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Summary of Planktonic Cephalopods, Including *Illex illecebrosus*, from *Kaiyo-Maru* Cruise 8201, with Recommendations for Future Sampling

by

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Among many unanswered questions in cephalopod ecology, two currently are receiving much attention: (1) what are the season and site(s) of spawning for the commercially important species Illex illecebrosus? and (2) what factors in the early life history of the species are crucial to its survival and recruitment to the fishery?

A multinational effort was organized by Canada, Japan and the United States to attempt to answer these questions. Intensive directed sampling for the early stages of I. illecebrosus was conducted during February and March 1982 from the Japanese research vessel Kaiyo-Maru. Personnel from all three sponsoring nations participated in the two-leg cruise.

The cruise sampled the area of the gulf stream off New England and Nova Scotia (Fig. 1). We have examined some of the cephalopods collected on this cruise as part of a broad-scale analysis of planktonic cephalopod distribution in the western North Atlantic including MARMAP and BLM material. During the second leg of the cruise from which our specimens were obtained, the Gulf Stream was meandering in through the sampled area. Thus, the stations for which we have data include water masses characteristic of Boreal Slope Water, the Gulf Stream, and the Sargasso Sea.

The biological sampling strategy was based on oblique tows. An open bongo system was used to sample between the surface and 200 m depth, and open midwater trawls were used between the surface and 1000 m depth. A complete hydrographic data set also was collected using expendable bathythermographs

and multiple bottle casts for conductivity, temperature, and dissolved oxygen.

The biological samples were sorted at sea and field identifications were attempted for young Illex, sometimes under weather conditions that were far from ideal. Preserved specimens then were divided among the representatives of the participating countries: 1/2 to Japan, 1/4 to Canada and 1/4 to the U.S. Therefore, the material available to us represented one fourth of the specimens collected on the second leg of the cruise. The material consisting of 66 specimens that were identified to 18 taxa. Young Illex (we believe I. illecebrosus) constituted the most abundant taxon collected (Table 1). The data include several other taxa for which we have very limited information on the early life history. These taxa include young Gonatus (probably G. fabricii) as well as several ommastrephids, octopodids, enoploteuthids, cranchiids, and onychoteuthids.

Figure 2 shows the station locations and the isotherms at the surface and at 200 m depth. These depths were chosen because they represent the sampling envelope for the oblique bongo tows. The temperature structure shows the meandering nature of the current, typical of the transition area between the gulf stream and the north Atlantic drift. It also shows the great variability in thermal structure within the sampled depth range. Distribution of the five most abundant taxa also is presented. Based on this limited subset of the complete data set, we see indications of mesoscale spatial segregation among these taxa. Whereas Gonatus sp. was collected only along the Slope Water edged of the system, Illex sp. and the unidentified octopods were concentrated along the central axis of the system, while Leachia sp. and Ommastrephes sp. appeared to be concentrated on the Sargasso Sea side of the system.

The stations at which Illex were collected included a broad range of the surface temperatures (Fig. 3). Inferences on the distribuion of young Illex based only on surface conditions where oblique tow collected specimens would indicate eurytopic habitat requirements. However, based on our earlier work with sampling programs from the shelf and slope (BLM and MARMAP), we have reason to believe that Illex probably are concentrated deeper in the water column. At approximately 150 m depth all of the temperature sections converge at about 13-18 degrees C. If we assume that this is close to the depth at which most of the Illex were collected, then we have reason to point out strong similarities among all of these stations.

The bottom part of Figures 3 shows the temperature and salinities of

these stations at 150 and 200 m depths. These waters are approximately isopycnal at Sigma-T of about 26.7, indicating subsurface mixing. This isopycnal mixing extends between what Wright and Parker (1976) refer to as the "slope-water themostad" and the Gulf Stream. We then can speculate that hatching may occur in subsurface waters at the interface between the slope water and the Gulf Stream. Since both of these water masses are present within the range of I. illecebrosus throughout the year, these data may also indicate the possibility of a prolonged spawning season along the shoreward edge of the Gulf Stream.

Although we are able to speculate about the larval distribution of I. illecebrosus, a more precisely defined sampling program probably would have provided sufficient data to verify the hypothesis. We recommend several changes in future sampling programs. First, discrete-depth sampling should be considered a requirement for the study of early life bongo systems or with multiple opening/closing systems such as the Multiple Opening-Closing Net and Environmental Sensing System (MOCNESS). If time and funding constraints are imposed on the number of samples that can be collected, then the number of stations should be reduced so that discrete-depth sampling can be accomplished. Second, definitive sorting and identification should not be attempted at sea. Cross-checks of the field logs against subsequent laboratory identifications indicate that several of the field identifications were incorrect. Even under the best of conditions, use of a microscope at sea is difficult. Hatchlings (ca. 2 mm or less in length) are easily overlooked sloshing about in a petri dish; furthermore, identification characters are easily misjudged. We strongly support collaborative studies and coauthorship, but recommend that subsequent collections be identified and analyzed at one institution, prior to dividing the material among participating organizations. This will insure consistency of analysis and interpretation without deminishing the collaborative effort.

Literature Cited

Wright, W.R. and C.F. Parker. 1976. A volumetric temperature/salinity census for the Middle Atlantic Bight. Limnology and Oceanography, 21(4): 563-571.

Table 1. Abundance ranking of cephalopod specimens received by Smithsonian Institution from Kaiyo-Maru cruise 8201.

Taxon	# of Specimens	Rank
Illex sp.	16	1
unid. Octopodidae	8	2
Gonatus sp.	6	3.5
Ommastrephes sp.	6	3.5
Leachia sp.	4	5
Abralia sp.	3	7.5
Pterygioteuthis sp.	3	7.5
Octopoteuthis sp.	3	7.5
Megalocranchia megalops	3	7.5
Pyroteuthis margaretifera?	2	12
Onychoteuthis banksii	2	12
Onykia carribaea	2	12
Ctenopteryx sicula	2	12
Brachioteuthis sp.	2	12
Abraliopsis sp.	1	16.5
Histioteuthis sp.	1	16.5
Ornithoteuthis antillarum?	1	16.5
unid. oegopsid	1	16.5
total	66 specimens	18 taxa

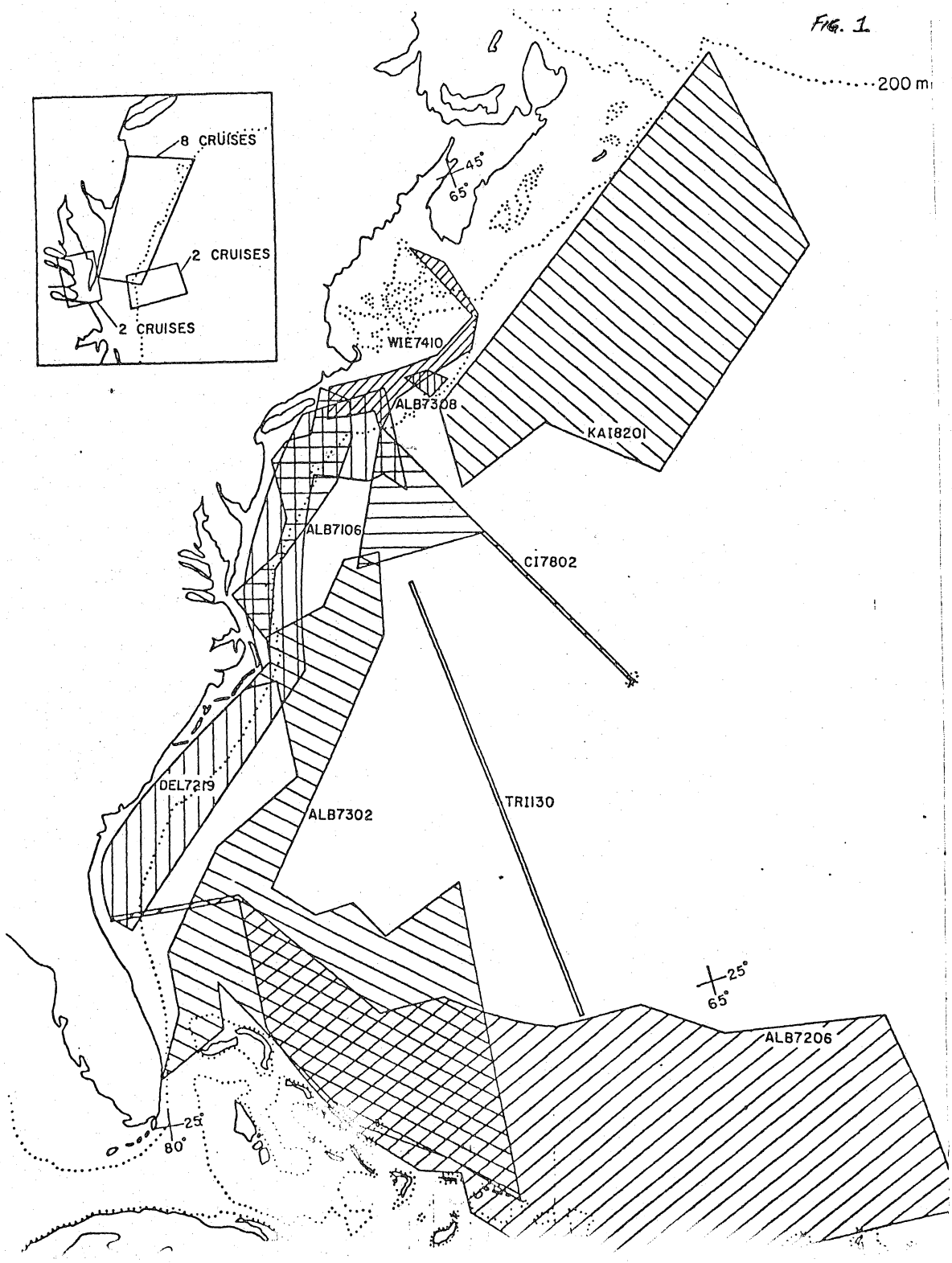

Fig. 1.- Sampling areas in the western north Atlantic for analysis of larval cephalopods. Kaiyo-Maru cruise 8201 is located in the northeastern sector.

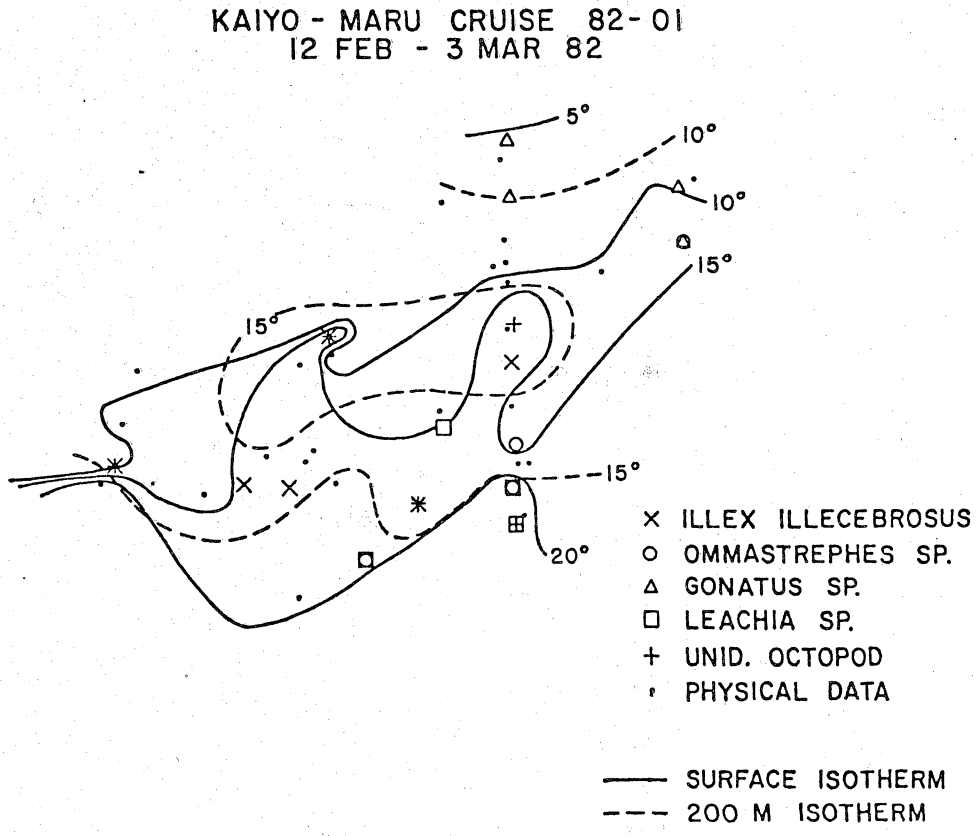

Fig. 2.- Kaiyo-Maru station locations plotted on surface and 200 m isotherms, with captures of the five most abundant cephalopod taxa.

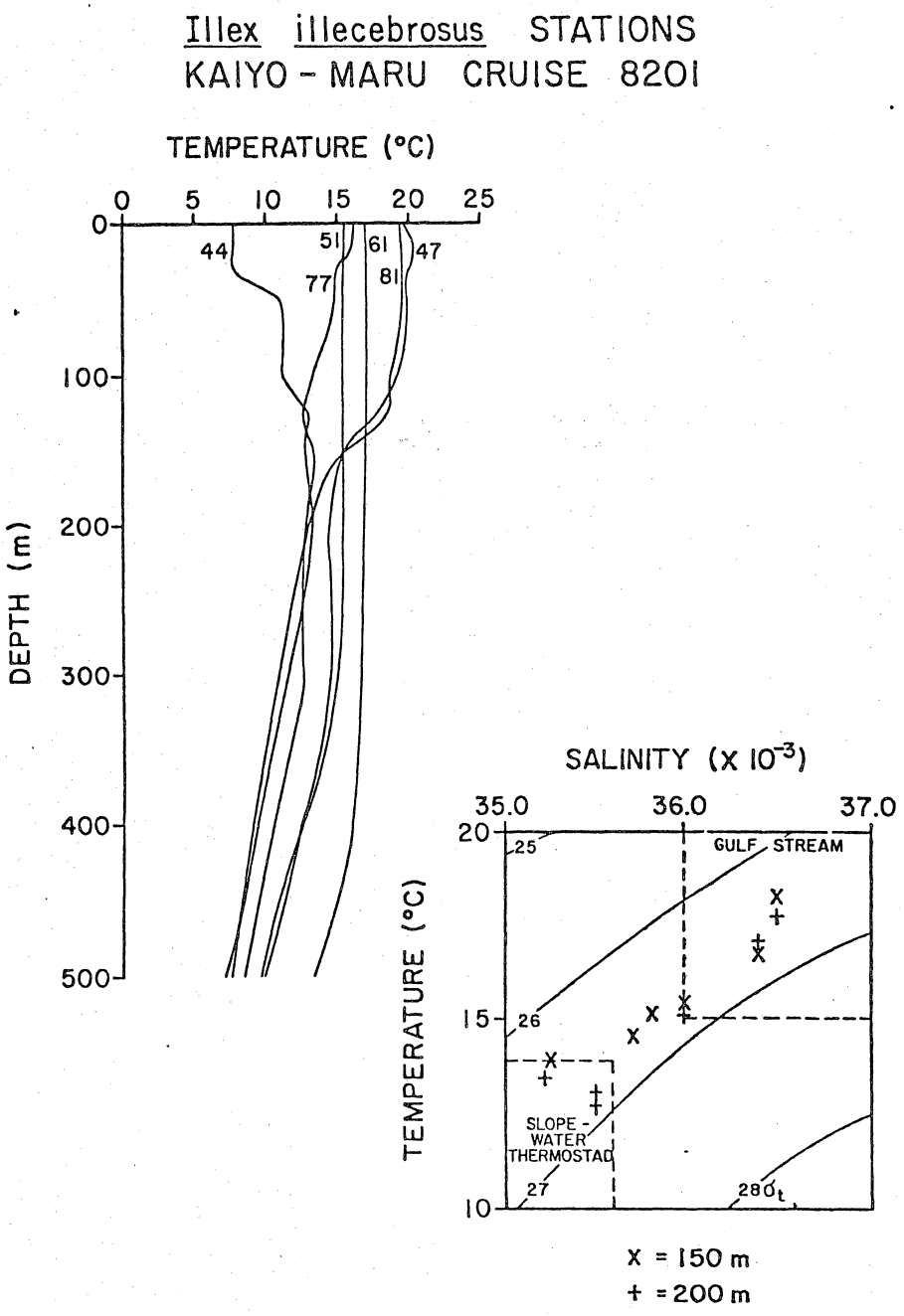

Fig. 3.- Top - Temperature profiles at Kaiyo-Maru stations where Illex illecebrosus were captured.

Bottom - T-S diagram of Kaiyo-Maru stations where Illex illecebrosus were captured with notation of water mass type.