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Field Guide for Data Collection for the Squid *Illex illecebrosus*

by

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INTRODUCTION

The Illex illecebrosus fishery is now commercially important both nationally and internationally (Amaratunga et al., 1978a and b). A complete understanding of the biology and distribution of this species, much of which is unknown, is required for proper management. Field data is the major source of information pertaining to growth, age, and other related questions of population structure. Data are available on Illex from different areas for many years (Squires, 1957, 1967; Mercer, 1973, 1975; Mesnil, 1976; and Tibbetts, 1975); however, due to varying format, correlation of data from these sources is very difficult.

Two different life cycles for Illex illecebrosus have been proposed (Squires, 1967; Mesnil, 1976). Both have been derived from interpretation of field data collected during a limited period of the year (May through November). It is important to note that data were not available for the critical maturation, breeding, and recruitment phases of the Illex cycle. For management purposes, it is crucial that extensive data be collected during the months of November through May in order to complete the present information. It is also important to unify all data collected; this will be simplified if the species is studied using standard criteria for data collection.

Mercer (1973) described an index of sexual maturity for males, but similar information on female maturity has not been

available until recently (O'Dor et al., 1977) when full maturity was observed in many captive females. A maturity index for females, as well as fecundity estimates, have been described from these laboratory studies and subsequent field samples (Durward et al., 1978). Utilizing these maturation indices, the maturity condition and process in both sexes can now be described in field samples.

The following is a guide for collection of data on Illex illecebrosus from catches on fishing and research vessels. The data collected will include morphometric measurements and observations that can be done by individuals with minimal training. The proposed guide has been partially tested in commercial fishing conditions and has been found both practical and reliable.

Relevance of Data Collected to Fishery Management

The procedures and standards presented in this paper as a guide for the biological sampling of Illex involve the collection of data on mantle length, total body weight, sex ratio, maturity stages, and gut fullness. The systematic collection of data will provide a foundation for subsequent research and standardization of information. This data bank is important in determining future management programs and research project priorities. This section discusses the relevance of the data.

A) Mantle Length. Length measurements taken on a research or commercial vessel give the simplest index of the composition of the stock, and can be recorded with high consistency by different observers. Historical data of this form may be used to assess annual or periodic trends in the stock. Length data, when correlated with laboratory studies, will also provide information pertaining to growth and age.

B) Total Body Weight (Total Wet Weight). Weight measurements are chiefly used to estimate total biomass and length-weight relationships. Weight of individual females are known to be related to fecundity (Durward et al., 1978). Utilizing biomass and fecundity data, the reproductive potential of a given stock can also be estimated.

C) Sex Determination and Maturation. It is important that data be collected for males and females separately, due to variations in growth rate and maturity. Sex ratios and the sequence of changes in maturation during the life cycle are important in building a thorough knowledge of the general biology. Reproductive biology is important in ascertaining size and age at which sexual maturity is attained. Data on maturation may provide clues to the duration of the reproductive cycle and the time and location of spawning. Age and size at maturity may provide management options to the duration of the fishing season in order to retain adequate spawning stock.

D) Gut Fullness. Gut fullness, correlated with time, allows preliminary estimation of feeding patterns on a diurnal and seasonal basis. Representative samples should also be examined to determine gut content in order to determine food preferences. This data may also allow development of a weight correction factor in relation to gut fullness. Neither growth rates nor gut fullness (a static measurement of feeding) provide information about the impact of Illex in relation to other fish stock; but when related to laboratory studies on feeding rates and growth efficiency, they should provide a means of assessing the interaction of various fisheries. The percentage of feeding animals can also be determined. Laboratory observations suggest that there is a complex social structure in Illex schools which affect feeding rates in individuals. The presence of dominant members in the schools may relate to breeding patterns and the quality of breeding stocks. Correlation between size and feeding frequency may help to clarify this behaviorial component of the species' life cycle.

Field Guide for Data Collection for the Squid Illex illecebrosus

The data collected are obtained as follows:

A standard sample of 100 randomly collected Illex should be used. All data will be recorded on the Data Sheet in

specified columns and all set information from the vessel log, pertaining to each catch, will be recorded on the Deck Sheet (see Figure 7).

1. Dorsal Mantle Length. Mantle length is measured in centimeters to the nearest 0.5 cm from the anterodorsal protruberance of the mantle to the apex of the tail fin, as illustrated in Figure 1. This measurement is recorded in column 1 of the Data Sheet.

2. Total Wet Weight. The total weight of each individual specimen is measured to the nearest 1.0 gram and recorded in column 2 of the Data Sheet. It is important to drain the excess water (fluid) from each squid and from the weighing pan prior to each weight determination.

3. Sex Determination. Sex determination is made by cutting the mantle along the ventral midline and observing the gonads and accessory organs. The general anatomy of each sex is illustrated in Figures 2 (Females) and 3 (Males).
   A) Early in the season (February through June), the key to sexing is the presence of two oviducal glands, in the female, one on each side of the stomach. Only one gland is present in males, the spermatophoric gland, and it is located on the animal's left side.
   B) Later in the season (July to December), the presence of two nidamental glands in the mid-ventral area of the female is the key feature for distinguishing the sexes.

4. Maturity Stages. The maturity stages of the gonads are determined using the following criteria*.
   A) Males. Staging of the male maturity condition is as follows:

      Male 1 = Immature: Spermatophoric organ is thin and transparent to translucent, or with a thin mid-lateral streak. The vas deferens is also thin and trans-

parent or with a slight white streak. Spermatophoric sac is empty.

Male 2 = Maturing: Spermatophoric organ has a white mid-lateral streak. The vas deferens is thick and creamy white in color. The spermatophoric sac can contain a few whitish particles. A representative Male 2 is shown in Figure 4a.

Male 3 = Mature: Spermatophoric sac contains spermatophores. The rest of the organ development same as in Male 2. A representative Male 3 is shown in Figure 4b.

Male 4 = Spent: After copulation and release of spermatophores.

B) Females. The maturity stage of the females is determined from the ratio of the nidamental gland length to mantle length. In the field, the length of the nidamental gland is measured to the nearest 0.5 cm and recorded in column 4 of the Data Sheet. The actual maturity stage can be determined later from the field data. Representative females at various times of the season are shown in Figure 5. Maturing females resembling those in Figure 5c and d should be preserved and returned for further study whenever possible.

Gut Fullness. Gut fullness is determined using the following scale and is based on visual observation of the stomach (whitish and muscular) and caecum (translucent, thin walled).

a/b; where a is stomach fullness, and
b is caecum fullness.

Fullness values are defined: 0 when empty (see Figure 2);
1 when ½ full;

2 when full;

3 when distended.

e.g. 1/2 means - stomach ½ full, caecum full;

o/1 means - stomach empty, caecum ½ full.

This data is recorded in column 5 on the Data Sheet.

*Note: Male maturity stages are defined on the basis of Mercer's criteria (1973). In this guide, Stage 0 and Stage 1 males have been combined to form Stage 1. This does not change the description of the life cycle, but provides greater accuracy in assessment of maturation by field observers.

Female maturity stages as mentioned, are determined by the ratio of nidamental gland length to mantle length. Although this need not be done in the field, Table 1 (Durward et al., 1978) is included here to aid in identifying the important advanced stages of maturity in females.

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TABLE 1. Characteristics of the maturation stages in female Illex illecebrosus (taken from: Maturation index and fecundity for female Illex illecebrosus (LeSueur, 1821) ICNAF Res. Doc. 78/II/1).

MATURATION STAGE	NG (mm) RANGE	NGL/ML RANGE§	DISTINGUISHING MORPHOLOGICAL FEATURE
1	11 - 25	$M \leq 0.09$	NG thin and transparent
2	20 - 35	$0.09 < M \leq 0.125$	NG transparent to translucent ovary - granular
3	25 - 60	$0.125 < M \leq 0.2$	NG translucent to opaque
4	55 - 90	$0.2 < M \leq 0.35$	NG white oviducts forming
5	110 - 120	$0.35 < M$	eggs in the oviducts

§ M = maturation stage

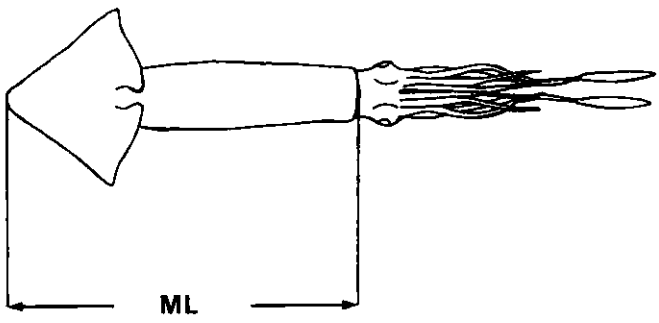

Figure 1. Dorsal side of Illex illecebrosus. Dorsal mantle length (ML) is measured from the anterodorsal protrubance of the mantle to the apex of the tail fin.

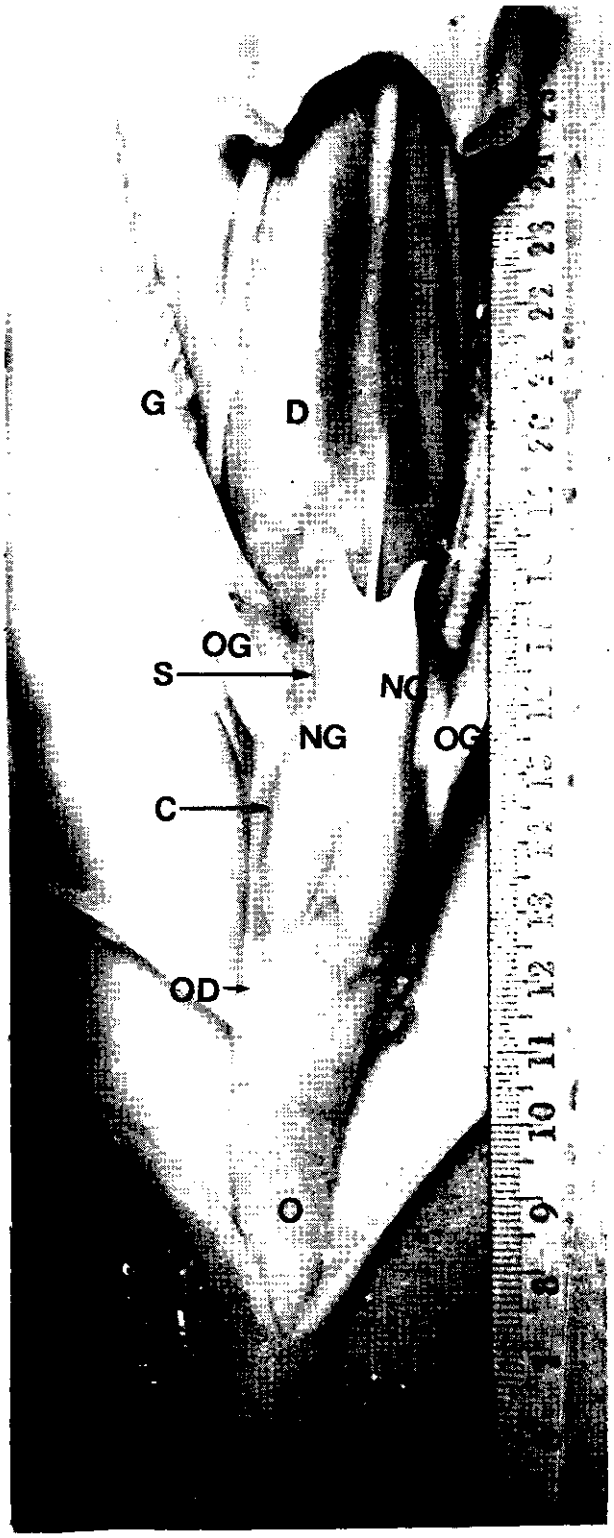

Fig. 2. General anatomy of the female *Illex illecebrosus*: C, caecum (empty, under lower half of NG); D, digestive gland; G, gill; NG, nidamental gland; O, ovary; OG, oviducal gland; OD, oviduct (not yet formed, but would develop in this area); S, stomach (empty, under top half of NG).

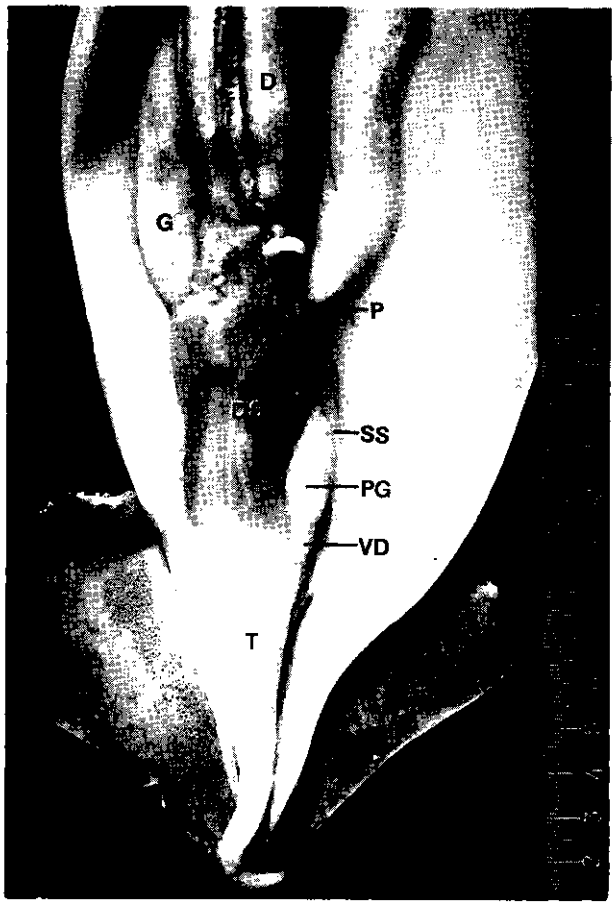

Fig. 3. General anatomy of the male *Illex illecebrosus*: D, digestive gland; DS, digestive system, G, gill; I, ink sac; P, penis; PG, prostate gland; SS, spermatophoric sac; T, testis; VD, vas deferens.

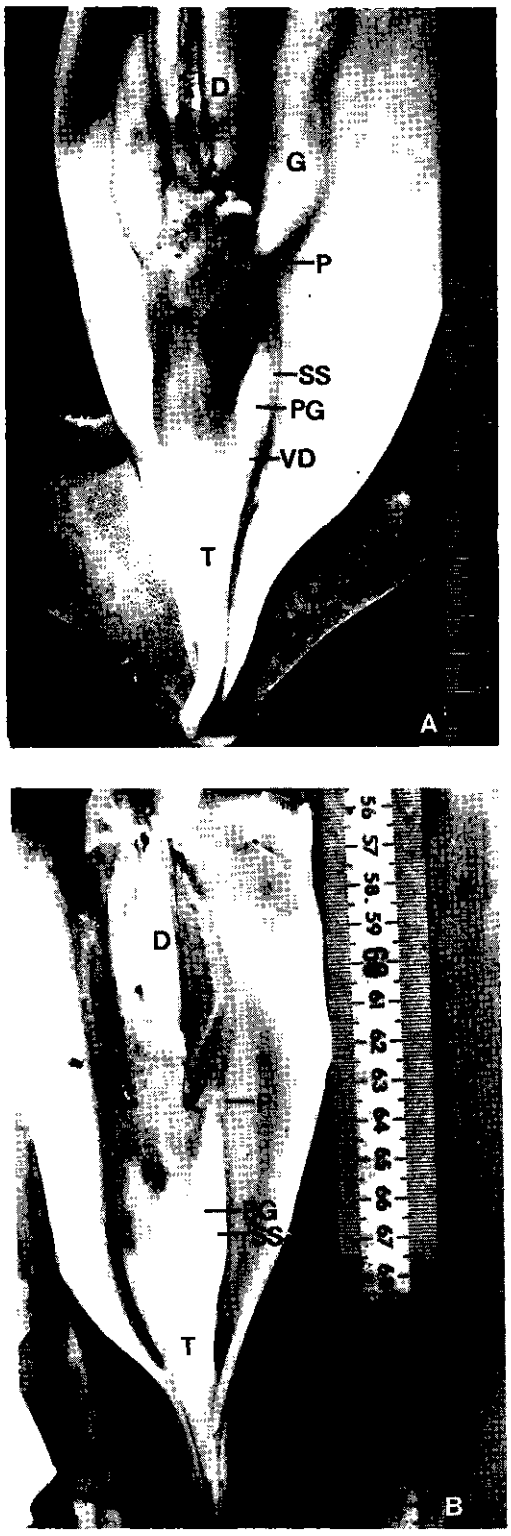

Fig. 4A,B. Typical specimens of male *Illex illecebrosus* in Stage 2 (4A) and Stage 3 (4B). Legend is same as in Fig. 3.

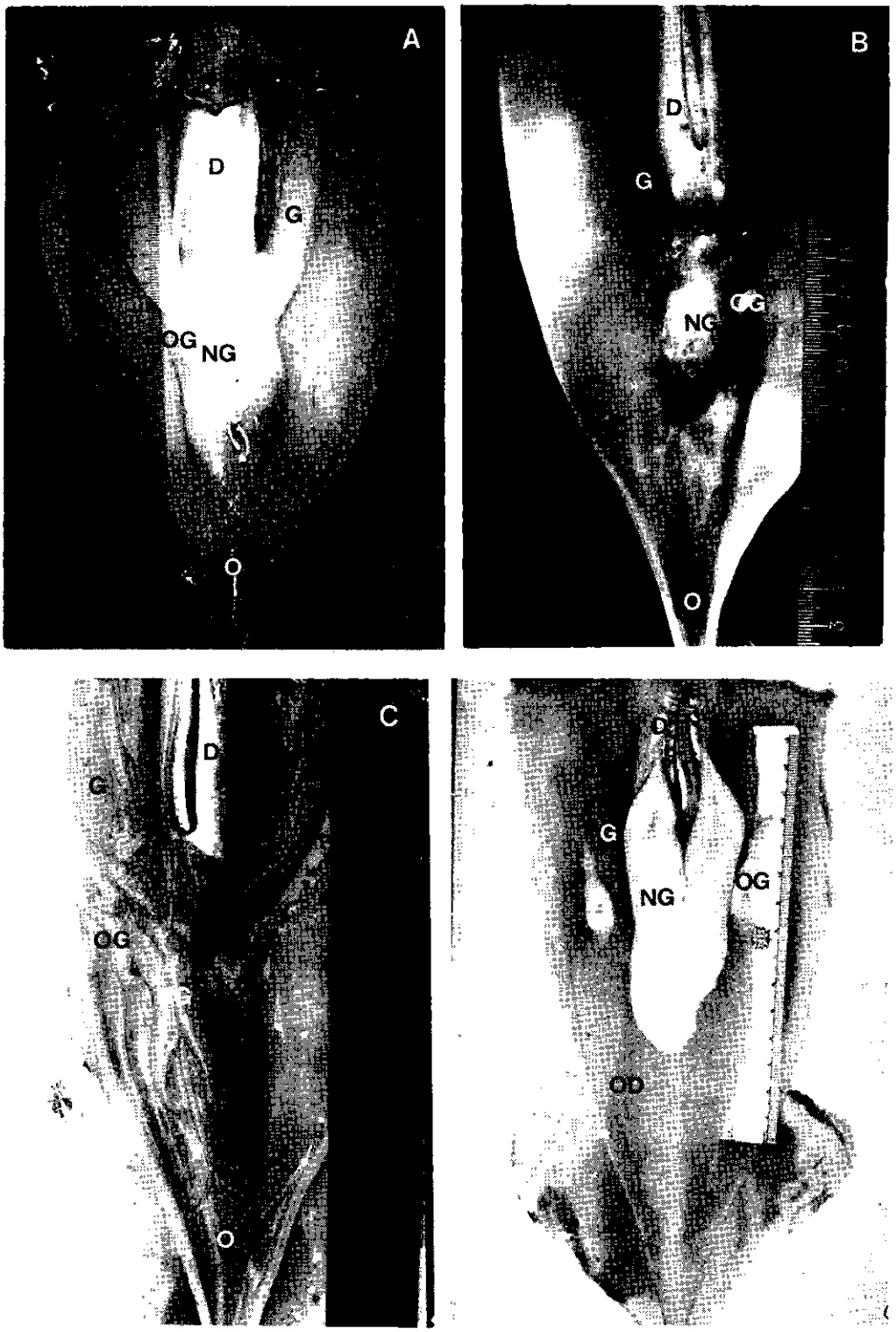

Fig. 5A,B,C,D. Typical specimens of female *Illex illecebrosus* caught in: (5A) late spring - early summer; (5B) summer; (5C) autumn; and (5D) early winter (November-January). Legend is same as in Fig. 2.