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Size-Age Composition of Witch Flounder (*Glyptocephalus cynoglossus*)
Catches in Divisions 3LMNO in 1980-1994

by

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Abstract

Data from trawl surveys conducted by PINRO research vessels in depth down to 850 m are given. Witch flounder occurred throughout all the depth studied as a bycatch in cod, redfish, American plaice, Greenland halibut and other fish catches.

Witch flounder 16-68 cm long at age 2-17 were found in catches. Among the fish of the same age, females were larger than males. The longest and oldest fish were caught in Div. 3L. In each Division size and age composition reduced with depth and from March to July. The mean length and age of witch flounder sharply decreased in the beginning of 1990s.

Introduction

Witch flounder is a bottom abundant boreal fish species. It is widely distributed over the both sides of the Atlantic Ocean. In the Northwest Atlantic witch flounder are distributed from the Cod Cape to the southern Labrador, on the Grand Bank of Newfoundland, in the Gulf of Maine and Gulf of St. Lawrence, as well as off southwestern Greenland. Northern boundary of witch flounder area is at the Canada coast, the Hamilton Bank. Witch flounder occur in catches at water temperature from -1° to 10° C but prefer temperature from 3.1° to 3.5° C.

Depth of dwelling is from 40 m to 1300 m, but there were reports about catches taken at 1569 m depth (Bowering, 1976). Witch flounder were fished mainly at 300 m depth.

Witch flounder are not a school fish and occurred scarcely, therefore, they are yielded in small amounts as a bycatch in cod, haddock, American plaice, redfish and Greenland halibut fishery. Only in March-May, they form spawning concentrations nearby the continental slope. Thus, in March 1965, BMRT "Neptun" when fishing by bottom trawl prespawning and spawning concentrations on the boundary between Div.2J and Div.3K at 500-700 m depth took catches more than 10 tons per 1 hour (Savvatimsky, 1969).

Maximum total catch of witch flounder in Divs. 2J3KL was taken in 1973 and amounted to nearly 24×10^3 tons. In the subsequent years catch sharply reduced (Bowering, 1978). In Divs. 3NO catch decreased from 15×10^3 tons in 1971 to 4.4×10^3 tons in 1994 (Bowering et al., 1994). Despite disperse distribution of witch flounder over the extensive area during the most part of the year and small catches, this species constitutes an important component of bottom fish resources in the Newfoundland area. Witch flounder biology is scantily known.

The purpose of this paper is to supplement information available in literature on dynamics of size-age composition of witch flounder catches with long-term data obtained during trawl surveys by Russian research vessels.

Materials and Methods

This paper uses data from catches taken by research bottom trawl 31.2/27.3 with a small-mesh insertion in the codend ($a=8-12$ mm) during trawl-acoustic surveys in 1980-1994 in Divs. 3M, 3L, 3N, 3O. All the data were matched to the catches per 1-hour tow. Surveys were conducted using stratified-random pattern (Doubleday, 1981). Survey methods were introduced earlier (Bulatova, Chumakov, 1986; Kuzmin, 1992; Mamylov, 1988). Among all number of catches, only those were chosen which contained witch flounder. In each survey not less than two tows were made in each stratum. Annually, the whole strata were covered by the survey except for coastal ones. Usually, tows were made down to 800-850 m depth. Witch flounder were selected from the catches, total length with 1 cm accuracy was measured and then ranked according to 2 cm age-classes. Size composition was converted to age using von Bertalanffy growth curve with appropriate coefficients given by W.R. Bowering (1976) by the formula:

$$T = T_0 - 1/k^{1/n}(1 - 1/L_0)$$

In Div. 3M witch flounder catches were not large, therefore, this paper give data summarized for all the study years.

When analysing different fish species ratio in catches all the data on depth were reduced to 3 ranges: 1-300 m, 301-600 m, 601-900 m because of small amount of catches containing witch flounder. Total amount of tows in each depth range was taken as 100% (Fig.1). Data on size composition of witch flounder catches were organized according to those depth range (Fig. 2-5).

Results

Attendant species in catches containing witch flounder were cod, redfish, American plaice, Greenland halibut and skates as well as grenadiers, capelin, yellowtail flounder and haddock referred by us to "others" category. In dependence on Divisions and depth range different fish species were predominant in catches containing witch flounder. Thus, in Div.3L at 1-300 m depth witch flounder most frequently were a bycatch to cod and American plaice but in 301-600 m and 601-900 m depth range they occurred as a bycatch to redfish (Fig.1).

In Div. 3M for 1-300 m depth range the main species in catches were cod and redfish while at 301-600 m depth they were redfish.

Divs. 3N and 3O had similar patterns of predominant species distribution. At 1-300 m depth witch flounder were a bycatch to American plaice more often than to redfish. At 303-600 m and 601-900 m depth range witch flounder more frequently accompanied redfish and Greenland halibut catches.

During trawl surveys witch flounder 16-68 cm long occurred in catches (Fig.2-5). Usually, females were larger than males. Judging by predominant length, the largest fish were observed in Div.3L: males 42-47 cm long (mean length 44.2 cm), females 46-53 cm long (mean length 47.7 cm). In the southern Grand bank of Newfoundland the fish were of smaller size. In Div.3N, preponderant length of males was within the range from 36 cm to 41 cm (mean length 39.8 cm) while that of females constituted 36-39 cm (mean length 41.5 cm). In Div.3N the fish were larger than in Div.3O and measured to be 38-43 cm (40.4 cm) and 42-49 cm (42.4 cm), respectively (Fig. 2-5, Tables 1-4).

Age composition of witch flounder catches in all the Divisions studied varied with depth. The largest individuals were caught at small depths (Fig. 2-5). This is the most pronounced when comparing the mean length of fish at different depth range (Tables 1-4).

Results from trawl surveys conducted mainly from March to July showed a downward trend in the mean length of fish from spring to summer in all the Divisions (Tables 1-4).

Analysis of year-to-year variations of the mean length of fish on the Grand Bank of Newfoundland proved clear distinctions in this parameter between males and females as well the fact that annually the largest fish are caught in Div. 3L (Fig.6) that may be an indirect evidence of the isolation of populations dwelling on the northern and southern Grand Bank of Newfoundland.

In all the Divisions a trend of smooth increase in the mean length of fish was observed from 1981-1982 to 1990-1991 following which that parameter drastically reduced (Fig. 6).

During study period witch flounder males aged 2-16 and females at age 3-17 occurred in catches. For the whole period of study in Div. 3L catches were dominated by witch flounder at age 7-9, except for 1994 when males at age 5-7 and females at age 6-8 were predominant. Unlike age composition of witch flounder in Div. 3L, catches in Divs. 3N and 3O consisted of younger fish among which males at age 4-6 and females at age 5-7 were preponderant (Fig. 7-9). Analysis of year-to-year variation of the mean fish age and its reduction in the beginning of 1990s (Fig. 10) proved the conclusions made before about the dynamics of year-to-year variations of witch flounder mean length. Decrease of older age groups portion in commercial catches by bottom trawl in Div. 3O in recent years have also been noted by Canadian researchers (Bowering et al., 1994).

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Table.1 Average length (cm) of Witch flounder
in Div. 3M by depth and months. 1980-1993

| DEPTH, m | MALES | | FEMALES | |
|----------|-------------|-----------|-------------|-----------|
| | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
| 101-200 | 44.1 | 74 | 47.0 | 42 |
| 201-300 | 40.2 | 89 | 42.9 | 155 |
| 301-400 | 41.6 | 153 | 42.6 | 120 |
| 401-500 | 30.8 | 13 | 32.9 | 25 |
| 501-600 | 42.9 | 5 | 41.0 | 4 |
| 601-700 | 33.3 | 5 | 30.5 | 1 |
| TOTAL | 41.3 | 339 | 42.5 | 347 |

| MONTH | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
|-------|-------------|-----------|-------------|-----------|
| MARCH | - | - | 46.5 | 1 |
| APRIL | 39.5 | 103 | 42.1 | 109 |
| MAY | 43.8 | 81 | 44.4 | 66 |
| JUNE | 40.4 | 75 | 39.8 | 85 |
| JULY | 41.3 | 68 | 43.1 | 68 |
| AUG. | 46.5 | 2 | - | - |
| DEC. | 43.1 | 10 | 48.9 | 18 |

Table.2 Average length (cm) of Witch flounder
in Div. 3L by depth and months. 1980-1994

| DEPTH, m | MALES | | FEMALES | |
|----------|-------------|-----------|-------------|-----------|
| | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
| 1-100 | 46.0 | 11 | 54.8 | 6 |
| 101-200 | 46.4 | 30 | 50.3 | 26 |
| 201-300 | 45.8 | 389 | 49.9 | 323 |
| 301-400 | 44.0 | 618 | 47.4 | 801 |
| 401-500 | 44.3 | 840 | 47.6 | 1303 |
| 501-600 | 43.7 | 528 | 47.5 | 670 |
| 601-700 | 43.2 | 457 | 47.2 | 791 |
| 701-800 | 41.4 | 22 | 45.9 | 64 |
| 801-900 | 46.5 | 1 | 48.3 | 10 |
| TOTAL | 44.2 | 2896 | 47.7 | 3994 |

| MONTH | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
|-------|-------------|-----------|-------------|-----------|
| FEBR. | 44.9 | 18 | 50.0 | 740 |
| APRIL | 46.4 | 241 | 48.2 | 509 |
| MAY | 44.7 | 1181 | 47.5 | 1207 |
| JUNE | 43.6 | 1292 | 46.7 | 1373 |
| JULY | 41.5 | 164 | 44.9 | 165 |

Table 3 Average length (cm) of Witch flounder in Div. 3N by depth and months, 1980-1993

| DEPTH. m | MALES | | FEMALES | |
|----------|-------------|-----------|-------------|-----------|
| | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
| 1-100 | 42.6 | 127 | 45.3 | 138 |
| 101-200 | 40.3 | 274 | 42.1 | 413 |
| 201-300 | 40.0 | 465 | 43.3 | 613 |
| 301-400 | 41.3 | 509 | 43.9 | 665 |
| 401-500 | 39.6 | 706 | 41.0 | 873 |
| 501-600 | 38.4 | 474 | 39.6 | 902 |
| 601-700 | 38.1 | 359 | 39.8 | 771 |
| 701-800 | 37.3 | 33 | 39.0 | 68 |
| TOTAL | 39.8 | 2947 | 41.5 | 4443 |

| MONTH | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
|-------|-------------|-----------|-------------|-----------|
| JAN. | 41.0 | 154 | 43.4 | 286 |
| MARCH | 39.6 | 955 | 41.1 | 1088 |
| APRIL | 39.7 | 605 | 41.8 | 849 |
| MAY | 40.3 | 1001 | 41.4 | 1955 |
| JUNE | 37.5 | 232 | 40.7 | 265 |

Table 4 Average length (cm) of Witch flounder in Div. 3"0" by depth and months, 1980-1993

| DEPTH. m | MALES | | FEMALES | |
|----------|-------------|-----------|-------------|-----------|
| | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
| 1-100 | 42.2 | 706 | 45.6 | 797 |
| 101-200 | 39.1 | 1209 | 41.1 | 1708 |
| 201-300 | 40.2 | 1058 | 42.3 | 1043 |
| 301-400 | 41.0 | 577 | 43.2 | 577 |
| 401-500 | 42.0 | 449 | 43.9 | 450 |
| 501-600 | 39.5 | 225 | 40.5 | 264 |
| 601-700 | 33.9 | 41 | 35.8 | 87 |
| 701-800 | 31.0 | 22 | 34.9 | 22 |
| TOTAL | 40.4 | 4287 | 42.4 | 4948 |

| MONTH | AVG. LENGTH | NO. SPEC. | AVG. LENGTH | NO. SPEC. |
|-------|-------------|-----------|-------------|-----------|
| JAN. | 42.9 | 494 | 45.3 | 601 |
| MARCH | 42.0 | 503 | 45.2 | 630 |
| APRIL | 40.7 | 2062 | 42.6 | 2041 |
| MAY | 38.3 | 965 | 40.3 | 1366 |
| JUNE | 37.7 | 263 | 39.2 | 310 |

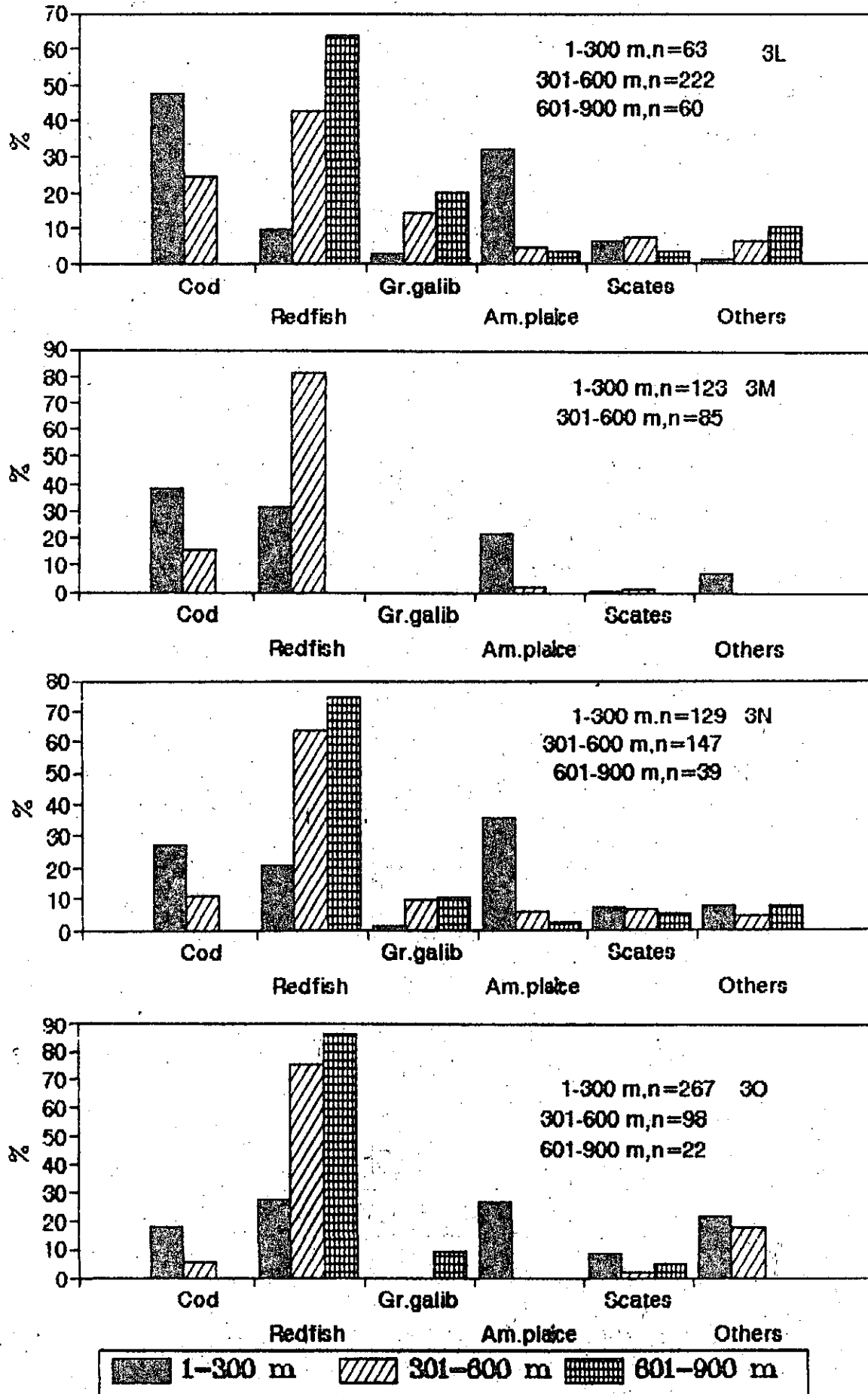


Fig.1 Catch distribution of predominant species on different depths, 1980-1993

(n - no. of tows)

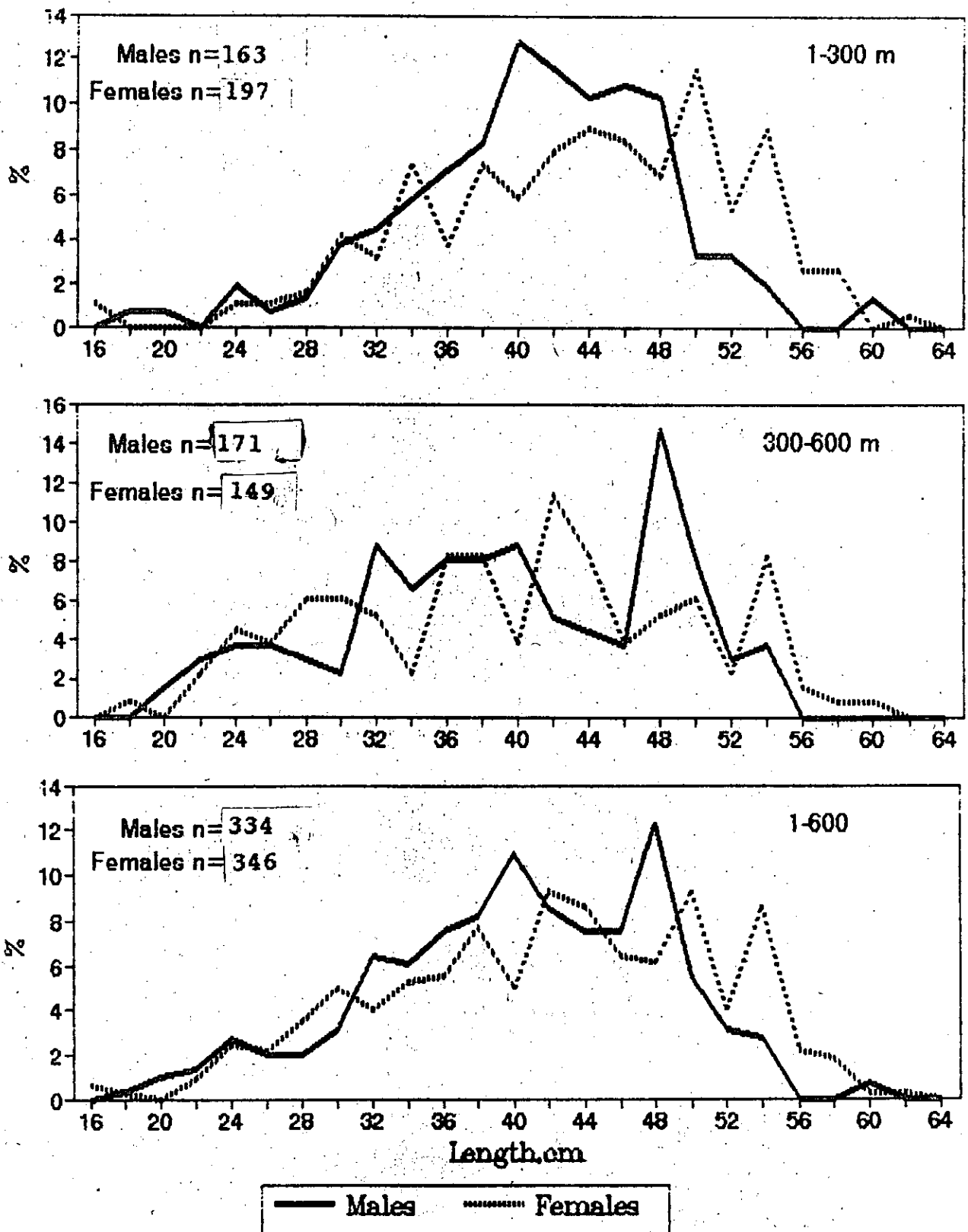


Fig. 2 Length composition of Witch on different depths Div.3M.1980-1993

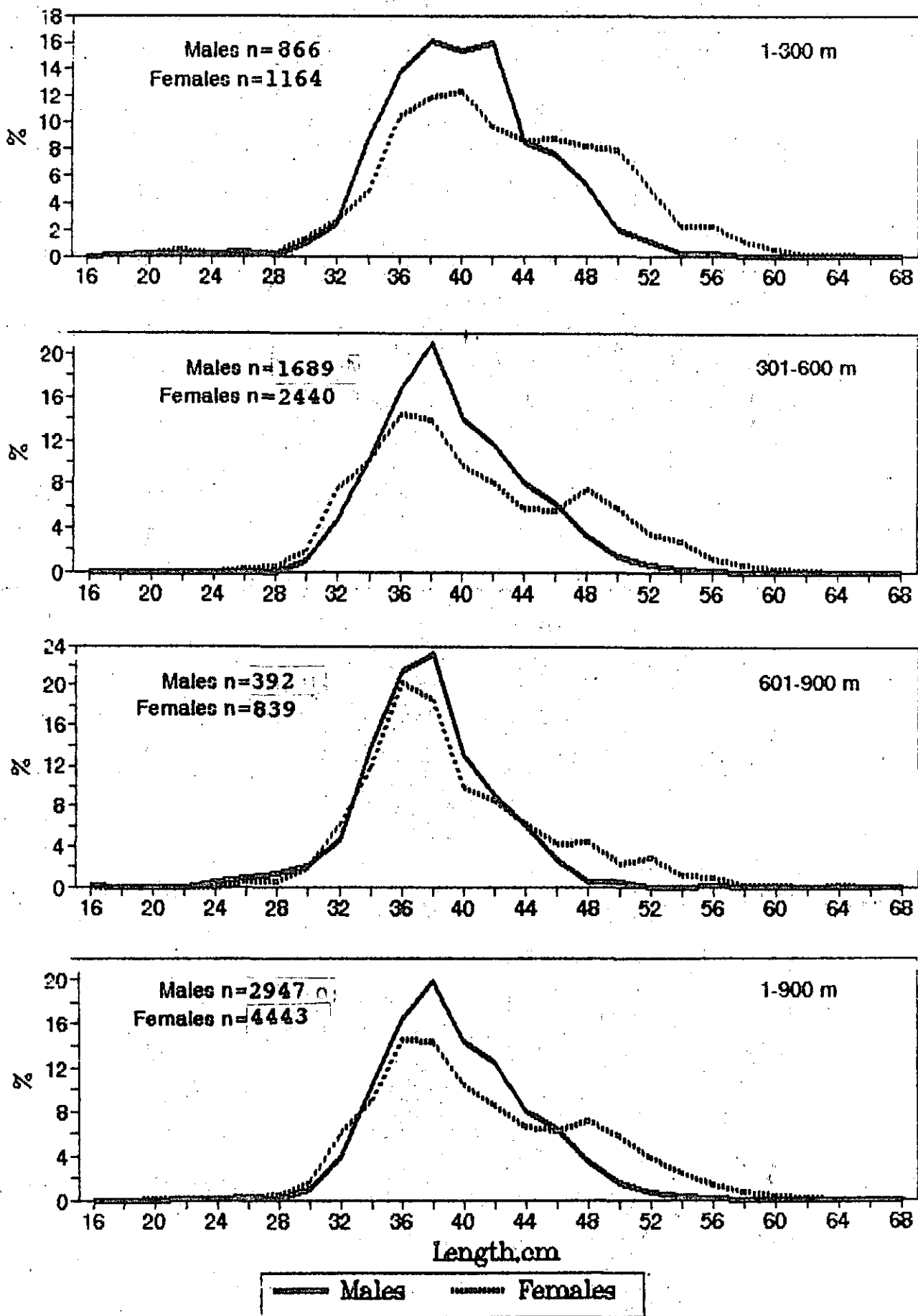


Fig. 3 Length composition of Witch on different depths, Div. 3N, 1980-1993

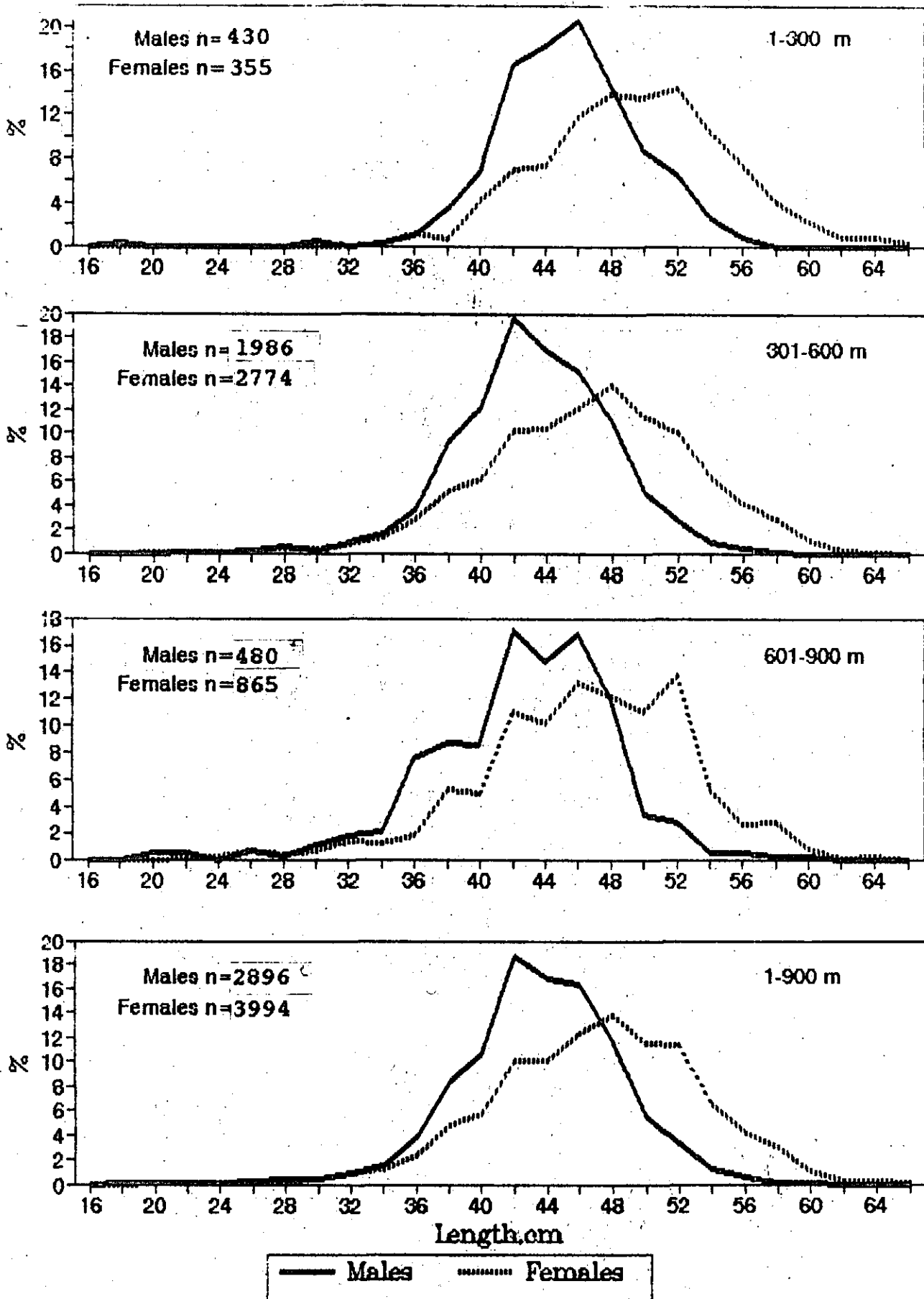


Fig. 4 Length composition of Witch on different depths, Div. 3L, 1980-1994

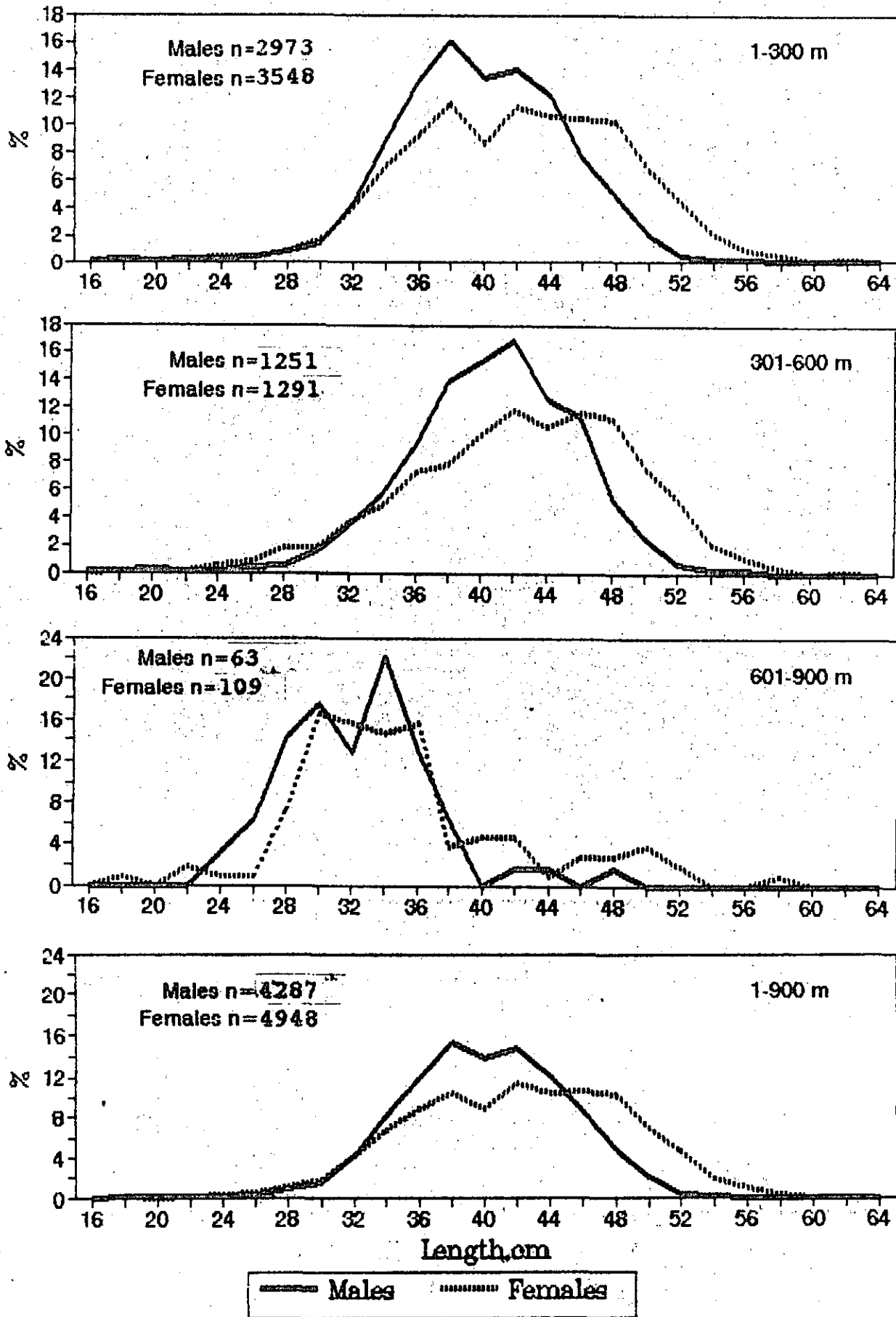


Fig.5 Length composition of Witch on different depths, Div.30, 1980-1993

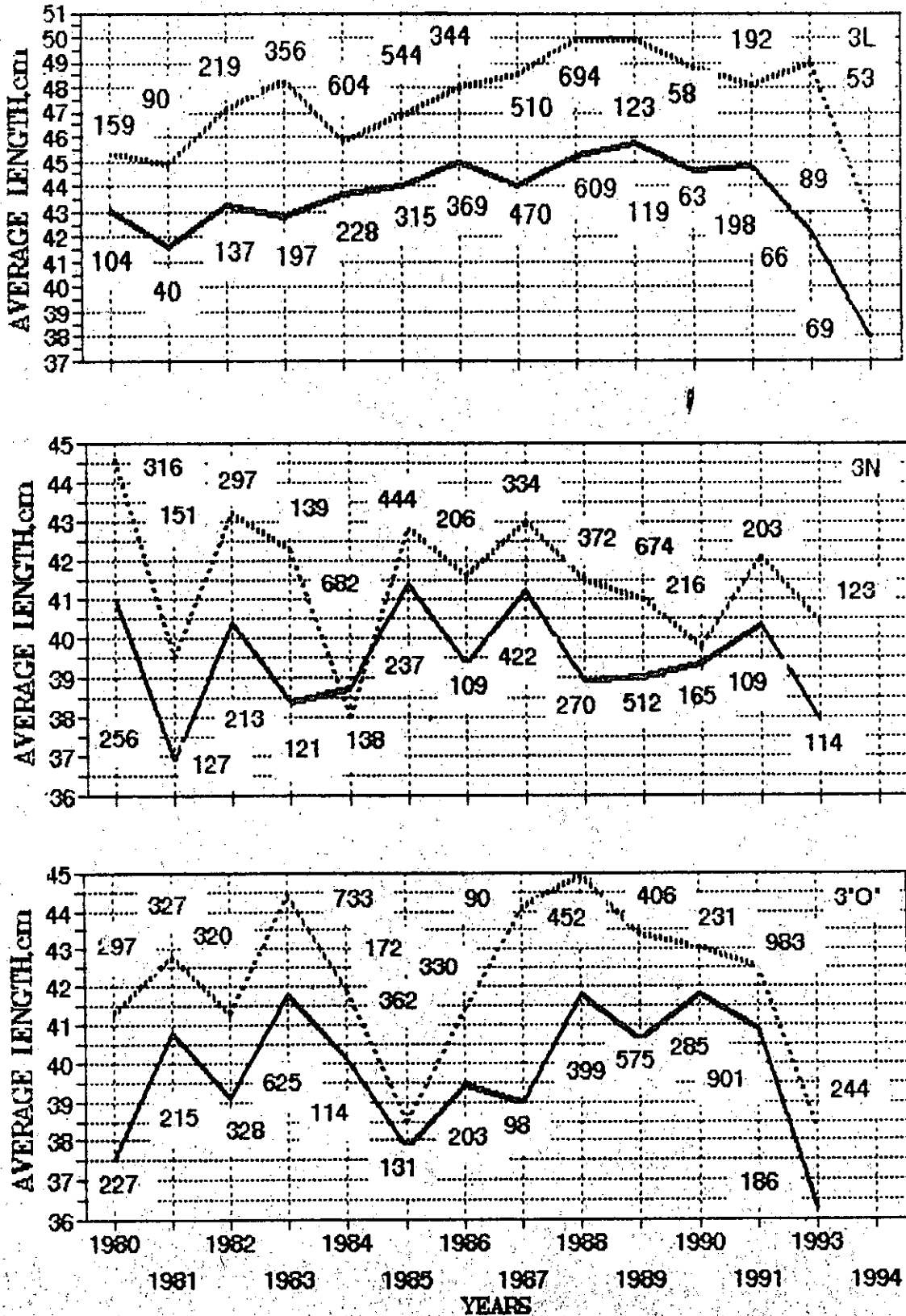


Fig. 6 Average length of Witch flounder in Divs. 3L, 3N, 3'O, 1980-1993 (figures inside-number of specimens)

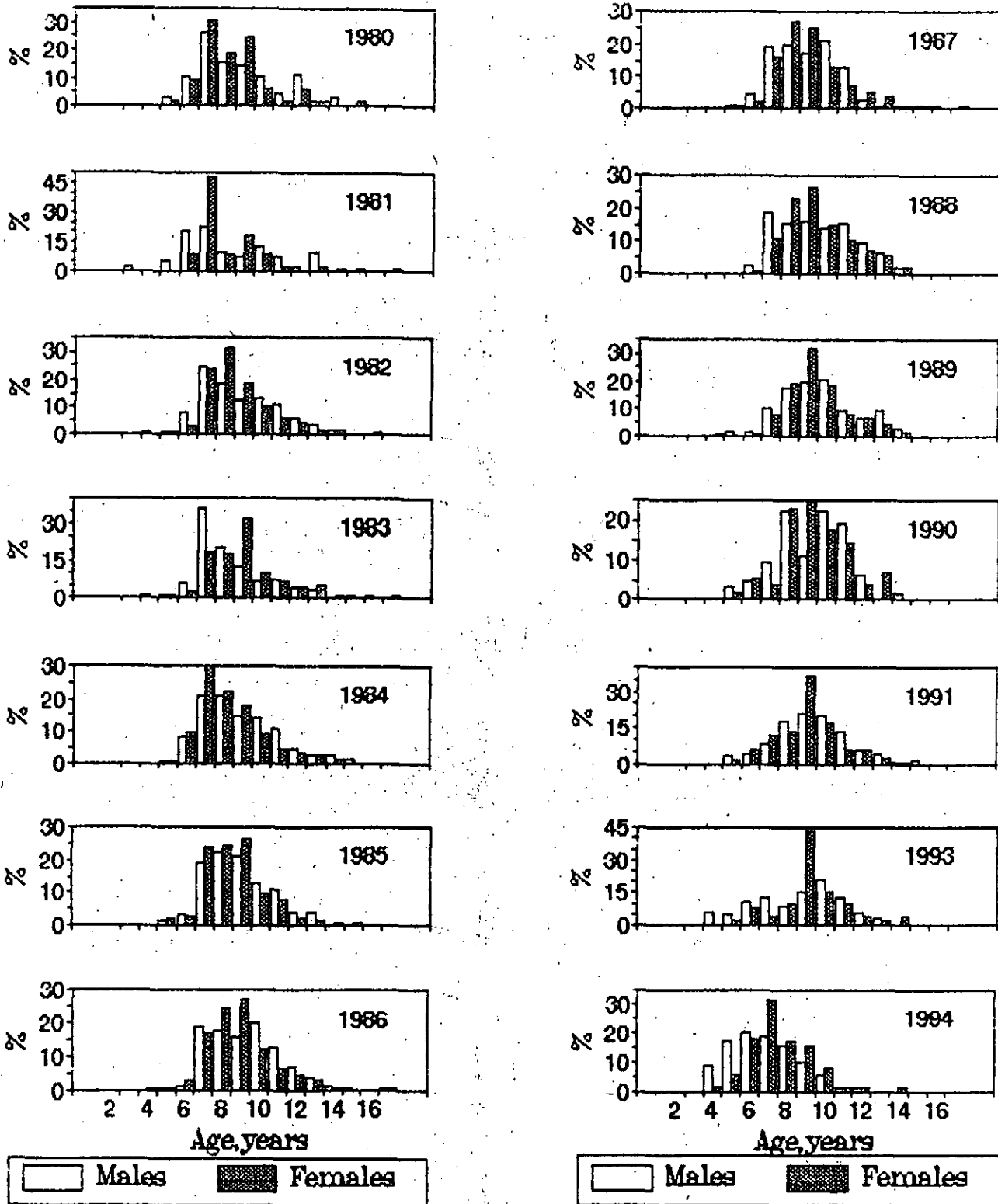


Fig.7 Age composition of Witch flounder in Div. 3L, 1980 - 1994

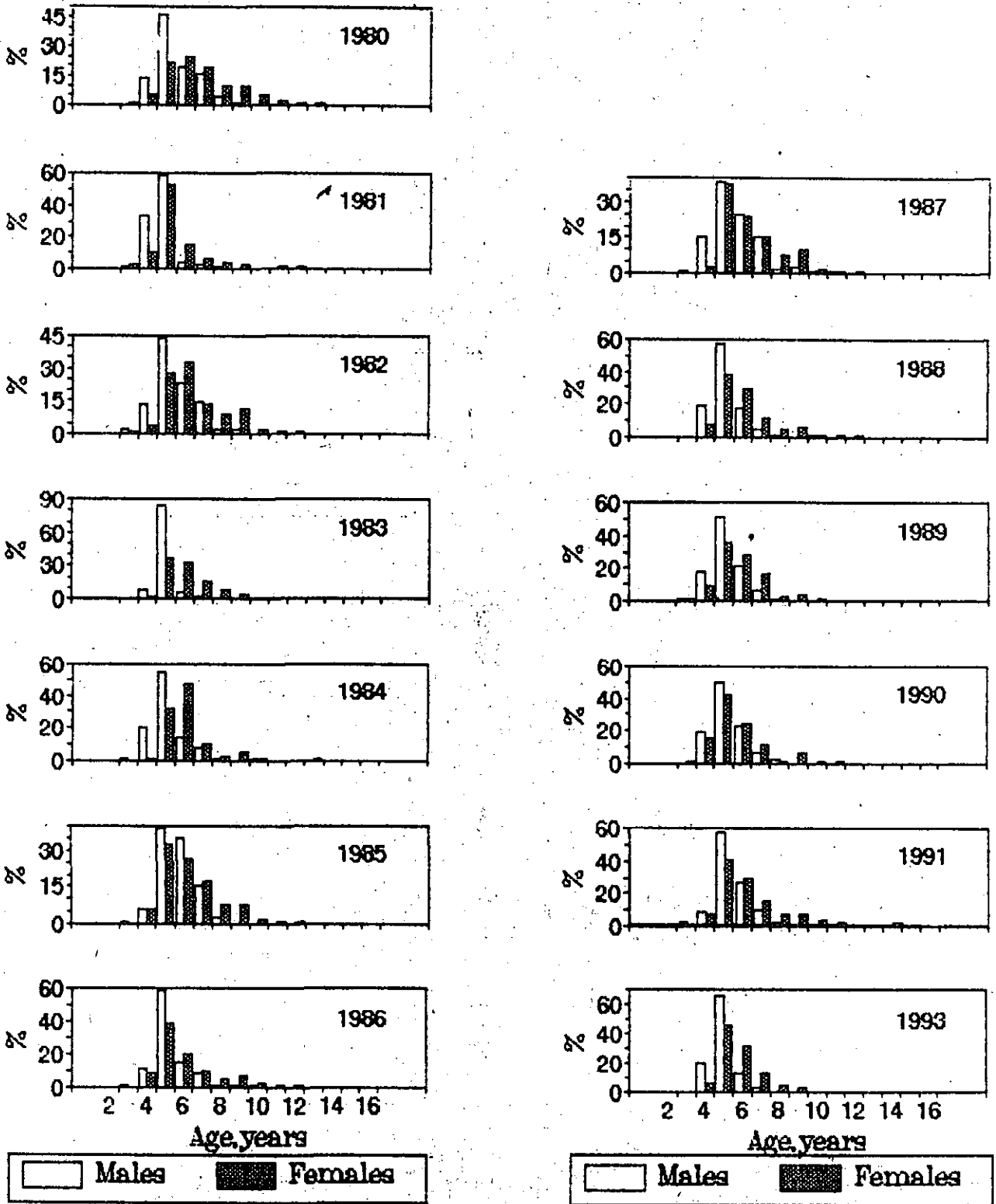


Fig. 8 Age composition of Witch Elounder in Div. 3N, 1980 - 1993

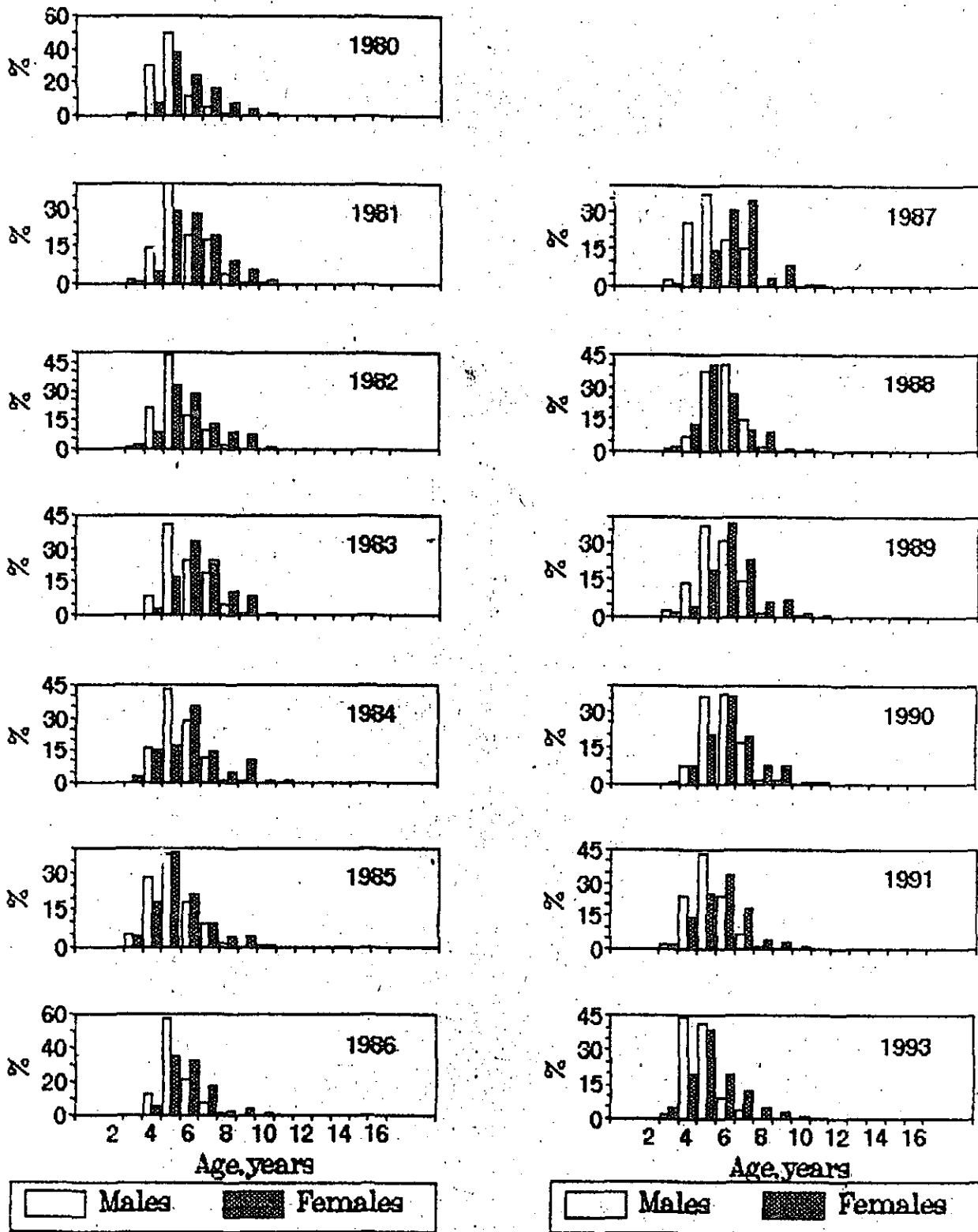
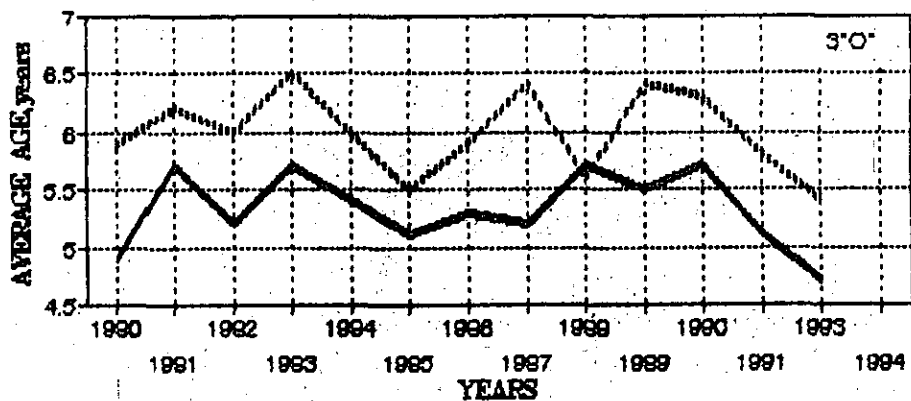
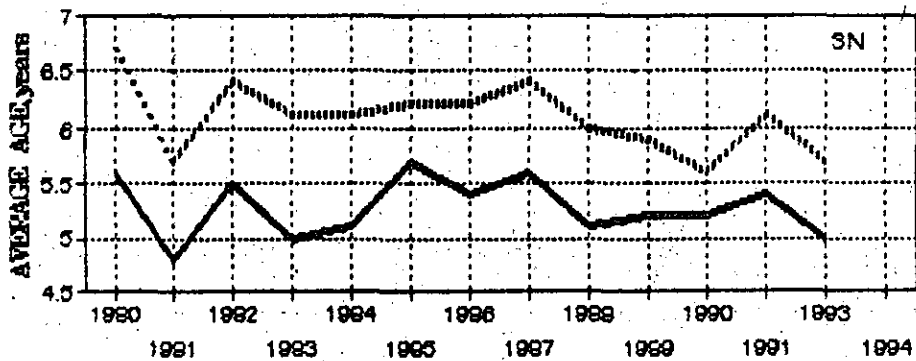
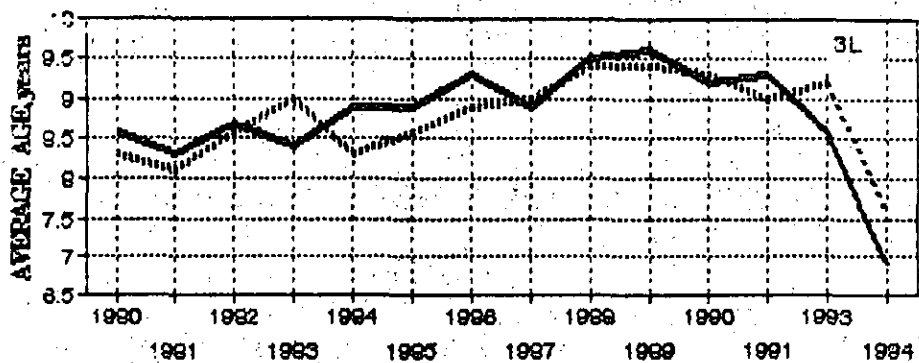


Fig. 9 Age composition of Witch flounder in Div. 30, 1980 - 1993



— Males Females

Fig. 10 Average age of Witch flounder in Divs. 3LNO, 1980-1994