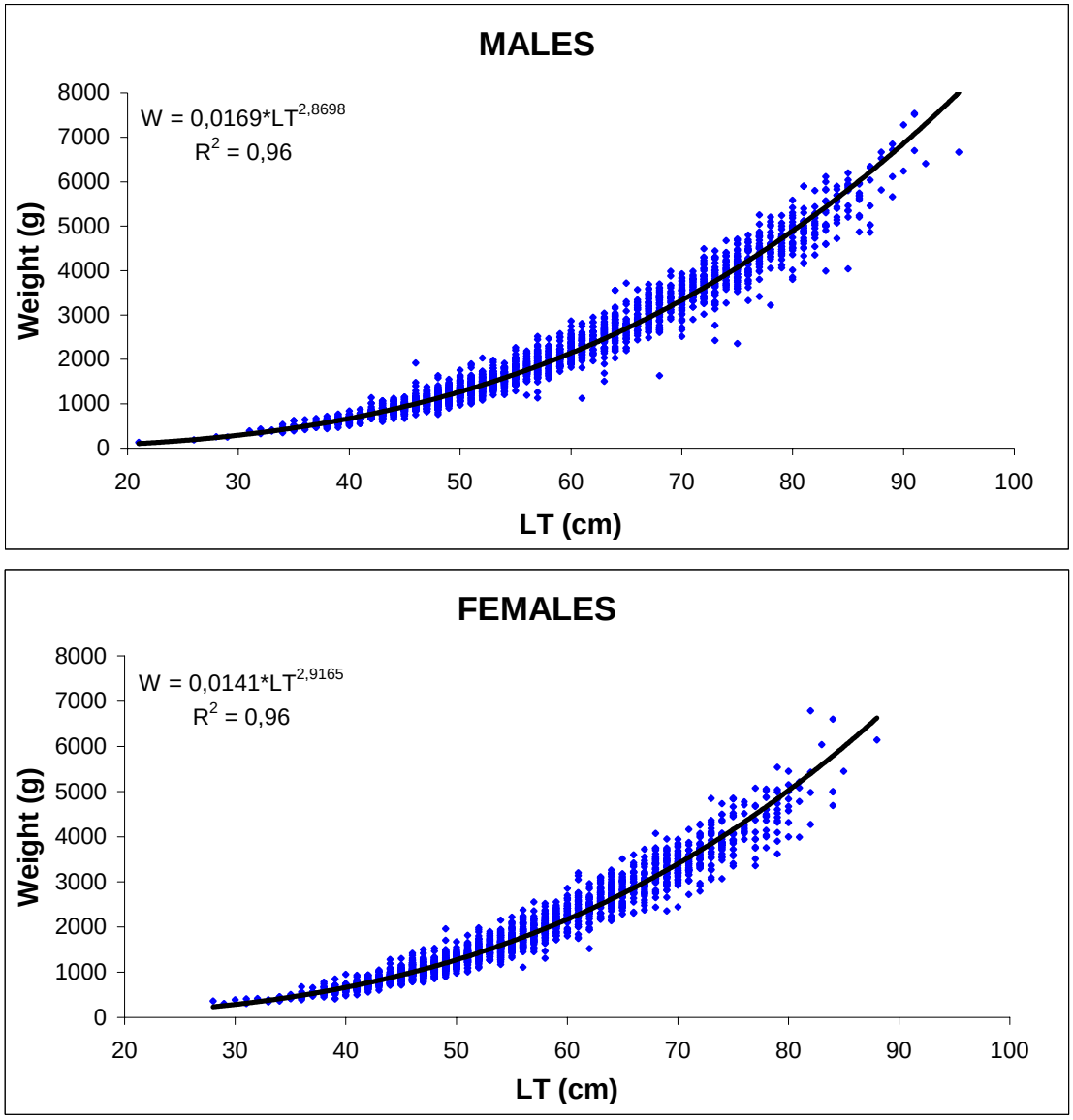



Fig. 6.- Thorny skate length-weight relationship in the Grand Bank by sex, 2000. Males: N=2630, $LT_{min}$=21, $LT_{max}$=95, $W_{min}$=130, $W_{max}$=7540. Females: N=2285, $LT_{min}$=28, $LT_{max}$=88, $W_{min}$=310, $W_{max}$=6790.