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Additional Information on the Biology of the Dealfish, Trachipterus ishikawai JORDAN & SNYDER[1]

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ON February 11, 1963, I obtained, through the courtesy of Mr. ISAO OKACHI of the Japan Sea Regional Fisheries Research Laboratory, a fine specimen of the dealfish, *Trachipterus ishikawai* JORDAN & SNYDER (Teleostei: Lamprida), which had been caught in Ryotsu Bay of Sado Island by set net on the preceding day. Measurements and observations were made without delay while the fish was still quite fresh. Methods of measurement and description of the results follow as a rule the practice adopted in my previous work (NISHIMURA 1963).

Female
Gonad: In immature phase

Standard length	1161*mm*
Weight	3028*g*
Volume	2914*cm*^{3}
Vertebrae	73
Dorsal fin-rays	133
Pectoral fin-rays	i+12—i+12
Caudal fin	(Torn off)
Gill-rakers on lst arch	12—11
Branchiostegal rays	6—6
In standard length:	
Head length	8.0
Greatest body depth (at anterior third of standard length)	6.7
Body depth at pectoral insertion	7.1
Body depth at anus	8.3
Least caudal peduncle depth	ca. 116
Preanal length	1.7
In head length:	
Snout length	2.9
Eye diameter	3.0
Interorbital space	4.6
Length of longest dorsal ray (at two-fifths of standard length from snout)	3.0
Length of longest pectoral ray (8th ray, on right side; damaged on left side)	2.4
Length of base of pectoral fin	10.4
In eye diameter:	
Longer diameter of pupil	2.0
Shorter diameter of pupil (both on right side; slightly damaged on left side)	4.4
Diameter of lens	3.3

Morphological features, both external and internal, of the present specimen essentially fit the description given in the previous report (NISHIMURA 1963). Only a few points of particular interest will briefly be mentioned below.

The longer axis of the ellipsoidal pupil is inclined postero-inferiorly, the dip angle being approximately 35°. The body is feebly covered with non-overlapping scales; they are elongate in outline, transparent and extraordinarily thin. Those taken from the mid-epiaxial region of body surface measured 3×5-7mm of size, without any structure such as spines or grooves; and not more than four circuli were noted. (After ten months of preservation in formalin, these scales have completely disappeared, possibly dissolved away into formalin solution, leaving no trace of scalation at all). The tubercles along the midventral line are enlarged, sharp-tipped and inclined forward. The anus is situated slightly on the left side instead of on the midventral line as in the previously reported two specimens. (In points of the presence of scales and the position of anus, the present species is divergent from the generic diagnosis of *Trachipterus*

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(s. s.) given by WALTERS & FITCH 1960). There is no trace of swimbladder. The ovary consists of greatly elongated lobes, the right and left ones lying closely together to each other in the anterior half part but completely fused into a single lobe posteriorly. The vertebrae steadily increase the centrum length backward to the antepenultimate vertebra; the penultimate one slightly diminishes its centrum length, and the last vertebra is decidedly shorter.

Density and sinking factor

The density of body of the present specimen is calculated as 3028/2914=1.039 grams per cm^3, thus sufficiently close to the value in a 1331-*mm* specimen previously measured (NISHIMURA 1963) and well within the bounds of errors of measurement. The sinking factor is then calculated to be 1.039×1000/1.026=1013. It is apparent that the dealfish keeps a notably small density in spite of lack in a swimbladder; and the possibility that the fish would continue to sink down slowly in the sea unless an appropriate effort is made against the gravitational pull is suggested again from the value of sinking factor obtained for the present specimen.

Notes on locomotory behavior

Mr. I. OKACHI had an opportunity at Sado Island to observe the swimming behavior of the dealfish entrapped in a set net. He kindly informed me of his results of observation as follows:

1. The swimming was achieved mainly by continuous lateral undulation of dorsal fin.
2. When the speed of locomotion was not great, *the longitudinal axis of body was inclined with the head turning obliquely upward; and an indication of sinking of the fish seemed to be observed* [italics mine : S. N.] Occasionally, the laterally compressed body rolled to one side, or from side to side, during the slow swimming motion. Messrs. SHOGO KASAHARA and KAZUHARU WATANABE, both of the Japan Sea Regional Fisheries Research Laboratory, who likewise had a chance to witness the locomotion of the dealfish in Ryotsu Bay, ascertained the same account.
3. *The longitudinal axis of body approached to be horizontal with increasing swimming speed* [italics mine: S. N.]
4. Lateral undulation of the trunk and tail was also noticed, but it was by no means strong.

This information was decidedly important in that it gave an observational evidence to my previous hypothesis concerning the locomotory mechanism in the oar-, deal- and related fishes (the taeniosomes) (NISHIMURA 1961, 1963), and further that it also bestowed a clue to the understanding of some inconsistencies as had apparently appeared in the previous reports by various persons. Now we may safely conclude that the dealfish (and the taeniosomatous species in general) will rely upon continuous lateral undulation of the dorsal fin in an ordinary gentle swimming behavior, that in this swimming the body will be kept inclined obliquely with the muzzle turning upward, that the fish may sink downward when the movement in the dorsal fin is not sufficient enough to counterbalance the gravitational force, and yet further that the body axis will become horizontal with increase in swimming speed (by more rapid undulation of the dorsal fin and initiation or reinforcement of lateral undulation along the trunk and tail in cases of, say, emergency).

Contents of digestive tract

While the specimen was being handled, a quantity of faeces containing guanine and colored dark silvery was discharged through the anus. Upon dissection, the intestine was found filled with similar mucous matter. And among the excretion and mucous matter, and from the inside of the stomach, pyloric appendages and intestine, numerous small eye-lenses, otoliths and vertebrae of teleostean origin were discovered. These remains proved, upon examination under microscope, all belonging to a single species of teleost: *Maurolicus muelleri japonicus* ISHIKAWA (Clupeida: Gonostomatidae). The longest radius of the roughly pyriform otoliths of *Maurolicus* which were recovered from the gut of the dealfish ranged from 0.54 to 1.10 *mm*, the majority being included in the class 0.7 to 1.0 *mm*. By extrapolating from the relationship between the longest radius of otolith and the body size in *Maurolicus muelleri japonicus* prepared by Mr. MUNEO OKIYAMA of the Japan Sea Regional Fisheries Research

Laboratory, the ingested *Maurolicus* were estimated to have ranged from 15 to 46 *mm*, mostly from 25 to 40 *mm*, in standard length. This gonostomatid fish is believed to occur in a large biomass in the southeastern part of the Japan Sea, and to be consumed by various carnivorous fishes and cephalopods in large quantities (NISHIMURA 1959, 1960). KATOH (1955) examined the size composition of *Maurolicus* found in the stomach of the Alaska pollack, *Theragra chalcogramma*, taken from various localities along the western coast of Honshu Island. According to this author, the ingested *Maurolicus* ranged from 15 to 55 *mm* in body length with the mode being located within the range from 30 to 45 *mm*. It is interesting to note that the size groups which occurred most frequently in the gonostomatid fish recovered from the present dealfish are almost identical to those size groups which are most greedily predated by the Alaska pollack populations.

In this connection, I wish to record that the squid beak found in the stomach of one of the previous specimens (NISHIMURA 1963), which I referred at that time to the family Enoploteuthidae, has proved through the courtesy of Dr. IWAO TAKI of the Faculty of Fisheries and Animal Husbandry, Hiroshima University, apparently to be of an undescribed species of that oegopsidean family (Personal communication dated December 16, 1963. In the same letter, Dr. TAKI further informed me that he had been intending to describe this animal as a new species under the name *Enoploteuthis theragrae*). This cephalopod seems to be distributed profusely at bathypelagic layers in the Japan Sea, since it is very frequently found ingested in the stomach of the Alaska pollack taken from the same sea basin (NISHIMURA, unpublished data). The individual ingested by the previous dealfish specimen was estimated to have been about 70 *mm* in mantle length.

Parasites

Two species of parasitic helminths, both of larval forms, were discovered in the present dealfish specimen: a single individual of the plerocercoid larva of a trypanorhynchan cestode (possibly, *Nybelinia surmenicola* OKADA) was found attached to the inner mucous membrane of the stomach between the longitudinal folds in addition to 65 specimens of the peculiar tailed tetraphyllidean plerocercoids (cf. NISHIMURA 1963) which were collected from the inside of the pyloric appendages and intestine.

Before concluding this note, I wish to extend my hearty thanks to Dr. I TAKI for his kindness in identifying the squid specimen and to Messrs. I. OKACHI and M. OKIYAMA for their kind assistance and advice.

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