

**SOME PRELIMINARY OBSERVATIONS ON THE BIOLOGICAL CHARACTERISTICS OF THE
CONCENTRATIONS OF BLUEFIN TUNA IN THE NORTHWESTERN AND CENTRAL
NORTH ATLANTIC OCEAN**

SCRS/1993/138

Col.Vol.Sci.Pap. ICCAT, 42 (1) : 267-270 (1994)

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Conspicuous catch concentrations of bluefin tuna are observed in the Northwestern and Central sections of North Atlantic Ocean north of 35N during autumn and early winter seasons (Fig.1).

Among these concentrations of fish, the one in the western part of the area had been utilized by some nations since years ago. Japanese longline fleet also has been operating on this concentration of fish for the last about twenty years.

On the other hand, exploitation of fish in the central part of the Ocean had occurred substantially later. In late 1970's and early 1980's, some Japanese pioneer longline boats tried to seek new ground of bluefin tuna in offshore area east of 50W mainly in the summer season. They could not go east beyond 47W because of the limit of capacity of boats at that time. As a result, the catch was not so prospective. Thereafter, fishing activities in this area had been rather sporadic. The first remarkable catch was made at 48N, 44W in November, 1989. And since 1990, fishing activities in the central section of North Atlantic Ocean expanded significantly.

The author likes to call the concentration in the northwestern part of the Ocean as Western concentration and that in the offshore area, the Central concentration. Also, for the convenience of observation, he likes to suppose the border line between the two concentrations at about 50W for the time being. Also, one fishing season is defined as a period from October of one year to May of next year.

Recently, some observations made by fishermen operating in the offshore area (Central concentration) have become available to us. Under this circumstances, the author tried to examine the biological characteristics of Central concentration of fish, with some considerations on the relations between the Central and Western concentrations, on the basis of catch statistics (compiled by National Research Institute of Far Seas Fisheries, Shimizu), information on distribution of surface water temperature by every 10 days (edited by Japan Fisheries Information Service Center, Tokyo) as well as observations by fishermen who experienced fishing in this ground.

Followings are the outcomes of the examination;

(1) There are some monthly changes in the pattern of distribution of longline fishing grounds under the examination, as are illustrated in Fig.1.

For the earliest part of fishing season from October to November, the Western and Central concentrations appear to be separated. The separation takes place in the area between 45W and 50W (Fig.1, A-1, B-1).

The two months from December to January are peak fishing period in the area north of 40N. During the peak fishing period, the Central and Western concentrations get close each other (1990-1991 fishing season) or linked together (1991-1992 fishing season) as are shown in Fig.1, A-1 and B-1. The linkage occurs through corridor between the southwestern section of Central concentration and the eastern edge of Western concentration. Japanese fishermen note that, even in this case, northern part of the western margin of Central concentration is still exposed to the area west of 45W, where fishing activity is very little.

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After February, as is shown in Fig.1, A-2 and B-2, the Western concentration in the area north of 40N disappears sooner or later. On the other hand, the Central concentration remains for about two more months at around 40N. At the same time, some southward movements of fish from the Central concentration are observed as will be mentioned below.

(2) The arrow-mark in Fig.2 represents the brief location of Labrador current. Here, Fig.2-a is for the last ten days of November 1991. Fig.2-b is for the first ten days of January 1992 and Fig.2-c is for the last ten days of the same month. The location of Labrador current is transcribed from Fig.2 to Fig.1 as a chain of small arrows. In Fig.1, A-1 and B-1, it can be seen that Labrador current comes along the western margin of the Central concentration. The western margin of this concentration appears to be cut off linearly in north-south direction by the strong current. As observed here, the influence of the Labrador current is particularly evident on the northern part of the concentration even when linkage with Western concentration occurs.

The Labrador current becomes indistinct south of 45N as one can guess with distribution of isotherm in Fig.2. Nevertheless, even on the southern side of 45N, Central concentration is still cut off its western margin and separated from Western concentration except the case of peak fishing months of 1990-1991 fishing season. It appears that such effect comes from supposed southward sub-surface extension of the Labrador current.

In Fig.3, are shown examples of the vertical change in temperature derived from the oceanographical survey done by one of the commercial longline boat in July, 1979, at about 40-41N, 50W. The occurrence of very cold water less than 3°C at depths from 10m to 50m suggests the existence of sub-surface stream that originates in Labrador current. Actually, they tried fishing but couldn't get good catch around this area. It is probable that poor catch by fishing south of 45N in the intermediate zone between the two concentrations is concerned with the southward sub-surface expansion of Labrador current.

Thus, it is presumed that Labrador current and its southward extension behaves itself like a discontinuity of Western and Central Concentrations of bluefin tuna.

(3) Experience of longline fishermen reveals that quality of fish in the Western Concentration are better than that in the Central. As a result, prices of fish from Central Concentration run lower.

It is some fishermen's opinion that fish in the Western concentration are more fattier. But it was not confirmed by data at this time.

The author presumes there might be some differences in the feeding circumstances in the two concentrations, at least, on the short time basis.

(4) Starting in February, there appears to be a gradual departure of fish in the Central Concentrations. It is the author's guess that aged fish leave the North Atlantic area in early spring to move southward toward spawning area. The primary movement from the Central Concentration is to the east southeast (ESE), appearing to reach Azores waters in March and the mouth of the Mediterranean in April. At the same time, another portion of the Central Concentration seems to shift southwest (SW).

(5) The author likes to summarize the observations mentioned above as follows:

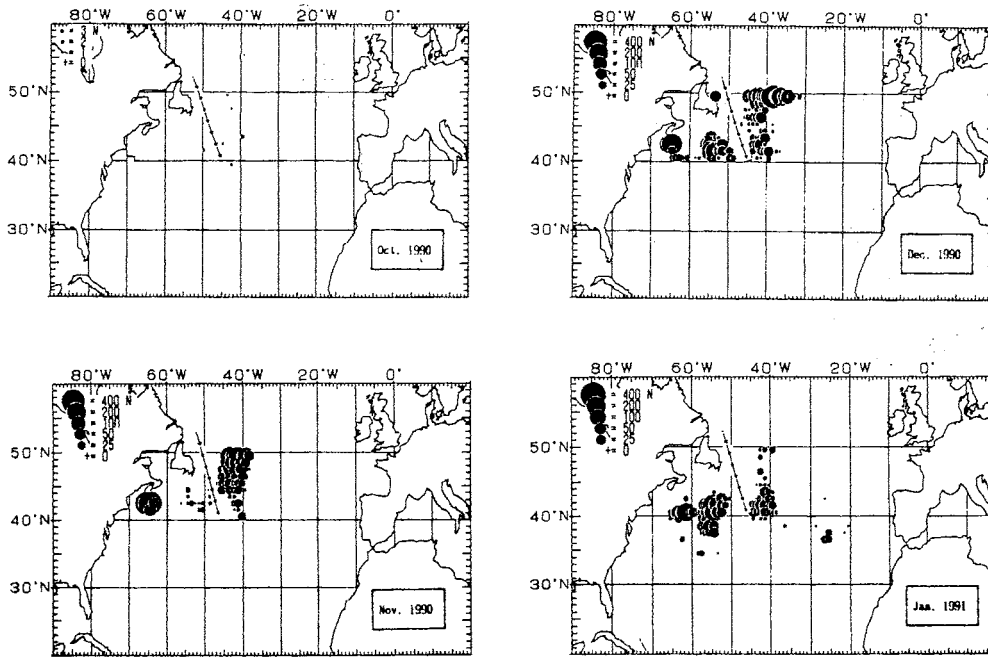
- a. On the basis of monthly change in the distribution of long line catch except peak fishing months of 1991-1992 fishing season, the Central and Western concentrations appear to be isolated. Fishermen's experiences reveal the difference in quality of fish meat and price at market between the two concentrations.

Thus, some disturbance is suggested on the intermingling of fish between the two concentrations, at least, on the short time basis.

- b. In the early spring, fish in the Central concentration move to south-east as well as south-west. Especially, south-east movement appears to reach to Mediterranean, which is spawning ground of eastern stock. So, the Central concentration seems to evidence a relationship between stocks on both the eastern and western sides.
- c. Accordingly, the Central concentration should be considered not as simply a continuation of the Western concentration but the mixture of both the eastern and western stocks.
- d. The Labrador Current, the most remarkable cold current throughout the North Atlantic ocean, is believed to act, with seasonal change in the extent of effect, as a barrier to the intermingling of fish between the Central and Western concentrations.

At the beginning of the present paper, the author set up a hypothetical border line of the two concentrations at about 50W. This hypothetical border should be replaced by Labrador current.

A-1: 1990-1991 fishing season



A-2: 1990-1991 fishing season (Continued)

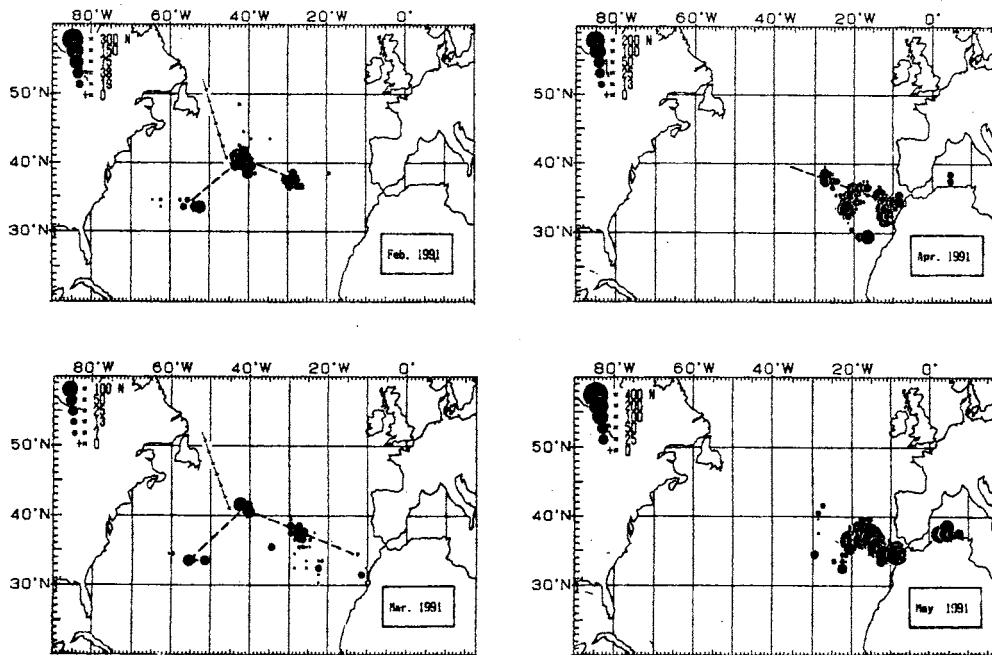


Fig. 1 Distribution of monthly catch in number of fish by 1 degree square (Prepared by Mr. H. Miyabe, National Research Institute of Far Seas Fisheries, Shimizu) with supposed movement of fish school
Here, A-1 and -2 are for 1990-1991 fishing season and B-1 and -2 are for 1991-1992 fishing season respectively.
Arrow line represents the brief location of Labrador Current and its supposed southward subsurface extension.
Broken line suggests southward movements of fish.

H. 1: 1991-1992 fishing season

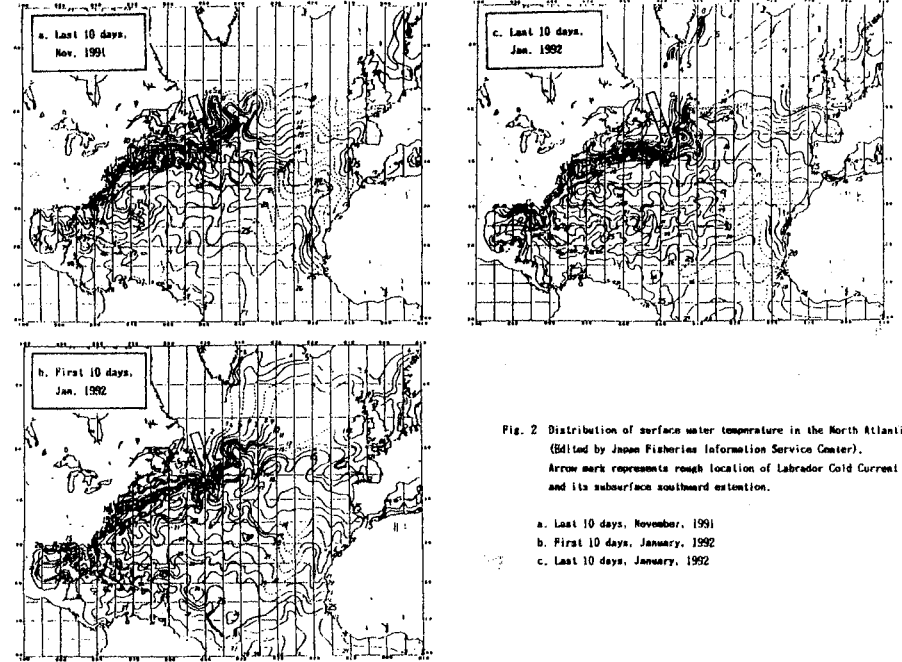
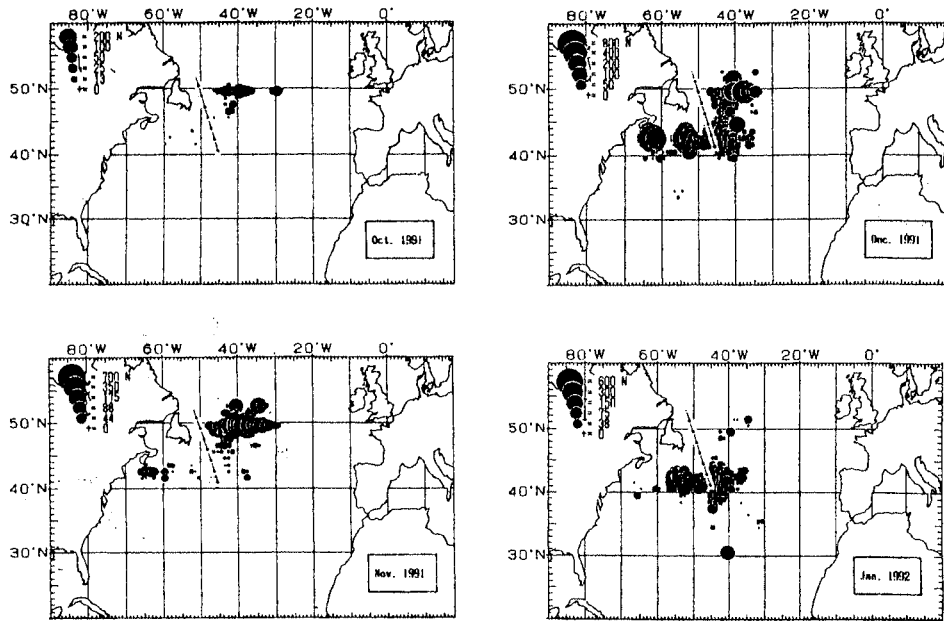


Fig. 2 Distribution of surface water temperature in the North Atlantic Ocean (Edited by Japan Fisheries Information Service Center).
Arrow mark represents rough location of Labrador Gold Current and its subsurface southward extension.

- a. Last 10 days, November, 1991
- b. First 10 days, January, 1992
- c. Last 10 days, January, 1992

H. 2: 1991-1992 fishing season (Continued)

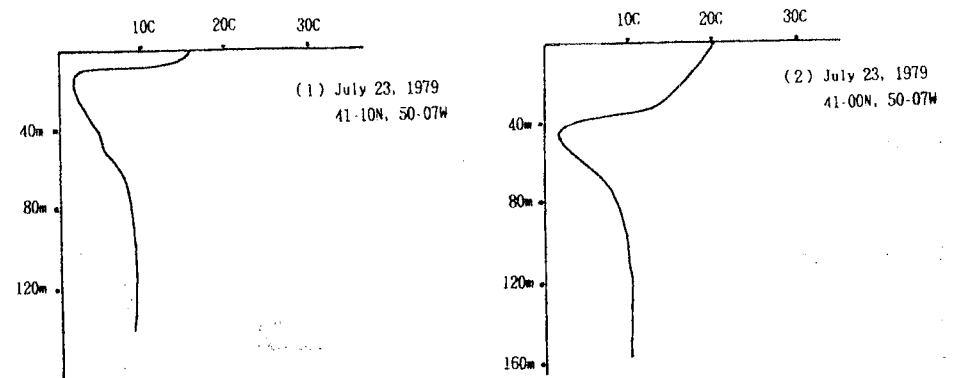
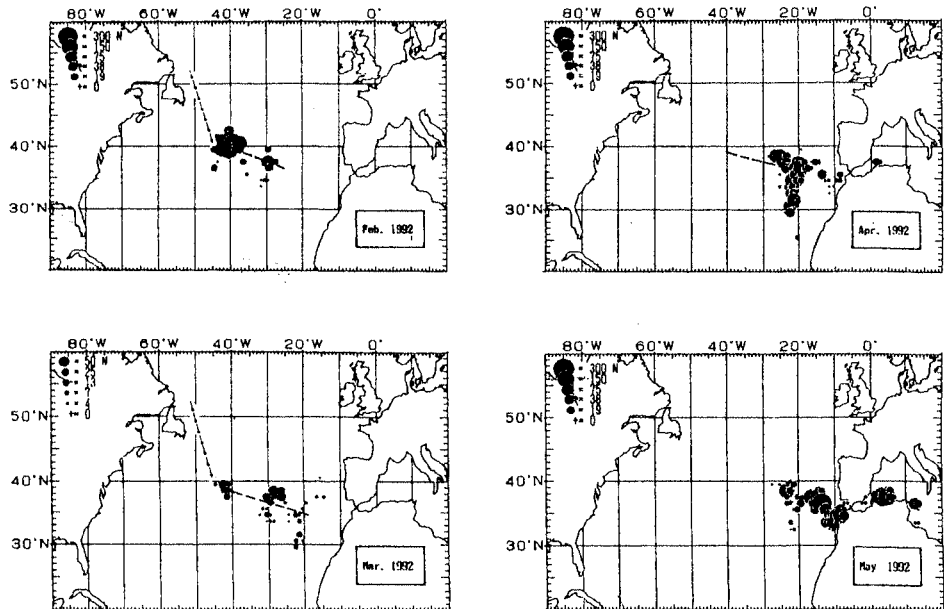


Fig. 3 Vertical change in the water temperature at about 40N in the intermediate area between Western and Central Concentrations of bluefin tuna in the North Atlantic Ocean (Submitted by Mr.Y. Ohyabu, Daito-Enyo Fishing Co., Tokyo)