

Gonadal Morphology of Threadfin Breams, *Nemipterus bathybius* and *N. virgatus*: Evidence of Rudimentary Hermaphroditism

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Abstract Gonads of young and adult *Nemipterus bathybius* and *N. virgatus* were examined histologically. In young *N. bathybius* males, the testis is composed of a dorsal and a ventral zone separated by thin connective tissue. A duct runs through the center of the dorsal zone, and has an opening on the ventromedian surface of the body, separate from the male genital pore. Along with the start of spermatogenesis in the ventral zone, germ cells distributed in the dorsal zone also begin spermatogenesis and eventually develop into spermatozoa. Consequently, in mature testes the sperm sinuses are formed to enclose the dorsal duct, leaving a small number of germ cells, including oviform cells, retained in the lamellar projections of the duct. Testes of *N. virgatus* also have essentially the same histological characteristics. No trace of testicular tissue is present in the ovaries, except in four cases of intersexual gonads found in both nemipterid species. It is concluded that the dorsal duct and its lamellar projections are remnants of the ovarian cavity-oviduct system and ovigerous lamellae of the ovarian portion of the gonad, and that these two nemipterid species are rudimentary hermaphrodites in which males have bisexual gonads of the delimited type in their juvenile stages.

Several species of threadfin breams, belonging to the genus *Nemipterus* of the family Nemipteridae, are known to be distributed in coastal waters south of central Japan and are objects for commercial fisheries. Among them the golden thread, *Nemipterus virgatus*, and the bottom threadfin-bream, *N. bathybius*, are important food fishes with high commercial value in Japan. Several studies have been conducted regarding the reproductive biology of these nemipterids, particularly *N. virgatus* (Li, 1954, 1960; Eggleston, 1970, 1972; Liu and Su, 1972; Kao and Liu, 1974). However, little information is available on the detailed histology of the gonad and gonadogenesis in these teleosts.

In a variety of fishes various types of hermaphroditism have been reported to occur (Atz, 1964; Reinboth, 1970; Sadovy and Shapiro, 1987). Sexuality of nemipterids has long been unknown until Young and Martin (1985) reported histological studies on gonads of thirteen nemipterid species found in northern Australia. They designated three *Scolopsis* species as protogynous hermaphrodites. Among seven *Nemipterus* species examined by them, six species including *N. bathybius* and *N. virgatus* were decisive gonochorists, and another species, *N. peronii*, had a hermaphroditic individual. Furthermore, they

described the occurrence of a "dorsal accessory duct" on the dorsal side of the testes in four species of nemipterids: *N. bathybius*, *N. virgatus*, *N. hexodon* and *N. nematopus*.

During our studies on the comparative histology of fish gonads, we also noticed the presence of a dorsal duct in the testis of some nemipterid fishes, and were deeply interested to elucidate the functional significance of the duct through observations of the gonadogenetic process in these fishes. The aim of the present study is to present histological evidence regarding the occurrence of rudimentary hermaphroditism in *N. bathybius* and *N. virgatus*, in which the dorsal accessory duct corresponds to a rudimentary ovarian cavity-oviduct system residing on the testis from the beginning of its development. This is contribution no. 99 from the Marine Science Museum, Tokai University.

Materials and methods

During the period from April 1983 to December 1986, 161 specimens of the threadfin-bream *Nemipterus bathybius*, ranging from 66 to 230 mm in standard length (SL), were captured by trawl net in the eastern area of Suruga Bay, Shizuoka Prefecture, or by beach seine along the Miho

Peninsula coast in Shizuoka Prefecture, Japan. Concurrently, 60 specimens of the golden thread *N. virgatus*, ranging from 49 to 385 mm in SL, were also sampled from the same areas. Only a small number of fishes could be obtained during the winter months from November to March. Regarding the samplings, prime consideration was given to collect as many small individuals as possible in order to get sufficient material for the analysis of the process of gonadal morphogenesis. The size distribution of the specimens sampled is shown in Table 1.

Histological studies on gonad morphology were carried out on all the specimens collected. The gonads were fixed in Bouin's fluid and embedded in paraffin. Serial cross sections were cut at 6 μ m in thickness and stained with Delafield's hematoxylin and eosin or with Mallory's triple stain. For smaller specimens the gonads on both sides were sectioned along the whole length, while in larger specimens a middle portion of each gonad was selected for sectioning after confirming that no essential difference existed in histological features between the anterior, middle and posterior portions of the gonad.

Results

A. Gonad morphology of *Nemipterus bathybius*.

Gonads are attached closely to the dorsal peritoneal wall along their dorsal side. Ovaries in particular are found to be buried in the peritoneal wall. Ovaries on both sides are cigar-shaped and joined at the posterior extremity to make their centrovarian cavities confluent with a single median oviduct which opens outside just anterior to the urinary pore. Histologically, the ovarian wall is composed of rather thick muscle layers. Ovarian oocytes develop within many ovigerous lamellae projecting radially into the centrovarian cavity (Fig. 1). Ovaries containing postovulatory follicles together with vitellogenic oocytes were found in females larger than 110 mm SL captured in late August. In November, all females had quite immature ovaries with oocytes mostly at the peripheral nucleolus stage.

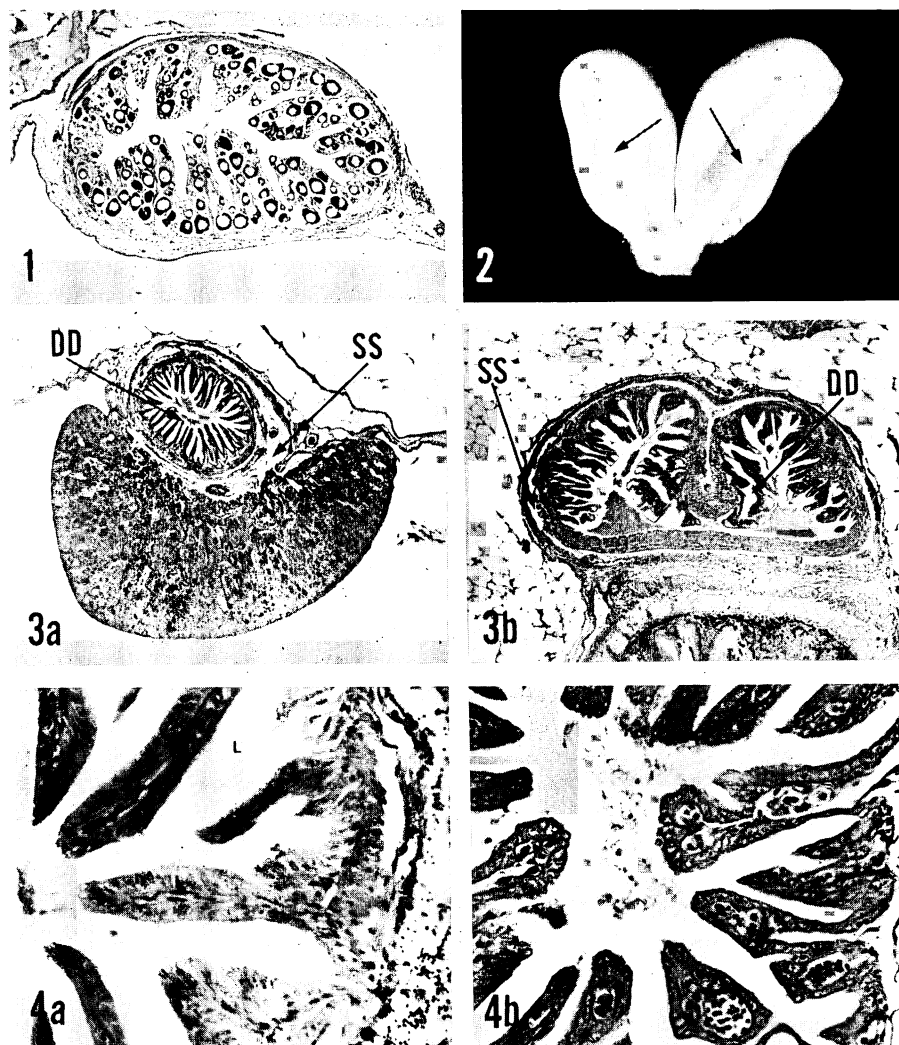
Testes are flattened dorsoventrally and are paired along their whole length, though a partial fusion of the germinal tissue occurs at their posterior extremity. A mature testis has a shallow craniocaudal depression on the dorsal side, in

which a cylindrical ridge is found to run along the long axis of the testis (Fig. 2). The bilateral ridges are fused together at the posterior end of the testes to form a single median ridge running caudalwards. In cross sections of mature testes, the ridge is a duct complex consisting of a duct (dorsal duct) with a surrounding sinus structure for preservation and transport of spermatozoa (Fig. 3a). In the dorsal duct, many lamellar projections extend radially from the muscle wall into the duct lumen. The lamellar projections are covered with a continuous layer of columnar cells (Fig. 4a) and, in a few cases, contain germinal elements such as spermatogenic cells, spermatozoa, and oviform cells inside them (Fig. 4b). The lumen in no case contains spermatozoa, and the epithelial cells of the lamellar projections do not appear to be glandular in nature. The dorsal ducts of paired testes extend posteriorly to join eventually in a common duct near the caudal end of the testes before reaching a median ventral opening on the anterior base of the urogenital papilla (Fig. 3b).

In mature testes of *N. bathybius*, a sinus structure filled with spermatozoa surrounds the dorsal duct. The sperm sinuses on both sides, which are each seen to be divided into a few wide compartments, completely encircle the dorsal ducts and extend posteriorly to unite in a single median cavity surrounding the single dorsal duct (Fig. 3b). The median cavity then becomes localized to the dorsal side of the duct near the level of the anus, and finally opens at the apex of the urogenital

Table 1. Size distribution of nemipterid specimens observed. * Actual size of the specimen.

Size class (SL, mm)	<i>N. bathybius</i>		<i>N. virgatus</i>	
	Male	Female	Male	Female
(49)*	—	—	1	—
60–89	20	26	1	—
90–119	24	20	8	6
120–149	10	13	4	10
150–179	16	7	2	2
180–209	9	12	3	7
210–239	2	2	3	5
240–269	—	—	2	—
270–299	—	—	2	2
(320)*	—	—	—	1
(385)*	—	—	1	—
Total	81	80	27	33

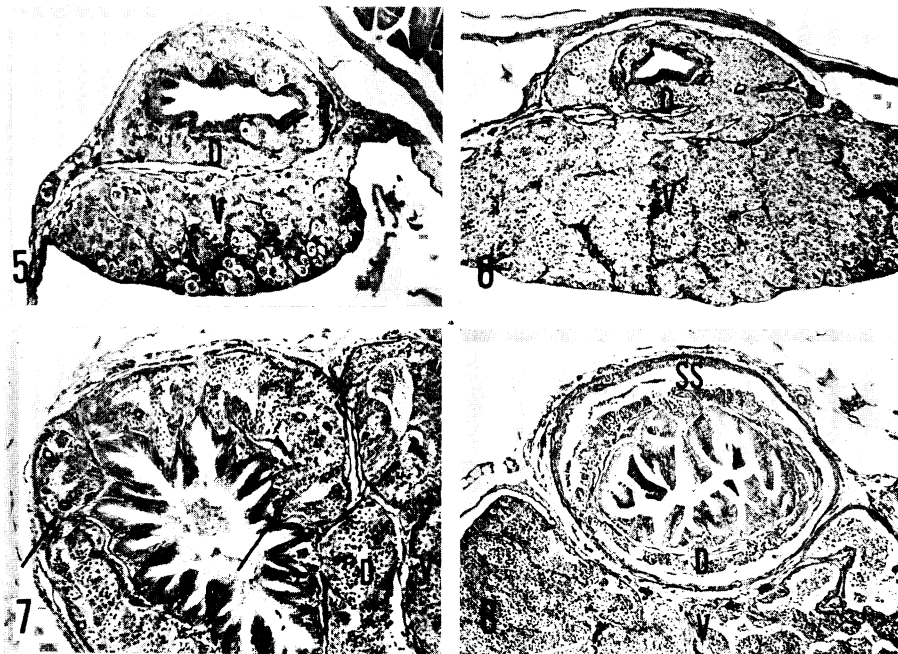


Figs. 1-4. *Nemipterus bathybius*. 1: Cross section of an ovary of a young female (77.6 mm SL, June). $\times 63$. 2: Dorsal view of testes of an adult male (222 mm SL, October). Arrows indicate the dorsal duct-sperm sinus complex. $\times 1.5$. 3: Cross sections of the middle (a) and caudal regions (b) of a testis of an adult male (123 mm SL, September), revealing the arrangement of the dorsal duct (DD) and the sperm sinus (SS). $\times 30$. 4: Cross sections of the dorsal ducts of maturing males (156 and 160 mm SL, April), showing lamellar projections without (a) and with germinal elements (b). a, $\times 240$; b, $\times 260$.

papilla separately from the pore of the dorsal duct. The sperm sinus never conjoins with the dorsal duct along its entire length.

In the smallest *N. bathybius* specimen (66.2 mm SL) captured in April, the gonads were quite immature with gonial germ cells only, and had on the dorsal side a well-defined zone which was separated from the ventral portion of the gonad by thin connective tissue (Fig. 5). The dorsal

zone was characterized by a duct lined with a layer of columnar epithelial cells, and the duct was surrounded by germinal tissue consisting also of gonial germ cells. The gonads are regarded as immature testes, since the smallest female (70.1 mm SL) captured in May had already had well-defined ovaries with many oocytes developing into the peripheral nucleolus stage. Spermatogenesis had already begun in the testes of young



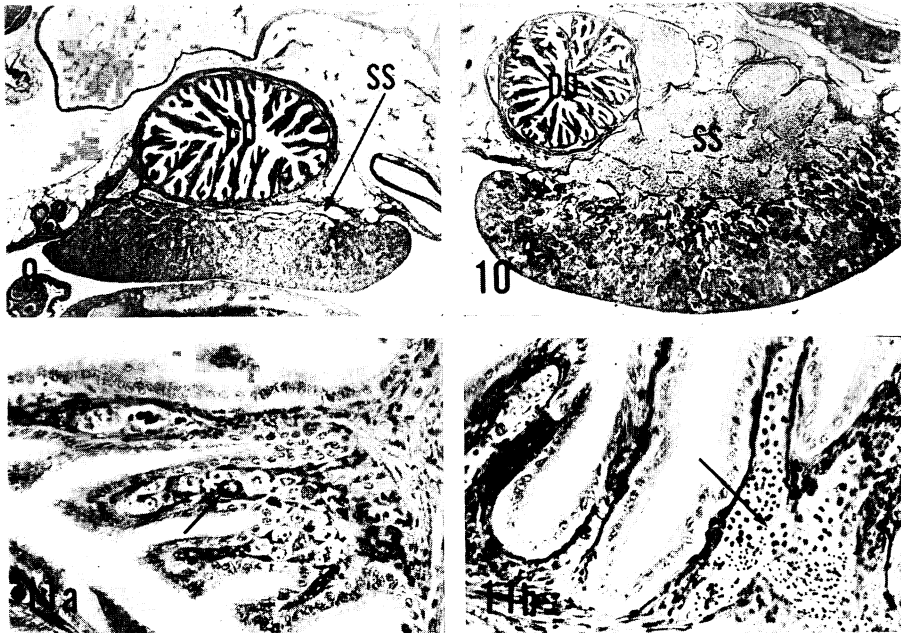
Figs. 5-8. Cross sections of the testes of *Nemipterus bathybius*, showing a synchronous development of the dorsal (D) and ventral (V) zones. 5: Immature testis of a male (66.2 mm SL, April), revealing a clear separation of the two testis zones by connective tissue. $\times 120$. 6: Testis of a male (99.6 mm SL, June) at the start of spermatogenesis. $\times 90$. 7: Testis of a male (93.3 mm SL, July) undergoing active spermatogenesis. Arrows indicate oviform germ cells appearing in the dorsal zone. $\times 100$. 8: Mature testis of a male (107 mm SL, September), showing the formation of sperm sinus (SS) in the dorsal zone. $\times 70$.

males around 80 mm SL, captured in April. Cysts of spermatocytes occurred not only in the developing seminal lobules of the ventral zone of the testis, but also in the germinal tissue in the dorsal zone (Fig. 6). The progress of spermatogenesis in the dorsal zone was nearly synchronized with that occurring in the ventral zone (Fig. 7), and all germ cells in the dorsal zone were successively transformed into spermatozoa, which eventually resulted in the formation of cavities containing a large amount of spermatozoa and completely surrounding the dorsal duct (Fig. 8). In a few cases, oviform germ cells were observed to exist among spermatogenetic cells in the dorsal zone (Fig. 7).

As spermatogenesis advanced, the seminal lobules of the ventral zone bordering on the dorsal zone became deprived of germ cells except for spermatozoa, thus forming the sperm sinus which became continuous with that in the dorsal zone through the connective tissue boundary.

Seminal lobules in the other region of the ventral zone were of the unrestricted spermatogonial testis-type (Grier et al., 1980), though spermatogonia were apt to be more abundant along the periphery than in the central region of the mature testes. Spermatogenetic activity appears to be continuously high from April through December in most males larger than 100 mm SL, suggesting a long spawning period in *N. bathybius*.

B. Gonad morphology of *Nemipterus virgatus*. Gross morphology of the reproductive system of *N. virgatus* is fairly identical with that of *N. bathybius* described above. Ovaries having post-ovulatory follicles together with vitellogenic oocytes were found in females larger than 180 mm SL captured between May and October, indicating the occurrence of intermittent spawnings during that long spawning period. Also, spermatogenesis was active in males larger than 130 mm SL observed in the same months as above. The smallest male (49 mm SL) collected in October had pre-



Figs. 9-11. *Nemipterus virgatus*. 9: Cross section of a testis of an adult male (175 mm SL, September). $\times 27$. 10: Cross section of a mature testis of a male (223 mm SL, June), showing fully expanded sperm sinus. $\times 20$. 11: Cross sections of the lamellar projections of the dorsal ducts, showing the existence of oviform cells (arrow in a) among gonial germ cells in a male (175 mm SL, September) and of germ cells (arrow in b) undergoing abortive spermatogenesis in another male (129 mm SL, July). a, $\times 250$; b, $\times 270$. DD, dorsal duct; SS, sperm sinus.

cociously begun spermatogenesis, having a small number of spermatozoa in the testis.

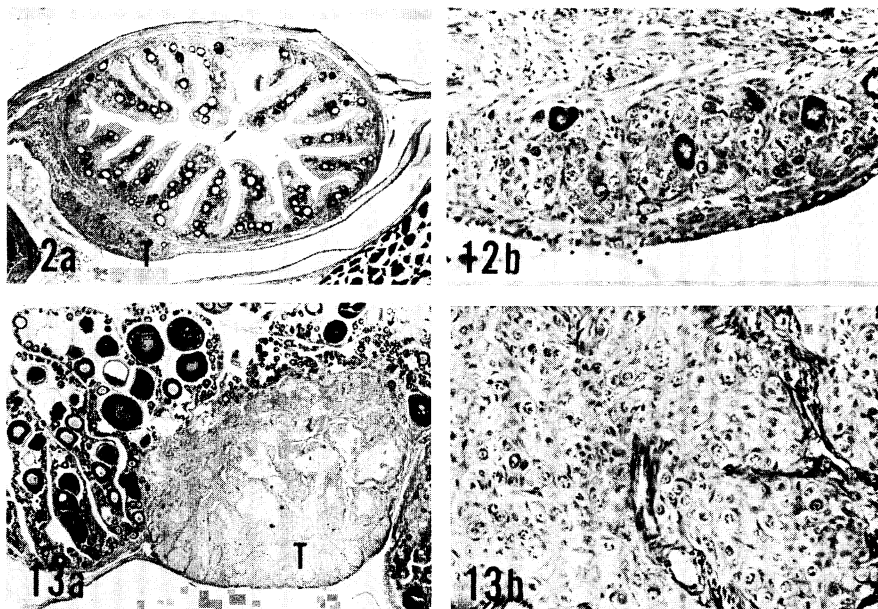
Histologically, the testis has a dorsal zone with a dorsal duct (Fig. 9), as is the case with the testis of *N. bathybius*. However, a histological comparison of the mature testes revealed the following three clear distinctions between these two nemipterid species. First, the topographic separation of the ventral zone from the dorsal zone of the testis is considerably definite in *N. virgatus*. In sharp contrast to *N. bathybius*, the occurrence of sperm sinus in *N. virgatus* is restricted mostly to the region near the border between the two testis zones, rarely extending over the dorsal and lateral sides of the dorsal duct (Fig. 10). In addition, although the width of the dorsal duct varies with the state of testis maturation, it is generally larger in *N. virgatus* than in *N. bathybius*.

Secondly, in *N. virgatus*, the germinal elements in the dorsal zone are never distributed throughout the whole periphery of the zone but are always localized within the lamellar projections extending into the duct lumen. The germinal elements are

various in aspects; in many cases they are clusters of gonial germ cells with occasional oviform cells (Fig. 11a), and in others they are germ cells undergoing aberrant spermatogenesis (Fig. 11b). Therefore, even at a fully matured state, the testis of *N. virgatus* is generally characterized by intralamellar localization of the germ cells in the dorsal zone.

Thirdly, in *N. virgatus*, the epithelial cells in the lamellar projections of the dorsal duct are fringed by dense and regular microvillous extensions of the cytoplasm (Fig. 11a, b), revealing a rather orderly arrangement when compared with those seen in *N. bathybius*.

C. Intersexual gonads. Three specimens (NB-22, 59 and 85) of the 80 *N. bathybius* females and one specimen (NV-10) of the 33 *N. virgatus* females examined were found to have gonads with some intersexual indications. The gonads of specimen NB-59 (83.5 mm SL) were histologically young ovaries with most advanced oocytes at the peripheral nucleolus stage. On the ventromedian surface of each ovary lay a



Figs. 12, 13. Cross sections of intersexual gonads found in *Nemipterus bathybius*. 12: Young ovary (a) with a nodule of testicular tissue (T), and an enlarged view (b) of the testicular tissue with sporadic oviform cells, of a female (83.5 mm SL, July). a, $\times 44$; b, $\times 200$. 13: A part of a maturing ovary (a) with vestigial testicular tissue (T), and an enlarged view (b) of the testicular tissue, of a female (115 mm SL, August). a, $\times 20$; b, $\times 200$.

longitudinal protuberance which was separated from the ovarian portion by a muscular ovarian capsule (Fig. 12a). The protuberance consisted of clusters of germ cells which were predominantly at the gonial stage, being similar in features to the germinal portion of an immature testis. Some of the clustered germ cells occasionally showed meiotic nuclear changes, possibly resulting in the occurrence of oviform germ cells in that region (Fig. 12b). Epithelial cells covering the ovigerous lamellae were cuboidal to columnar in shape, resembling those covering the lamellar projections in the dorsal duct of the testis. However, the protuberance occurred only locally in the middle region of the gonad, and it was considered that the gonads as a whole were young ovaries with a trace of underdeveloped testicular tissue. The gonads of specimens NB-22 (81.1 mm SL) and NV-10 (195 mm SL) also showed a similar but less extensive occurrence of testicular tissue on the ventral side of the ovaries in comparison with that of specimen NB-59.

The remaining specimen (NB-85, 115.8 mm SL) had definite ovaries with vitellogenic oocytes. In the ventromedian part of the ovaries, a region

existed in which large clusters of germ cells were confined in irregular compartments bound by thin connective tissue (Fig. 13a). The germ cells were mostly at the gonial stage, though solitary oviform cells were also encountered occasionally. The histological features of that region had some resemblance to those of underdeveloped testicular tissue, though the arrangement of the germ cells in that region appeared to be rather atypical when compared with that seen in normal testis (Fig. 13b). There was no obvious connective tissue boundary between the ovarian portion and the presumed testicular portion of the gonad.

Discussion

Results of the present study indicate that the duct running longitudinally along the dorsal side of the testis of *Nemipterus bathybius* and *N. virgatus* is a remnant of the duct that was formed in the dorsal region of the testis at an early stage of testicular morphogenesis. This structure is constantly maintained in the testes of all males. Young and Martin (1985) first described the existence of a 'dorsal accessory duct' in the testis

of 'primary males' of five species of the genus *Nemipterus* including *N. bathybius* and *N. virgatus*, but they did not describe the nature of the dorsal duct, only mentioning the occurrence of extensive glandular epithelium lining the duct.

In juvenile males of *N. bathybius*, testes are evidently separated into ventral and dorsal zones by thin connective tissue, and the dorsal zone has a duct surrounded by a large number of germ cells. The dorsal duct is perfectly separate from the sperm sinus-sperm duct system. These morphological characteristics are reminiscent of those of the gonad with a bisexual organization of the delimited type found in functional hermaphrodites of some teleost fishes (Sadovy and Shapiro, 1987). The bisexual gonad consists of a dorsal ovarian zone with an ovarian cavity surrounded by germinal tissue and a ventral testicular zone with compact germinal tissue separated from the dorsal zone by connective tissue (Lissia Frau and Casu, 1968a), and is further characterized by having a completely separated gonoduct system for the ovarian and testicular parts (Reinboth, 1962).

Based on these findings, we assume that the dorsal zone of the testis of *N. bathybius* may correspond in its original nature to the ovarian part of bisexual gonad, and that the dorsal duct and its lamellar projections may be regarded, respectively, as an ovarian cavity-oviduct system and ovigerous lamellae of the ovarian portion residing in the testis from the beginning of its morphogenesis. This appears to be also the case with the testis of *N. virgatus*. A possible female nature of the dorsal zone of the nemipterid testis seems to be reflected in the frequent occurrence of oviform germ cells in that zone, which is more prevalent in *N. virgatus* than in *N. bathybius*. In addition, intersexual gonads found in both species of nemipterids are accompanied by underdeveloped testicular tissue on their ventral side, suggesting that the dorsal zone of the nemipterid testis is substantially ovarian in nature.

Characteristics of hermaphroditism occurring in the two nemipterid species are as follows: (1) no histological signs of development of the dorsal zone of the testis into the ovary can be detected at any stage of sexual maturation in males; (2) most, if not all, of the germ cells in the dorsal zone develop into spermatogenetic phases from the beginning of their development; and (3)

ovaries of the nemipterid females are never accompanied by testicular tissue except for the four cases of intersexual gonads. Young and Martin (1985) have suggested possible protogyny in *N. peronii*. In fact, remnants of an ovarian cavity and oviduct in the testis of adult fishes are often stressed as evidence of protogynous hermaphroditism. However, the hermaphroditism demonstrated by the present study of *N. bathybius* and *N. virgatus* is evidently not functional but rudimentary in nature. According to Atz (1964), rudimentary hermaphroditism is defined as "normal hermaphroditism exhibited by an individual that functions only as a male or only as a female." It is thus concluded that both *N. bathybius* and *N. virgatus* examined in the present study are rudimentary hermaphrodites in which all males have functional testes with rudimentary ovarian portions throughout their life.

Fishes of the closely related family Sparidae are known to include many species with bisexual gonads of the delimited type (Sadovy and Shapiro, 1987). Among them several species have been listed as rudimentary hermaphrodites (Atz, 1964; Reinboth, 1970). It was suggested by Mehl (1973) that *Lithognathus lithognathus* was a rudimentary hermaphrodite in which either one of the two sexes remained non-functional permanently. In *Oblada melanura*, some maturing males were observed to reveal a rudimentary hermaphroditic condition in which ovarian areas in the testicular gonads became shrunk and were eventually deprived of germ cells in extreme cases (Lissia Frau and Casu, 1968b). In this sparid, however, males and females with definite testes and ovaries, respectively, were also detected along with hermaphrodites. It was reported that, in *Diplodus sargus* and *Sarpa salpa*, all mature males had testes having ovarian tissue which remained inactive during the breeding season while no females had testicular tissue in their ovaries (Joubert, 1981). Unfortunately, the lack of histological figures in the latter two papers makes it difficult to precisely compare the rudimentary hermaphroditic conditions between these three sparid species and the two nemipterid species examined in the present study. However, these nemipterid species seem to be secondary gonochorists in an advanced phase of the transitory stage from an ancestral hermaphroditic condition. In this sense they seem to have some resemblance

to fresh water cyprinid fishes such as the zebrafish *Brachydanio rerio* (Takahashi, 1977) and the topmouth gudgeon, *Pseudorasbora parva* (Takahashi and Maeno, 1986), in which adult males have testes with rudimentary ovarian cavities as a consequence of their juvenile intersexuality.

Literature cited

- Atz, J. W. 1964. Intersexuality in fishes. Pages 145–232 in C. N. Armstrong and A. J. Marshall, eds. Intersexuality in vertebrates including man. Academic Press, London.
- Eggleston, D. 1970. Biology of *Nemipterus virgatus* in the northern part of the South China Sea. Pages 417–424 in J. C. Marr, ed. The Kuroshio: a symposium on the Japan Current. East-West Center Press, Univ. Hawaii, Honolulu.
- Eggleston, D. 1972. Pattern of biology in the Nemipteridae. J. Mar. Biol. Assoc. India, 14(1): 357–364.
- Grier, H. J., J. R. Linton, J. F. Leatherland and V. L. de Vlaming. 1980. Structural evidence for two different testicular types in teleost fishes. Amer. J. Anat., 159: 331–345.
- Joubert, C. S. W. 1981. Aspects of the biology of five species of inshore reef fishes on the Natal coast, South Africa. Invest. Rep. Oceanogr. Inst., (51): 1–16.
- Kao, C.-L. and H.-C. Liu. 1974. Maturity and spawning of golden thread, *Nemipterus virgatus* (Houttuyn) in the East and the South China Seas. J. Fish. Soc. Taiwan, 3(2): 85–91. (In Chinese with English summary.)
- Li, K.-M. 1954. An account of the golden thread group fishery in Hong Kong, and a preliminary note on the biology of *Nemipterus virgatus* (Houttuyn). Hong Kong Univ. Fish. J., (1): 1–18.
- Li, K.-M. 1960. On the biology of the Hong Kong golden thread, *Nemipterus virgatus* (Houttuyn). Hong Kong Univ. Fish. J., (3): 89–109.
- Lissia Frau, A. M. and S. Casu. 1968a. Il processo gonadogenetico in alcune specie di Sparidi (Teleostei, Perciformes). Studi Sassaesi, (1): 1–23.
- Lissia Frau, A. M. and S. Casu. 1968b. Il differenziamento sessuale di *Lithognathus mormyrus* (L.) e di *Oblada melanura* (L.). Studi Sassaesi, (2): 1–19.
- Liu, H.-C. and M.-S. Su. 1972. Maturity and spawning of golden thread (*Nemipterus virgatus*) from the northern area of the South China Sea. J. Fish. Soc. Taiwan, 1(1): 39–46. (In Chinese with English summary.)
- Mehl, J. A. P. 1973. Ecology, osmoregulation and reproductive biology of the white steenbras, *Lithognathus lithognathus* (Teleostei: Sparidae). Zool. Afr., 8(2): 157–230.
- Reinboth, R. 1962. Morphologische und funktionelle Zwischengeschlechtlichkeit bei marinen Teleostieren (Serranidae, Sparidae, Centranchidae, Labridae). Zool. Jb. Physiol., 69: 405–480.
- Reinboth, R. 1970. Intersexuality in fishes. Pages 515–543 in G. K. Benson and J. G. Phillips, eds. Hormones and the environment. Cambridge Univ. Press, Cambridge.
- Sadovy, Y. and D. Y. Shapiro. 1987. Criteria for the diagnosis of hermaphroditism in fishes. Copeia, 1987(1): 136–156.
- Takahashi, H. 1977. Juvenile hermaphroditism in the zebrafish, *Brachydanio rerio*. Bull. Fac. Fish. Hokkaido Univ., 28(2): 57–65.
- Takahashi, H. and Y. Maeno. 1986. Occurrence of an accessory cavity in the testis of the topmouth gudgeon, *Pseudorasbora parva*, and its relation to juvenile intersexuality. Japan. J. Ichthyol., 33(2): 180–185.
- Young, P. C. and R. B. Martin. 1985. Sex ratios and hermaphroditism in nemipterid fish from northern Australia. J. Fish Biol., 26: 273–287.
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ソコイトヨリとイトヨリダイの生殖腺の形態：痕跡的雌雄同体性の証拠

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ソコイトヨリ *Nemipterus bathybius* の雄幼魚の生殖腺の背側には薄い結合組織層で分離された部分があり、その中央部を1本の管(背管)が縦走している。成魚の精巢の背側部にはこの背管を囲んで輸精洞が存在する。イトヨリダイ *N. virgatus* の精巢も基本的にはこれと同様の構造と特徴を持つ。両種の精巢の発達過程を組織学的に観察して、この背側部が幼期の両性的生殖腺の卵巢部分で背管はその卵巢腔一輪卵管系に相当すること、背側部の雌的性能が特にイトヨリダイでは成魚期にも認められることがわかった。両種の計4個体に間性型生殖腺が見られたが、一般に卵巢には精巢組織が存在しなかった。これら2種のイトヨリダイ科魚類は精巢にのみ両性的構造を保持する痕跡的雌雄同体種とみなされる。

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