

ATLANTIC BLUEFIN TUNA LARVAL SURVEY BY THE R/V SHOYO-MARU IN 1994

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The R/V Shoyo-maru, the research vessel of Japanese Fisheries Agency, conducted the survey to address to the validity of two-stock hypothesis for Atlantic bluefin tuna by comparing characteristics of larvae produced in two spawning grounds. The main objectives of cruise were set as 1) to collect bluefin tuna larvae to examine genetic differences between two spawning grounds, 2) to calibrate and standardize sampling efficiencies on tuna larvae among vessels from the United States, European Community, and Japan, and 3) to examine a distribution of tuna larvae especially in the Mediterranean. The whole activities were conducted in a cooperation with concerned nations under the Bluefin Year Program (BYP) of the ICCAT.

The cruise took about six months starting on March 17, 1994 until September 16, 1994. Most of analysis have just started and requires much more time and effort to complete, even preliminarily. Therefore, this report only provides a brief description of cruise activities by the Shoyo-maru in the Gulf of Mexico and Mediterranean.

1. General observation:

The BONGO net with 70cm diameter and 0.5 mm mesh size was generally used to collect tuna larvae. The net was deployed from the stern to the set depth and retrieved obliquely. The towing depth was determined to cover the upper mixing layer based on CTD observations, which was fixed to 100 m in the Gulf of Mexico and 75 m in the Mediterranean, in most cases. The samples collected with the one side of tow were always preserved in 5% buffered formalin. However, several different ways of preservation including frozen and alcohol preservation, were examined for samples from the other side of tow, seeking for the best way of preservation for genetic work.

CTD observations up to 1000 m were made for basically every degree in latitude and/or longitude. Water samples from 11 layers of upper 200 m were also collected at CTD stations for chlorophyll and nutrient measurement. The MANTA net, a kind of neuston net, was also deployed at the same stations as CTD. The location of stations was shown in Fig.1.

Temperature, salinity and size and density of particles including plankton in a surface water were continuously monitored with Electronic Plankton Counting and Sizing System (EPCS) during the whole cruise. Acoustic Doppler Current Profiler (ADCP) also continuously monitored strength and direction of under water current of every 16 m up to around 600 m along a ship track.

2. Activities in the Gulf of Mexico:

The survey in the Gulf of Mexico was conducted from April 28 through May 19, 1994. The major objective during this period was to compare the larval sampling methods between the United States and Japan and to develop a calibration of sampling efficiency on tuna larvae between two methods. This was a collaborative survey with the South East Fisheries Science Center, and the NOAA R/V Oregon II, the United States. During this leg, Dr. S. Turner was on board the Shoyo-

maru to observe and record about the Japanese operations, whereas Mr. K. Uosaki of the NRIFSF, Japan, being on board the Oregon II. The one set of gears was also exchanged before the leg.

At the cooperative stations, two boats kept a course in parallel and deployed both Japanese and US BONGO nets simultaneously in this sequence. This is intended to distinguish gear effect and handling or deployment effects on sampling efficiencies. The cooperative stations were set at the ordinary US larval stations of every degree of longitude and latitude, which covered the north part of Gulf of Mexico. Furthermore, in order to increase the number of positive stations of tuna larvae, the additional cooperative tows were made across the oceanographic front, at the stations where tuna larvae acknowledged at the spot, and so on. As a result, 67 cooperative stations were made.

In addition to the cooperative stations, the Shoyo-maru made 43 independent BONGO tows to examine the overall distribution of larvae and multi-layer simultaneous tow with MTD-nets for examination of diurnal change of vertical distribution of larvae.

3. Activities in the Mediterranean:

Survey in the Mediterranean was conducted from June 6 to August 10, 1994. The major objective for this phase was to examine the distribution of bluefin tuna larvae in the Mediterranean by an intensive sampling. Survey lines were set around every 60 nm in the north-south direction and BONGO net oblique tows were made every 15 to 20 nm along a line. In the Tyrrhenian Sea, which was supposed to be a center of tuna spawning, the interval between survey lines was narrowed to 30 nm. As a result, total 445 BONGO tows were made. CTD observations including water sampling for chlorophyll and nutrients measurement, and neuston sampling were made for 107 stations. Dr. A. Garcia of the Instituto Español de Oceanografía, Spain, joined to the cruise for the leg from Palermo to Bari, Italy, July 8-22, 1994.

Calibration of sampling efficiency between the EC and Japanese vessels was made on 19 and 20 July, 1994 in the Ionian Sea. Inter-calibration of efficiency was originally planned to be held in the Tyrrhenian Sea where the densest tuna patches could be expected. However, since exploratory sorting on board could detect no tuna larvae in samples from the Tyrrhenian Sea, we shifted the area to the Ionian Sea. The Coopernaut Franca, the EC funded vessel directed by Prof. C. Piccinetti of the Università di Bologna, Italy, joined to this activity. Mr. T. Itoh of the NRIFSF, Japan, was on board the Coopernaut Franca to observe the EC method of tows. No gear exchange was made between vessels at this time. Total 23 tows were made simultaneously by both vessels. Although the number of cooperative stations was low, the preliminary sorting on board at least detected some tuna larvae, possibly albacore, which enabled a comparison of sampling efficiencies between boats. The differences in gear descriptions, tows methods and handling of samples among three parties, the United States, the EC (Italia), and Japan will be reviewed in detail in near future.

4. Oceanographic feature during the survey:

Although most of analysis are now under way, very brief feature of oceanographic condition of survey area is shown in Fig. 2 and 3.

In the Gulf of Mexico (Fig. 2), high temperature water mass intruded to the southeast of survey area, which seemed to correspond to the north edge of meandering Florida current. Lower salinity was observed in the west of the Gulf, which suggested a strong influence of coastal water.

However, the influence of coastal water was not observed for the water below 50 m in depth.

In the Mediterranean, the salinity seemed to be a better indicator of oceanographic feature, since surface temperature fluctuated so rapidly according to the weather condition and time of the day. Fig. 3 showed salinity of 10m depth which was selected to indicate a characteristics of water of seasonal mixing layer. Low salinity water corresponding to the water mass from the Atlantic Ocean was found in the Alboran Sea and moved along the African coast. In general, the European coast showed higher salinity than the African coast and the salinity increased when moving eastwards. Water mass lower than 37.8 ‰ in the Tyrrhenian Sea suggested a northeastwards invasion of the Atlantic-originated-water through the west of Sicily. Strong salinity fronts were observed in the west of Majorca, and the outlet Messina Strait.

5. Distribution of tuna positive tows:

Fig. 4 showed a distribution of bluefin tuna positive tows based on sorting done until this moment, including exploratory on-board sorting. Although the number of sorted stations was very small, many bluefin positive stations were observed in the Ionian Sea.

6. Time schedule of future analysis:

The followings are the current time schedule of analyses:

- Chlorophyll and nutrients analysis -- to complete until the end of this year.
- Genetic comparison between tow spawning grounds -- to complete around March, 1995.
- Calibration of sampling efficiencies among three parties -- to complete within a year and provide at least one cooperative paper to 1995 ICCAT meeting.
- Mapping of tuna larvae distribution -- to complete within few years but at least provide preliminary map to 1995 ICCAT meeting.

The detailed cruise and stations data will be made available to all interested parties around March of 1995.

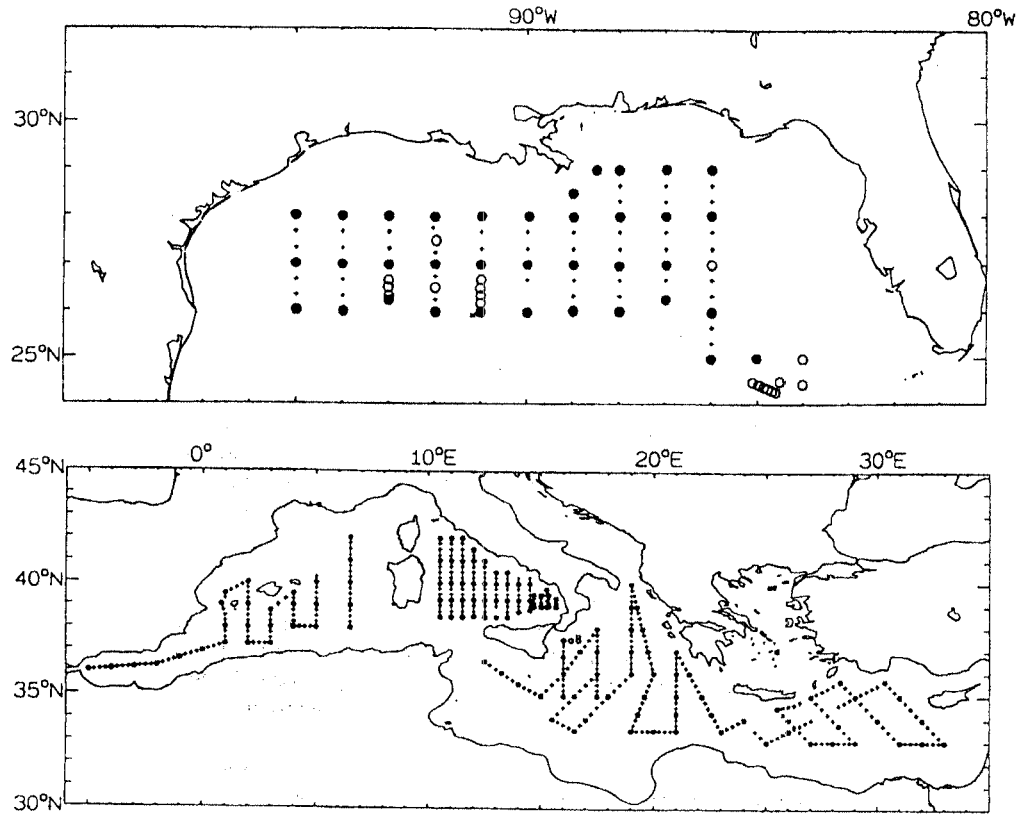


Figure 1. The location of stations of the Atlantic bluefin tuna larval survey by the R/V Shoyo-maru in 1994. Solid circle and plus meant BONGO tows station with and without CTD observation, respectively. Open circle showed cooperative stations for sampling efficiency calibration. All CTD stations in the Gulf of Mexico were cooperative stations with the US vessel.

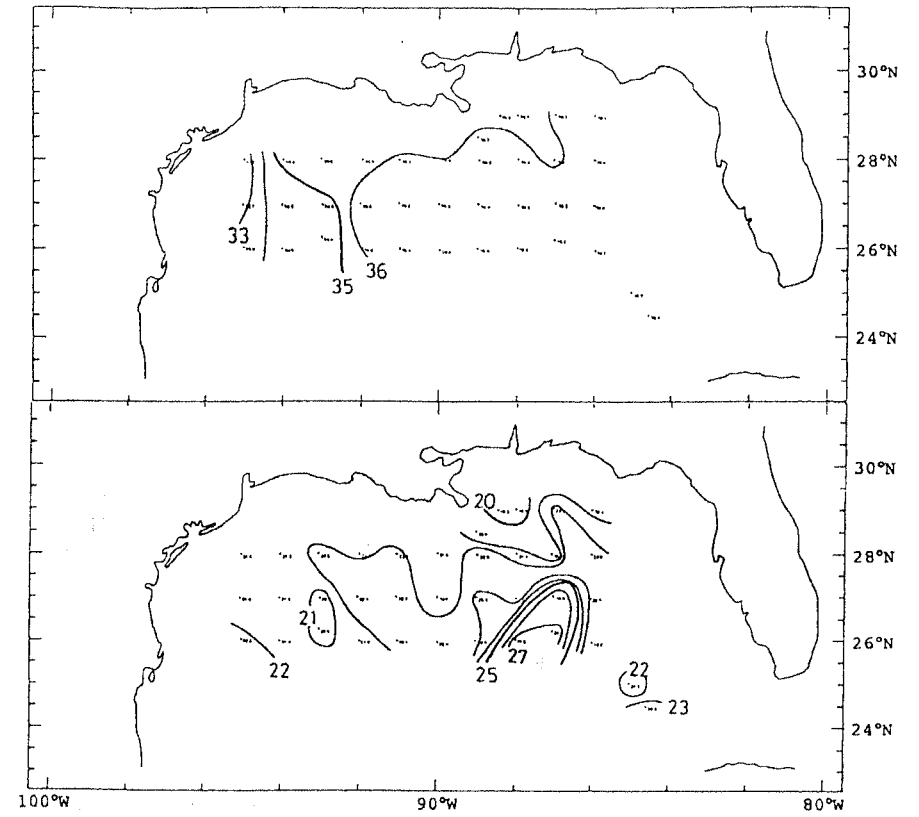


Figure 2. Oceanographic feature of the Gulf of Mexico during the survey. Upper figure : temperature at 50 m depth. Lower figure : salinity at 10 m depth.

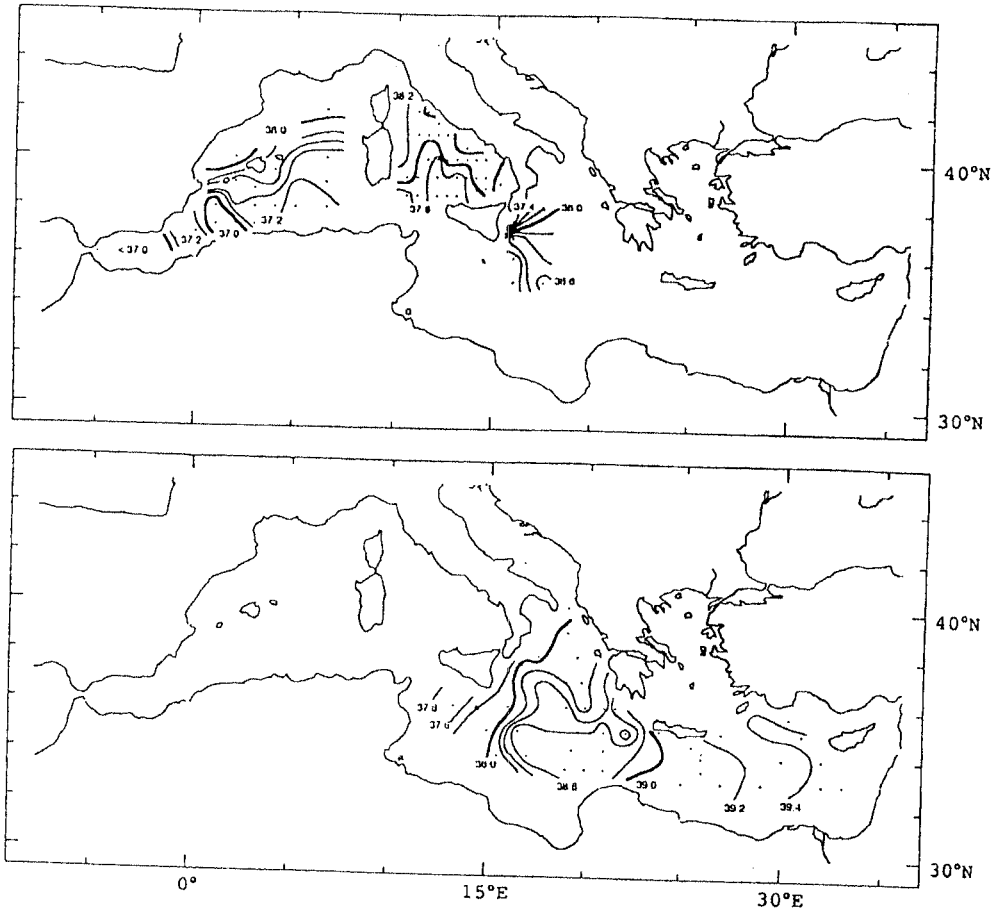


Figure 3. Salinity distribution at 10 m depth of the Mediterranean during the survey.

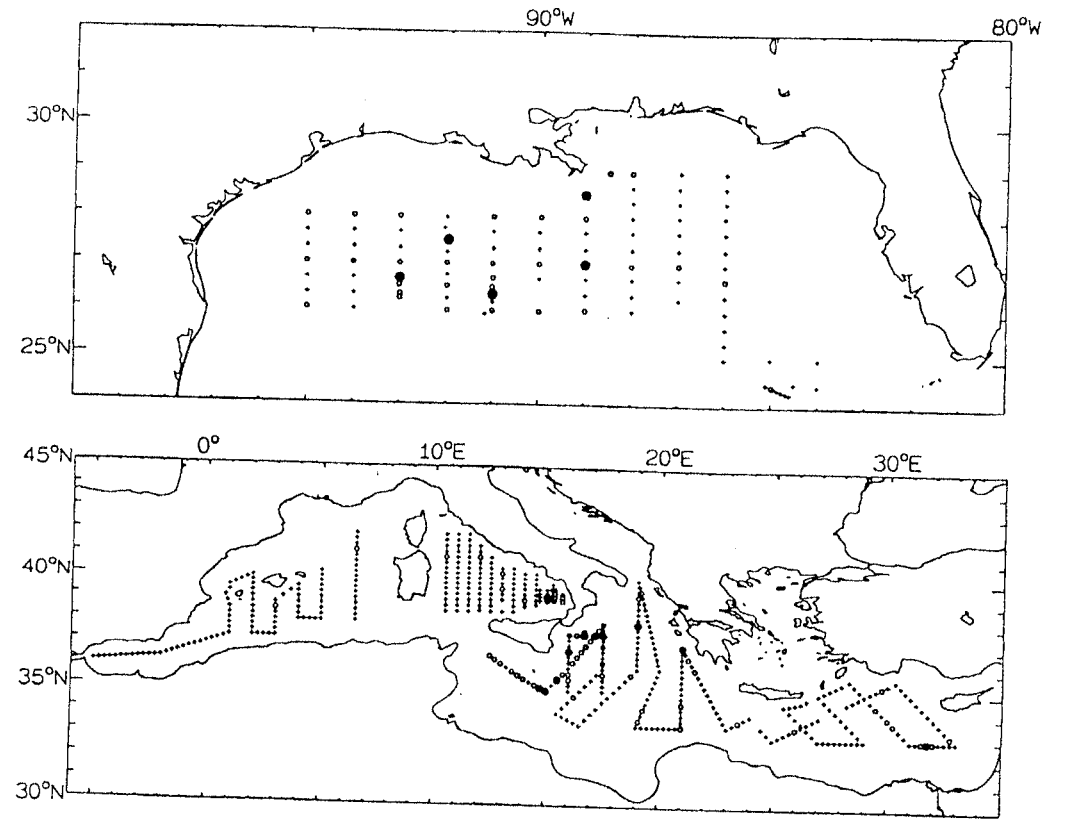


Figure 4. Bluefin tuna positive stations. Solid circle showed stations where bluefin tuna larvae caught. Open circle and plus corresponded to sorted and unsorted stations, respectively.