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Northwest Atlantic Fisheries Organization

Serial No. N3032

NAFO SCR Doc. 98/42

SCIENTIFIC COUNCIL MEETING - JUNE 1998

Feeding chronology of American plaice (*Hippoglossoides platessoides*) and yellowtail flounder (*Limanda ferruginea*) in the Grand Bank (NAFO Division 3N)

by

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ABSTRACT

A total of 970 individuals of American plaice and 1999 individuals of yellowtail flounder were sampled from six hauls carry out in a period of 24 hours for studying the feeding chronology. The main prey of yellowtail flounder were gammaridae (19,5%), *A. dubius* (10,1%) Annelidae (6,3%), Mysidacea (6%) and Antozoa (%,6%). The predominant preys in American plaice were *A. dubius* (72,3%) followed by Mysidacea (8,5%) and *E. Parma* (6,1%). Significant differences to the average values of Fulness Index between hauls were obtained for both species. But for the Mean Weight Fulness Index values only for yellowtail flounder significant differences were noted. During a composite 24-hour day peak stomach content weight occurred at nightfall (21 h) in yellowtail flounder. In the American plaice occurred at dawn. These two species present a lesser feed intensity during the night. This fee.ding behaviour may be related to the different catchability by day/night.

INTRODUCTION

Knowledge of feeding behaviour is important to understand the trophic relations in the marine ecosystem; this is useful for studying interactions between species and provides information for stock management.

Yellowtail flounder (*Limanda ferruginea*, Storer) and American plaice (*Hyppoglossoides platessoides*, Fabricius) occupy the same habitat, and are distributed both to the east and west of the North Atlantic, although American plaice extends to deeper (Iglesias et al., 1996). Both species comprise an important fish resource. The two species in the Grand Bank of Newfoundland (Div. 3LNO) have been regulated since 1973 and are currently in moratorium since the mid '90's (Walsh et al. 1997; Morgan et al. 1997). In recent years, abundance have declined and the stocks appear to remain at a low level although, for the Yellowtail flounder population, there may have been some slight improvement between 1966 and 1997 (Anon., 1997)

The different catchability of the demersal species during the day and night is a well known phenomenon (Sissenwine and Bowman, 1978). Some authors have reported that, in general, demersal species were significantly more vulnerable to trawl gear during the night than during the day. On the Grand Bank, Walsh (1989) had observed that catches of both American plaice and yellowtail flounder were significantly higher at night, confirming that both species exhibit strong diel behaviour. One of the factors related with the diel behaviour are the feeding habits. No clear diel feeding pattern has been documented for these species in the Area.

The theoretical and practical importance of knowledge about fish feeding chronology is already well documented in the literature (Jenkins & Green, 1977). The aim of our study is to contribute to knowledge on American plaice and yellowtail flounder over a 24 hour period. To do this, we apply inferential statistics to several indices, which makes it possible to reflect food intensity under different aspects. Their respective diets and variation throughout the day are described. The relationship of the diel feeding pattern with the night/day effect in catchability is also considered.

MATERIAL AND METHODS

In April and May of 1997, a bottom trawl survey was carried out on the Great Bank of Newfoundland on board the commercial fishing vessel *Playa de Menduíña* (Paz et al., 1997). Although the aim of this survey was to estimate the biomass of the most important species, a series of samples was also taken, over a 24 hour period, in order to study the daily feeding behaviour of American plaice (*Hippoglossoides platessoides*) and yellowtail flounder (*Limanda ferruginea*). With the information gathered in this survey, an area was chosen with a large abundance of both species with as wide a size range as possible.

From the 14 to the 15th of May, 1997, the same zone six hauls was carry out for a variable duration of between 1h. To 2 h. 15 min. As hour of fishing was considered the average between haul out and the haul in. The main characteristics of each haul are shown in Table 1.

A stratified sampling by length was designed to minimize the influence of length on the results. For the purposes of sampling, 4 size classes were made which were 10 cm in the case of American plaice (20-29, 30-39, 40-49 and (50 cm), and 5 cm. for yellowtail flounder, (25-29, 30-34, 35-39 y (40 cm). In each haul, the intention was to analyse 50 individuals randomly selected from each size class in both species. Size distribution of the individuals analysed is shown in Figure 1.

The following details were noted for each individual: total length to the nearest and lowest cm, sex and degree of stomach repletion. The stomach contents of all the individuals sampled in each range were extracted, removing the liquid with an absorbent surface, and when gathered. A total of 970 individuals of American plaice and 1999 individuals of Yellowtail flounder were sampled.

At the laboratory, the stomach contents of the whole stomach of each size range were defrozen and prey identified to the nearest possible taxonomic class. Each type of prey was weighed individually and the percentage of each was calculated in terms of the total weight of the stomach content (Table 2). When a variation between the fresh weight of the stomach contents obtained on board and those weighed in laboratory was noted after defreezing and having removed excess liquid, this relationship was studied using a Linear Regression Analysis, to which a Fisher-exact test was applied, obtaining a significant linear regression in yellowtail flounder ($N=24$; $R2=0,973$; $p<0,05$) and in American plaice (($N=24$; $R2=0,996$; $p<0,05$).

The weight of the individuals sampled was obtained from the parameter values of the size/weight relationship estimated in the same survey.

American plaice *males*: a=0,005015; b=3,132563; *females*: a=0,002723; b=3,327688.
Yellowtail flounder *males*: a=0,008350; b=3,021307; *females*: a=0,005625; b=3,149088.

In order to test the extent of homogeneity in the samples, we applied a χ^2 test for homogeneity in the different hauls.

Data processing. The problems and limitations of the uses of different indices in fish feeding have been studied by various authors (Hyslop, 1980; Sture Hansson, 1980; Amezaga, 1988).

In the description of diet, preys are expressed as a percentage of the total weight of the preys. The few individuals of over 50 cm. were only included in the description of the American plaice diet.

To analyse the food intensity several indices were used. These indices were calculated for each size range by haul were as follows:

- *Fullness Index (FI):* percentage of individuals with stomach content. This is a measurement of feeding intensity.

$FI = n/Nt * 100$

n = number of individuals with stomach content in period t.
Nt = total number of individuals in period t.

- *Mean Weight Fullness Index (MWFI):* weight percentage of stomach content weight in terms of predator weight. This index reduces the effect of predator size on stomach content weight.

$MWFI = Pc / Pt * 100$

Pc = stomach content weight in range 1 during period t.
Pt = live weight of all individuals in range 1 during period t.

Stomach content weight refers to the weights obtained on board.

- *Prey Weight Fullness Index (PWFI)*: weight percentage of a given prey in terms of predator weight. This index reduces the effect of predator size on stomach content.

PWFI= Pxi / Pt *100

Pxi = total weight of prey x in range 1 during period t.

Pt = live weight of all individuals in range 1 during period t.

According to Jenkis, it is more efficient to use inferential statistics to analyse the variations in food intensity over time than explaining these variations with descriptive variations. So we used several inferential tests to analyse this food intensity over a 24 hour period (Jenkis & Green, 1977).

In order to know if there were significant differences in the proportion of individuals with stomach content presence among the various hauls, we applied a χ^2 test to the values of the FI. Likewise, in order to see if there were significant differences between stomach contents in terms of time size, a Friedman test was applied. Friedman´s test is a non-parametric test for several related samples.

RESULTS

The characteristics of individuals of the American plaice and Yellowtail flounder sampled are shown in Tables 3 and 4. The larger sizes in both species are not sufficiently represented, particularly as regards American plaice (Fig. 1a).

whereas in American plaice they present certain variability (Fig.2b). Applying a homogeneity χ^2

between the samples taken of yellowtail flounder and in American plaice, excluding the size range 50 cm; nor were there significant differences between the distributions of the sampled sizes.

In the individuals analysed of yellowtail flounder a low proportion of individuals with an empty stomach was observed. In American plaice, however, the proportion of individuals with an empty stomach increases proportionally as size increases.

Food. The main prey of Yellowtail flounder obtained in the different hauls were: Gammaridae (19.5%), *A. dubius* (10.1%), Annelida (6.3%), Mysidacea (6%) and Antozoa (5,6%), although the important contribution of the unidentified group of prey must be taken into account (43,8%) (Table 2). The predominant prey in American plaice was *A. dubius* (72.3 %), followed by Mysidacea (8,5%) and *E. Parma* (6.1%) (Table 2). In the 20-29 cm. range, the main prey were Mysidacea, reducing in value as the size increases. (Table 5).

Feeding intensity. The FI values per haul for Yellowtail flounder show a slightly higher value at 16:20h, except for the 30-34 cm range, which presents the opposite tendency to the other size groups. The minimum value (84,0) appears at 6:30h (Fig. 3a).

In American plaice, lower FI values were obtained than for yellowtail flounder, giving their minimum value (62.7) at 2:30h, which was particularly pronounced in 40-49cm range (Fig. 3b). In this species, the MWFI values were higher and showed a higher variability throughout the day than those of Yellowtail flounder. The ranges with greater and smaller sizes present opposite maximum and minimum values (Fig.4b).

The Mean Weight Fullness Index (MWFI) in Yellowtail flounder presents a minimum value in all sizes at 6:30h, except for the 40 cm range, and a maximum value at 21:25h in almost all the ranges, which is particularly evident in the 25-29 cm group. The 25-29 cm. shows a greater variability in MWFI values throughout the 24 hour period (Fig.4a).

Calculation of the average MWFI values in each haul showed that the maximum value in Yellowtail flounder (0.55) appeared at 21:55h; and the minimum (0.25) at 06:30h (Fig. 6a). In the case of American plaice, the maximum MWFI value (0.85) appeared in the haul at 06:30h and the minimum value (0.60) occurred at 02:30h (Fig. 6b).

To determine if the daily variation of the average FI values has any repercussion on the daily PWFI variation of the main prey, we designed a graphic illustration combining both indices in terms of time. In Yellowtail flounder, only Annelida has a similar pattern to that of FI in terms of time, although most of these main species have their minimum PWFI value at daybreak, with the exception of Mysidacea, which coincides in time with the minimum FI value (Fig. 5a). In American plaice, the most striking case is that of that of Pisces which shows the highest PWFI values and, furthermore, their pattern is quite similar to that of FI (Fig. 5b).

In the case of Yellowtail flounder, the most abundant prey in all sizes was Amphipoda. The Pisces increase the percentage value when predator size increases (Table 5).

Daily feeding pattern. After applying a test χ^2t for homogeneity ($p<0,05$) to the average values of FI in the different haul over the 24 hour period, significant differences were obtained between the average values of the 6 hauls of Yellowtail flounder (2=18,98; df=5) and in American plaice there were also significant differences (2=14,44; df=5). Applying the Friedman non-parametric test to the MWFI values in Yellowtail flounder, significant differences were obtained (V= 11,62; df=5; $p<0,05$) between the stomach content weights over a 24 hour period. In American plaice, no significant differences were noted (V=2; df=5; $p<0,05$) in the weight variation of the stomach contents during the day.

DISCUSSION

Yellowtail flounder food in the zone is not as adequately studied as American plaice. Although there are few quantitative studies on its diet, they coincide in that the main prey are small crustacea (mainly amphipods) and polychaetae. For the south of New England and George Bank, Langton (1983) found that the polychaetae and amphipods accounted for 50-70% of the stomach contents. No size determining influence was observed in the diet composition, but however, the amphipods were more important in the small sizes, the polychaetae in the larger and the antozoos in the individuals of over 26 cm. Similar results were obtained by Pitt (1976) for the Grand Bank. In this study, the gammaridae were the most important prey (19.5%) in terms of the total stomach content weight. The presence of *A. Dubius* (10.1%) is also notable in the larger sizes.

There are several studies on the food of American plaice in Northwest Atlantic, and all coincide in the fact that it feeds off fish and benthonic invertebrates, fish species being more important in the diet of the larger sized individuals, and amphipods and equinoderms in the smaller sizes. Vázquez et al. (1989) found equinoderms and bivalves as the main prey in American off Flemish Cap. Rodríguez-Marín et al. (1994) also observed off Flemish Cap that ofiura and, to a lesser extent, hyperid, were the most important prey in the diet of American plaice using volumetric methods. Pitt (1976) found on the Grand Bank that the diet of American plaice comprises large prey, such as Echinodermata and especially Pisces, although in the small individuals (<29 cm.) Crustacea were the main prey. In his study Zamarro (1992) about the American plaice south of the Grand Bank of Newfoundland for individuals >40 cm., he observed that their main prey were *A. Dubius*, *M. villosus* and Ofiura.

In this study, the main prey of American plaice over 30 cm. was *A. dubius* (64% in individuals (50 cm, at 82,3% in sizes of 40-49 cm), whereas in sizes of <30 cm. it was Mysidacea (53,5%) (Table 5). Pitt (1976) comparing the diets of both species on the Grand Bank and using gravimetric and occurrence methods, found how the main common preys in the diets of both species are: crustaceans, fish, annelidae and equinoderm. Annelida and crustaceans occurred more frequently in yellowtail, but smaller American plaice (< 30 cm.) take proportionally larger quantities of crustaceans in relation to the total food than did yellowtail. Fish were selected more frequently by American plaice and, for those greater than 30 cm, comprised the largest proportion of total food weight.

In this study, the results were similar, but however differences were noted. In American plaice, the main component of the diet in weight was Pisces (76%), which, apart from having a certain importance in yellowtail flounder (11%), was greater than that obtained by Pitt (1976). Crustacea are an important prey of yellowtail flounder (30%) in all size ranges, and in American plaice their importance lessens as size increases, being the main prey in the smallest size range (54%) (Table 5). The annelidae are an important component of yellowtail flounder diet, although in American plaice it is minimal. In all cases, the presence of the different prey varies with the size of the predator.

According to Langton (1983), yellowtail flounder south of New England and George Bank preferably feeds during the day and presents its maximum MWFI value at nightfall. In our study, yellowtail flounder presents a lesser feed intensity at nightfall and during the day presents a similar feed intensity (Fig.3b). Stomach content weight shows its minimum value at daybreak and its maximum value at nighfall. (Fig.6a). This seems to indicate that in yellowtail flounder there is a daily feeding pattern with a greater feed intensity during the day with a flexible timetable depending on the type of prey and as the feed intensity is greater than the speed of digestion, a maximum accumulation of stomach content would occur at nightfall. At night, feed intensity reduces and, due to digestion, produces a reduction in stomach contents down to minimum levels.

Zamarro (1992), studying individuals measuring >40 cm. south of the Grand Bank, affirms that American plaice preferably feeds during the day and that its behaviour shows a flexible timetable to feed off its prey when they are more accessible. This author also states that the daily changes in feed intensity are particularly related to the preys Pisces. According to Pitt (1989), American plaice feeds during the day and shows a preference for large sized prey. In our study, we obtain significant differences with the average FI values over the 24 hour period, with a minimum value at (Fig. 3a). We did not, however, obtain significant differences using the average MWFI values obtained in the 6 hauls (Fig. 6b). This appears to indicate a greater feed intensity in American plaice during the day, but this is not reflected in the time variation of stomach contents. This may be related to the size range analysed, with very few individuals of over 50 cm., where the presence of the prey Pisces would make it possible to detect variations in stomach content better.

Walsh (1987) studying the daily variation in catchability of Yellowtail flounder in Division 3LNO of Grand Bank observes that more abundant catches are obtained at night rather than the day. In a further study (1989), Walsh obtains a greater catch and greater vulnerability of large sizes in nocturnal fishing both in yellowtail flounder and in American plaice, the average size of yellowtail flounder being greater by night than by day. In our study, we obtain that yellowtail flounder and American plaice present a lesser feed intensity during the night, and the smaller sizes present a more benthonic prey in the diet, this being particularly the case in American plaice. This feeding behaviour may be related to the different catchability by day/night.

It is not possible to conclude that a regularly recurrent feeding pattern exists by sampling only a few 24 hour periods. Only after long term experimental analysis can a cyclic nature in any behaviour be determined. This study is restricted by the short sampling period and by not taking into account the different degrees of digestibility and evacuation of the various types of prey. To confirm these results, further studies should be carried out at various times of the year, preferably during the period of maximum feeding activity, and to integrate the various evacuation rates of the main preys.

Acknowledgements. The authors are indebted to Enrique R-Marín for his comments on the manuscript. This research was supported by a Working Agreement between the Secretaría General de Pesca Marítima (SGPM) and the Instituto Español de Oceanografía (IEO).

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Haul	Reference time	Time set out (GMT)	Location set out	Time board the net (GMT)	Location board the net	Depth (m)
1	11:20 (Midday)	10:15	43° 31´79 N 50° 48´79 W	12:30	43° 38´20 N 50° 52´87 W	66
2	16:20 (Afternoon)	15:50	43° 39´06 N 50° 53´51 W	18:05	43° 32´67 N 50° 49´10 W	66
3	21:25 (Dusk)	20:10	43° 40´02 N 50°48´92 W	22:40	43° 32´05 N 50° 49´40 W	66
4	02:30 (Night)	00:55	43° 39´62 N 50° 48´90 W	03:10	43° 32´73 N 50° 49´42 W	66
5	06:30 (Dawn)	05:30	43° 39´49 N 50° 48´83 W	07:30	43° 32´97 N 50° 49´26 W	66
6	09:30 (Morning)	09:00	43° 33´15 N 50° 49´44 W	10:00	43° 36´16 N 50° 48´23 W	66

Table 1.-Characteristics of hauls sampled.

PREY TAXA	HAUL						WEIGHT (%)	
	1	2	3	4	5	6	A. plaice	Y. flounder
CNIDARIA								
Eschifozoa			●				0,23	
Antozoa	●+	●+	+	●+	●+	●+	0,09	5,62
ANNELIDA	●+	●+	●+	●+	●+	●+	0,10	6,30
CRUSTACEA								
Cumacea	+	+	+	+	+	+		1,99
Mysidacea	●+	●+	●+	●+	●+	●+	8,53	6,02
Isopoda	●+	●+	●+	●+	●+	●+	0,25	2,34
Amphipoda								
Gammaridae	●+	●+	+	●+	●+	●+	0,12	19,46
Caprellidae	●	●+	●	●+	+		0,02	0,08
Other Amphipoda	●+	+	●+	●+		+	0,09	0,58
Decapoda								
Brachyura								
Chinoecetes opilio		●					1,32	
Other Brachyura	+	+		●		●+	0,10	0,08
Natantia			+			●	0,06	0,76
Other Crustacea	+	●+	●+	●+	●+	●+	0,22	0,52
ECHINODERMATA								
Ophiuroidea								
Ophiura	●+	●	●	●	●		0,66	0,01
Echinoidea								
Echinorachinus parma	●+	●+	●+	●+	●+	●+	6,09	1,14
MOLLUSCA								
Gastropoda					●		0,03	
Bivalvia	●+	●+	●+	●+	+	●+	0,90	0,53
PISCES								
Ammodytes dubius	●+	●+	●+	●+	●+	●+	72,27	10,10
Mallotus villosus		●					1,33	
Cottidae	●	●			●	●	1,05	
Unidentified Pisces	+	●	+	●+			1,36	0,68
UNIDENTIFIED PREYS							5,17	43,80

Table 2.- Presence and total weight (%) of prey items found in American plaice (*Hippoglossoides platessoides*) (●) and Yellowtail flaunder (*Limanda ferruginea*) (+) stomachs sampled.

HAUL (GMT)	Size range (cm)	Nº Indiv. sampled	Mean length ± SD (cm)	F I	Wt. stom. cont. on board (g)	MWFI
11:20	20-29	50	27.2±2.4	90.0	53	0.66
	30-39	50	33.7±2.3	70.0	121	0.74
	40-49	50	42.3±1.9	72.0	395	1.12
	50	11	56.8±5.6	18.2	23	0.11
16:20	20-29	39	27.8±1.5	84.6	43	0.65
	30-39	50	35.4±2.9	74.0	159	0.83
	40-49	49	43.7±2.5	71.4	370	0.96
	50	23	55.5±5.4	43.5	140	0.34
21:25	20-29	50	26.4±2.5	94.0	60	0.82
	30-39	50	34.8±2.6	84.0	162	0.90
	40-49	50	43.6±2.3	52.0	324	0.83
	50	16	57.1±7.0	31.2	184	0.57
02:30	20-29	50	27.4±1.8	84.0	40	0.49
	30-39	50	35.4±2.2	72.0	154	0.81
	40-49	50	43.7±2.5	32.0	194	0.49
	50	10	56.5±5.7	30.0	27	0.14
06:30	20-29	49	27.8±1.4	81.6	44	0.53
	30-39	50	35.0±2.6	54.0	193	1.05
	40-49	50	43.3±2.5	64.0	371	0.98
	50	6	52.8±2.3	16.7	4	0.04
09:30	20-29	50	27.3±1.9	90.0	26	0.3
	30-39	50	33.8±2.6	74.0	92	0.56
	40-49	49	41.8±2.5	62.0	441	1.21
	50	18	55.4±5.0	44.4	92	0.29

Table 3.- Haul (mean hour GMT), Size range (cm), Number of individuals sampled, Mean length (cm)±S.D, Fullness Index, Weight of stomach contents on board (g), and the Mean Weigth Fullness Index of American plaice (*Hippoglossoides platessoides*).

HAUL (GMT)	Size range (cm)	Nº Indiv. sampled	Mean length ± SD (cm)	F I	Wt. stom. cont. on board (g)	MWFI
11:20	25-29	50	27.4±1.2	94.0	52	0.55
	30-34	50	32.5±1.2	96.0	50	0.31
	35-39	50	36.8±1.4	92.0	66	0.28
	40	50	42.4±2.1	92.0	179	0.49
16:20	25-29	50	27.5±1.2	100	50	0.52
	30-34	50	32.3±1.2	88.0	53.5	0.34
	35-39	50	36.7±1.6	96.0	119	0.51
	40	50	43.1±2.1	94.0	71	0.18
21:25	25-29	50	27.6±1.2	94.0	84	0.88
	30-34	50	32.5±1.2	90.0	72	0.45
	35-39	50	37.1±1.4	84.0	86	0.35
	40	50	42.9±2.1	88.0	196	0.50
02:30	25-29	50	27.4±1.3	88.0	52	0.55
	30-34	50	32.3±1.3	88.0	54	0.35
	35-39	49	37.1±1.4	83.7	96.8	0.40
	40	50	43.4±2.2	86.0	138	0.34
06:30	25-29	50	27.5±1.3	90.0	33	0.35
	30-34	50	32.2±1.2	88.0	22	0.15
	35-39	50	37.2±1.4	82.0	61	0.25
	40	50	42.7±2.3	76.0	93	0.24
09:30	25-29	50	28.0±1.1	96.0	59	0.58
	30-34	50	32.4±1.3	94.0	57	0.36
	35-39	50	37.0±1.4	88.0	78	0.33
	40	50	43.5±2.7	90.0	112	0.27

Table 4 .- Haul (mean hour GMT), Size range (cm), Number of individuals sampled, Mean length (cm) ± S. D, Fullness Index, Weight of stomach contents on board (g), and the Mean Weigth Fullness Index of Yellowtail flounder (*Limanda ferruginea*).

PREY TAXA	WEIGHT (%) by size group (cm)							
	American plaice				**Yellowtail flounder**			
	20-29	30-39	40-49	50	25-29	30-34	35-39	40
CNIDARIA								
Esciphozoa			+					
Antozoa	+	+	+	+	+	1.5	2.7	9.8
ANNELIDA	+	+	+	+	2.8	7.8	10.9	10.6
CRUSTACEA								
Cumacea					1.7	3.0	2.1	1.1
Mysidacea	53.5	15.0	1.5		14.9	7.2	2.9	1.2
Isopoda	+	0.5	+		3.1	4.1	2.7	2.8
Amphipoda								
Gammaridae	+	+	+		13.8	14.7	22.3	16.6
Caprellidae	+	+	+		+	+	+	+
Other Amphipoda	+	+	+		1.4	1.5	1.8	0.9
Decapoda								
Brachyura								
Chionoecetes opilio			2.4					
Other Brachyura		+	+	+		+	+	+
Natantia		+				1.7		+
Other Crustacea	0.7	+	+		1.1	0.9	0.8	0.6
ECHINODERMATA								
Ophiuroidea								
Ophiura		+	0.6	2.2				+
Echinoidea								
Echinorachinus parma	+	+	5.8	18.9	+	0.9	1.1	2.6
MOLLUSCA								
Gastropoda			+					
Bivalvia	+	+	+	4.4	0.5	0.7	0.7	1.2
PISCES								
Ammodytes dubius	11.3	73.8	82.3	64.0	5.7	1.3	13.8	30.2
Mallotus villosus				9.5				
Cottidae		0.7	1.7					
Unidentified Pisces			2.4	+		1.8	+	
UNIDENTIFIED PREYS	33.0	6.9	1.8	+	54.1	52.7	37.9	22.3
Number stomachs	288	300	298	84	300	300	299	300
Total Stomachs Weight	266	881	2095	470	330	308.5	506.8	789

Table 5 .- Prey items in stomachs of Yellowtail flounder (*Limanda ferruginea*) by 5 cm length classes, and of American plaice (*Hippoglossoides platessoides*) by 10 cm length classes. Data are expressed as a percentage of the total weight of stomach contents (+ indicates present<0.5%).

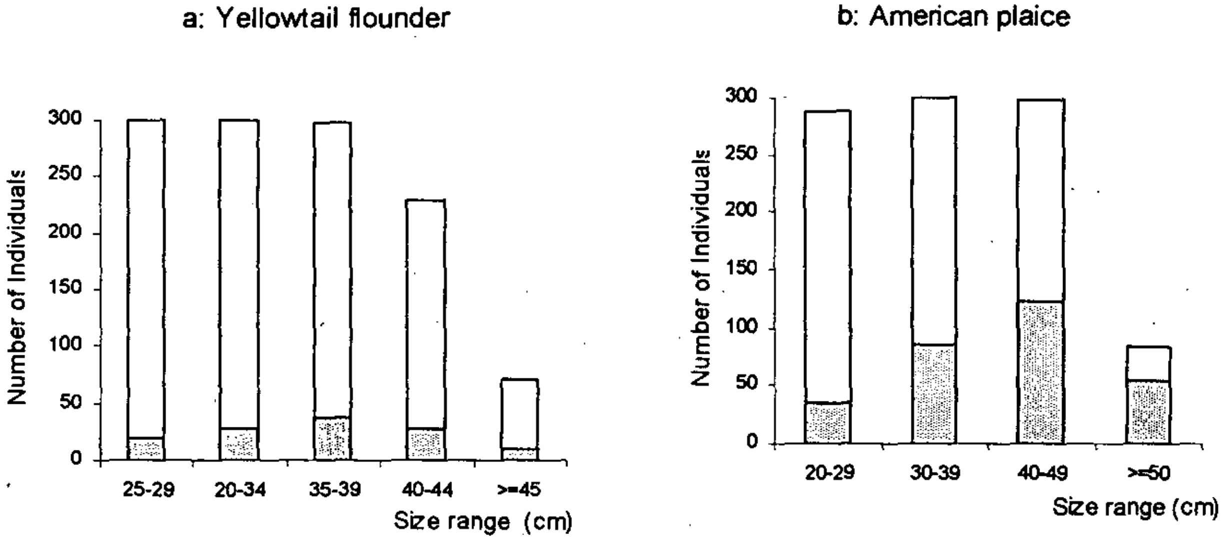


Figure 1.- Size range distribution in the American plaice and Yellowtail flounder samples. The portion blank represents the number of individuals with stomach contet.

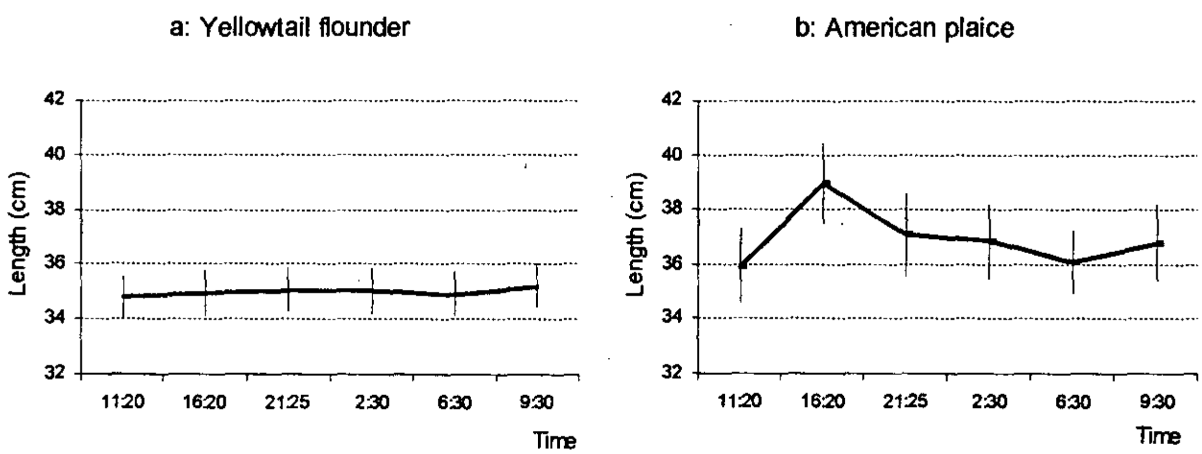
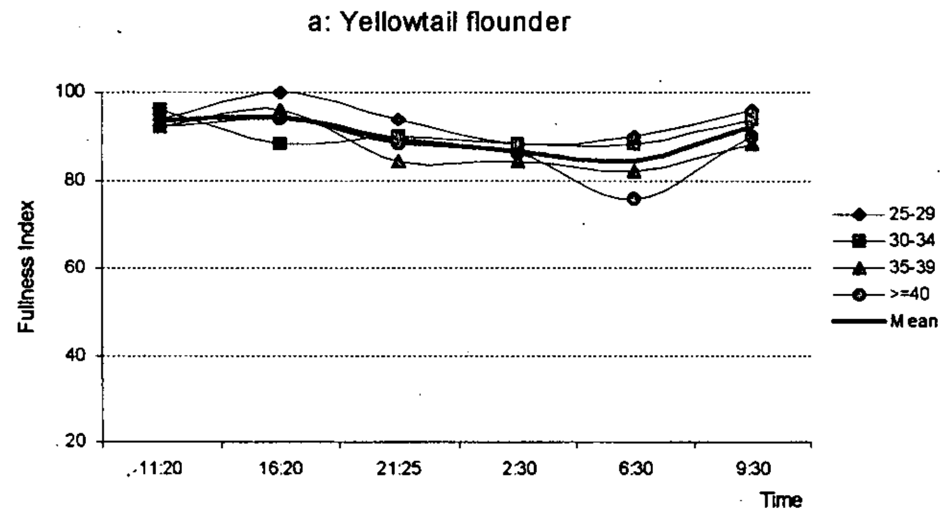


Figure 2.- Mean lengths at samples colected for each haul. a: American plaice and b: Yellowtail flounder. Vertical lines are 95% confidence limitis.



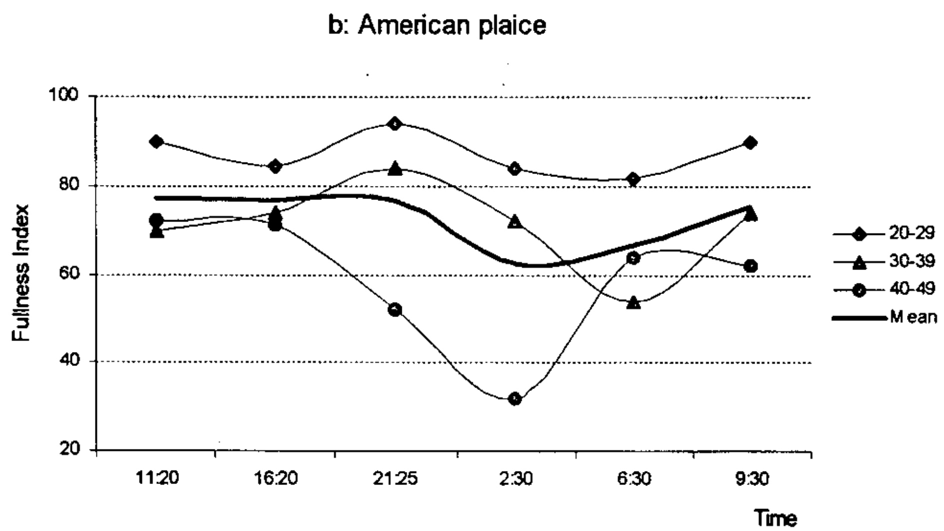
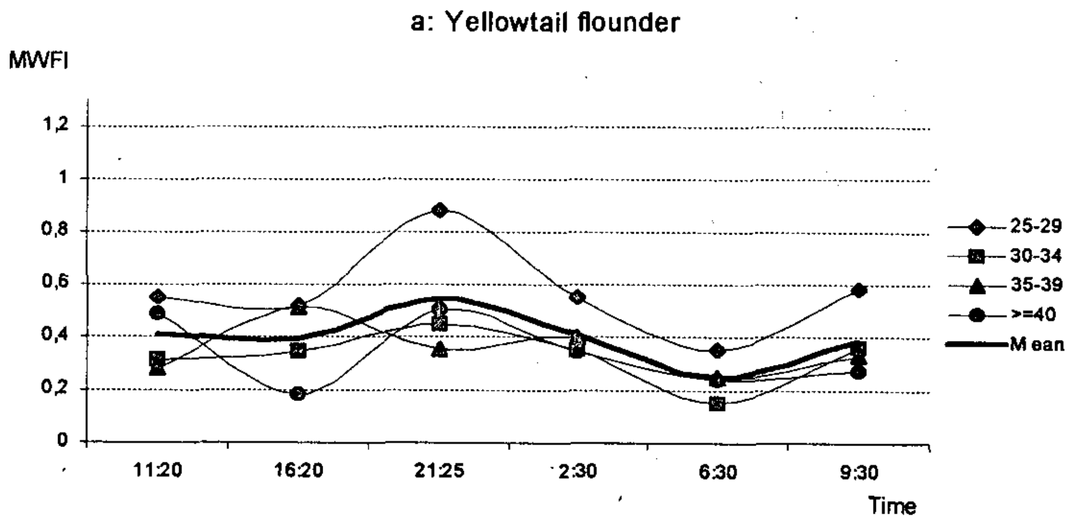


Figure 3.- Fullness Index by size range (cm) and time and mean Fullness Index for a: American plaice and b: Yelowtail flounder.



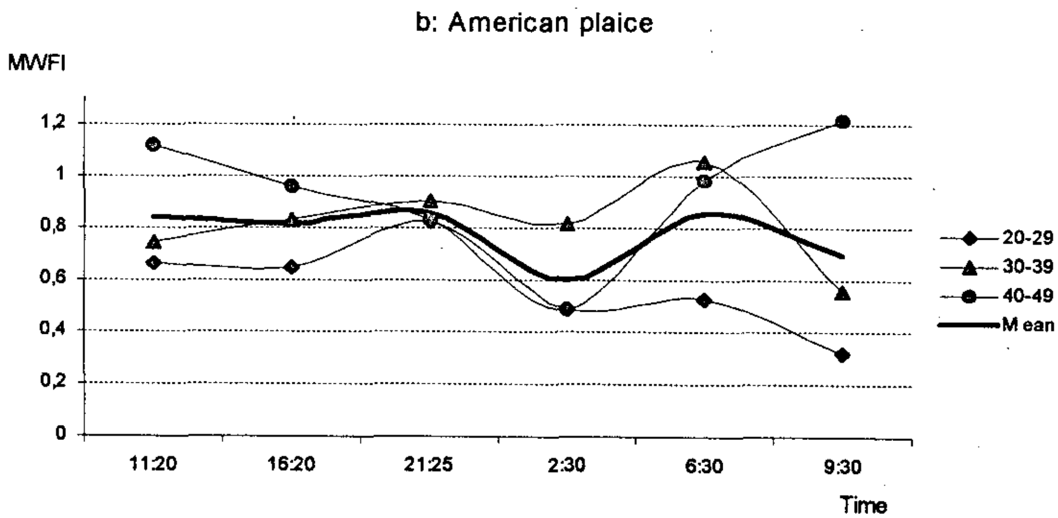
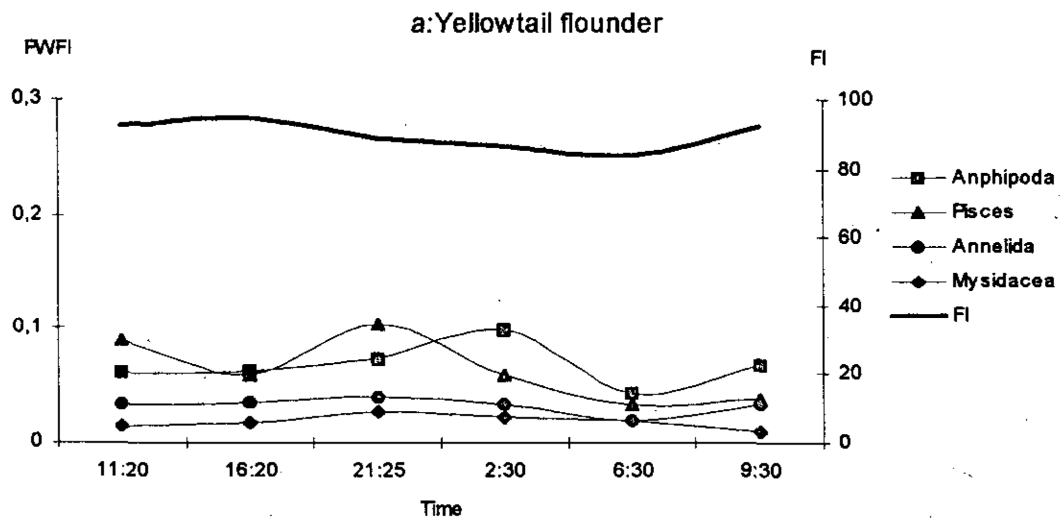


Figure 4.- Mean Weight Fullness Index by size range and time and total Mean Weight Fullness Index for a: American plaice and b: Yellowtail flounder



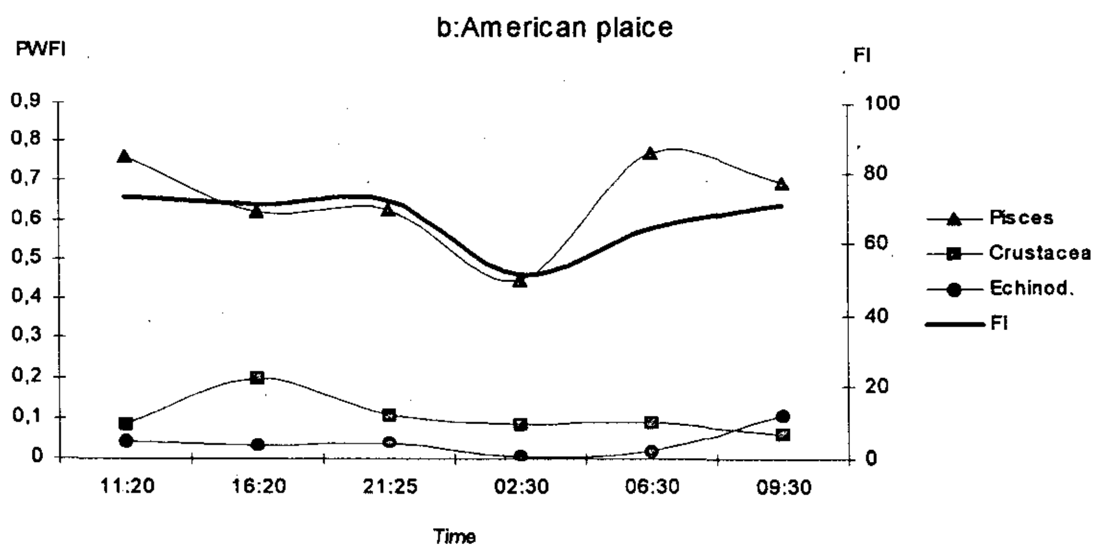
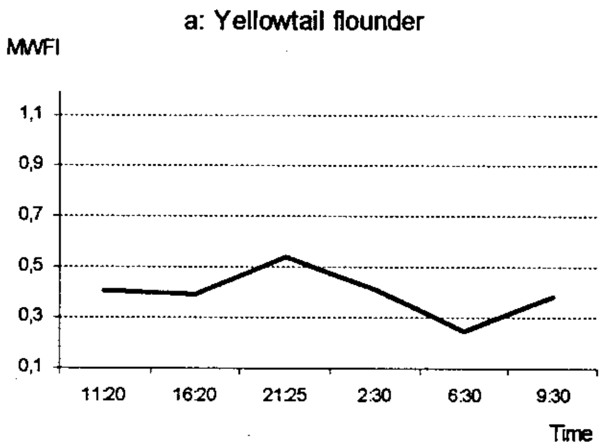


Figure 5.- Prey Weight Fullness Index main preys items and mean Fullness Index by time for a: American plaice and b: Yellowtail flounder.



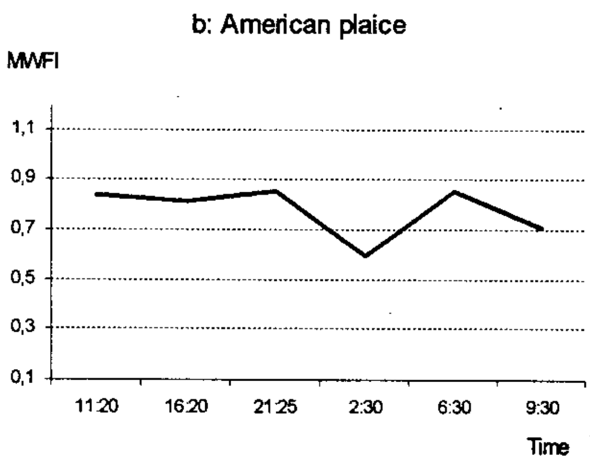


Figure 6.- Mean Weight Fullness Index by time for a: American plaice and b: Yellowtail flounder.