

## Some Observations on the Reproductive Duct of the Japanese Sea Bass, *Lateolabrax japonicus* (Cuvier and Valenciennes).

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**Abstract** The microscopical structure of the reproductive ducts of *L. japonicus* has been studied. Both spermiduct and oviduct of the fish are single, short organs, and are characterized by the folded condition of tunica propria lined with a single epithelial cell layer mainly consisting of cuboidal or squamous cells. No cyclic changes of the epithelium and the tunica propria have been observed except that the vessels in the tunica propria became filled with blood at the spawning time and that the partial stratification of epithelial cell layer was found in the spermiduct of mature male collected in early January. Judging from the histological features, the duct seems to serve mainly as a pathway of gametes from the gonad to the extremity. It was also believed that the spermiduct may play a certain role in a degenerating process of the remaining spermatozoa in the duct. The oviduct is closed in the immature females as well as in the adult females in the months intervened between the spawning seasons, as observed in some other teleosts. The orifice is produced between the anus and the urinary orifice just prior to ovulation.

Although the structures of the gonads of the bony fish have been examined up to date by various investigators, few information is available concerning the reproductive ducts which are closely associated with the gonads. It is widely known that the duct of the bony fish is formed by the elongation of the mesorchium or the mesovarium from the posterior end of the gonad without any contact relation to the mesonephric duct throughout the developmental stage, different from other vertebrates in which the duct is formed as the derivatives from the mesonephric duct (Kendall, 1940). The ducts of the bony fish therefore seem somewhat different morphologically and functionally from those of other vertebrates. In addition many variations are believed to exist even among bony fish. Thus, for the initial step to clarifying the problems concerned the author intended to observe in detail the duct of Japanese sea bass, *La-*

*teolabrax japonicus* along with the process of sexual maturation.

### Materials and methods

The fish used for this study were obtained in Wakasa Bay by set-net and line during 1965 through 1968. For the study of expected seasonal changes in the histological features of reproductive duct, collections were made as regularly as possible throughout the seasons especially during its spawning season. The specimens, measured and weighed, were dissected and the tissues of the organs were picked out. They were fixed in Bouin's fluid and 10 per cent neutral formalin followed by the decalcification with 5 per cent formic acid for a few days; sections, 7–10  $\mu$  in thickness, were then prepared by the usual paraffin method and stained with Mayer's acid haemalum-eosin and Mallory's triple stain.

### Observations

Both spermiduct and oviduct are short and single and they extend ventro-posteriorly from the portion where the bilobed gonads

terminally fused. They exhibit narrow slit-like lumens in cross section (Figs. 1 and 9), and are surrounded by tunica propria, that is, thick connective tissues rich in collagenous fibers, which dye well with anilin blue. In

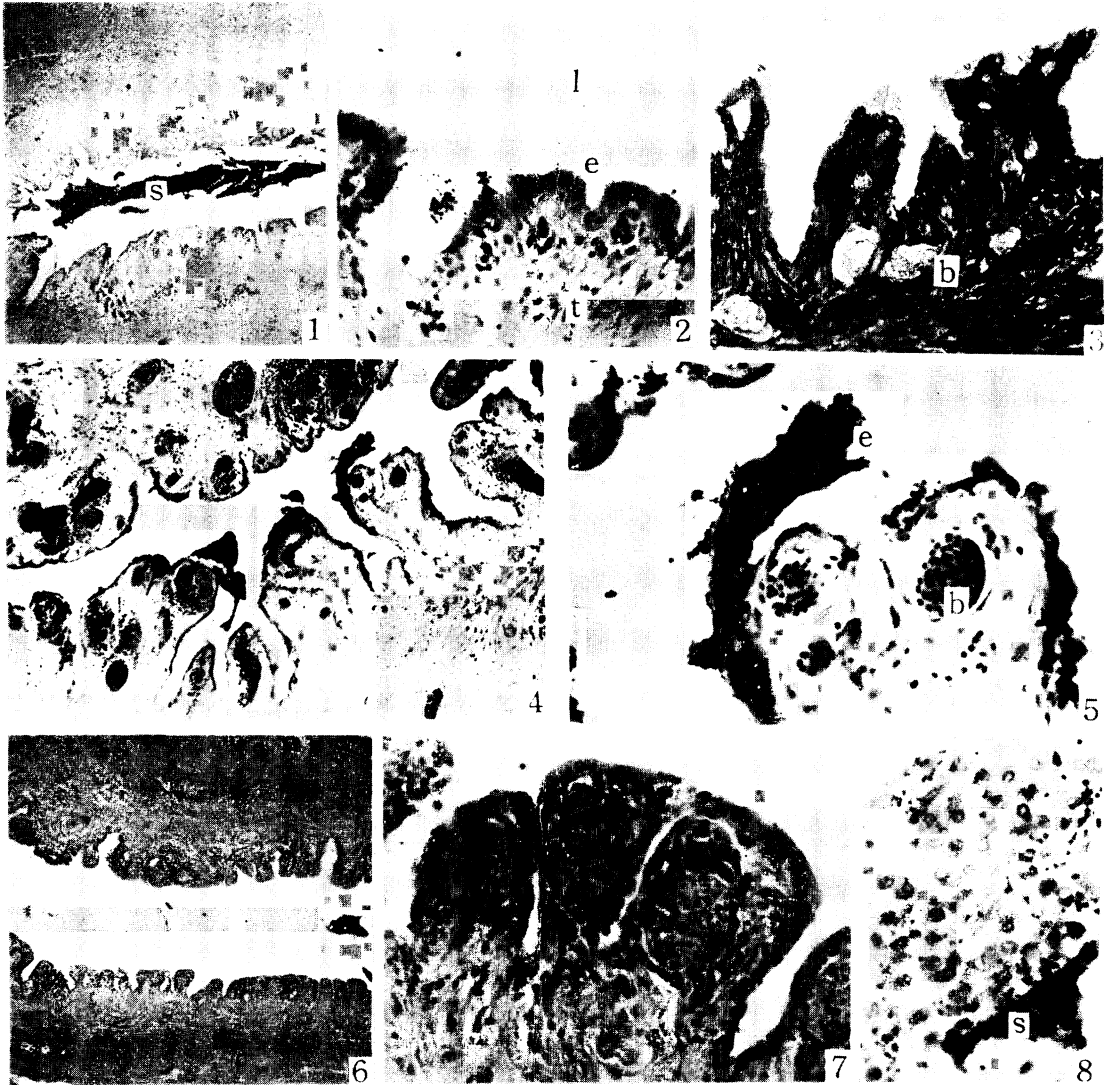


Fig. 1. Histomicrograph of spermiduct of *Lateolabrax japonicus*. 1, Cross section of the organ in a specimen obtained on December 14, 1966 showing mature spermatozoa in the lumen ( $\times 80$ ); 2, Enlarged view of 1 to show epithelial cell lining ( $\times 320$ ); 3, Cross section of the organ in a fish collected on the same date as above, Mallory's triple stain showing blood vessel in tunica propria ( $\times 320$ ); 4, Cross section of the organ of a fish obtained on January 13, 1967 showing markedly folded condition of tunica propria with well developed vessels ( $\times 80$ ); 5, Enlarged view of the above to show partial epithelial stratification ( $\times 320$ ); 6, Cross section of the organ of a fish obtained on April 23, 1965, well folded condition of tunica propria after spawning shown ( $\times 80$ ); 7, Enlarged view of the above to show well developed blood vessels in tunica ( $\times 320$ ); 8, Spermatozoa remained and another type of cells regarded as degenerated spermatozoa seen in the lumen of spermiduct of a fish collected on April 15, 1965 ( $\times 320$ ). Symbols used are: b, blood vessel; e, epithelial cell layer; l, lumen; o, oviduct; r, rectum; s, spermatozoa; t, tunica propria; u, urinary duct.

the tunica propria, blood cells are scattered sporadically (Fig. 1-3). The tunica propria is immediately surrounded by scattered smooth muscle bundles; circular and longitudinal muscle.

The spermiduct, lying between the rectum and the urinary duct, is located closer to the urinary duct. Its inner surface is markedly folded and is lined with a thin epithelial cell layer mainly composed of cuboidal or squamous cells (Fig. 1-2). These epithelia and the folded condition are somewhat different not

only by individuals but also by the parts of the duct in a fish, making it doubtful at present moment whether or not any seasonal change might take place. But, a partial epithelial stratification observed in the fishes ready to spawn in early January might present an evidence of seasonal change in the present species (Fig. 1-5). Furthermore the blood cells become exceedingly prominent in the tunica propria at the spawning time resulting in a fact that such a congestion is discernible macroscopically at the genital

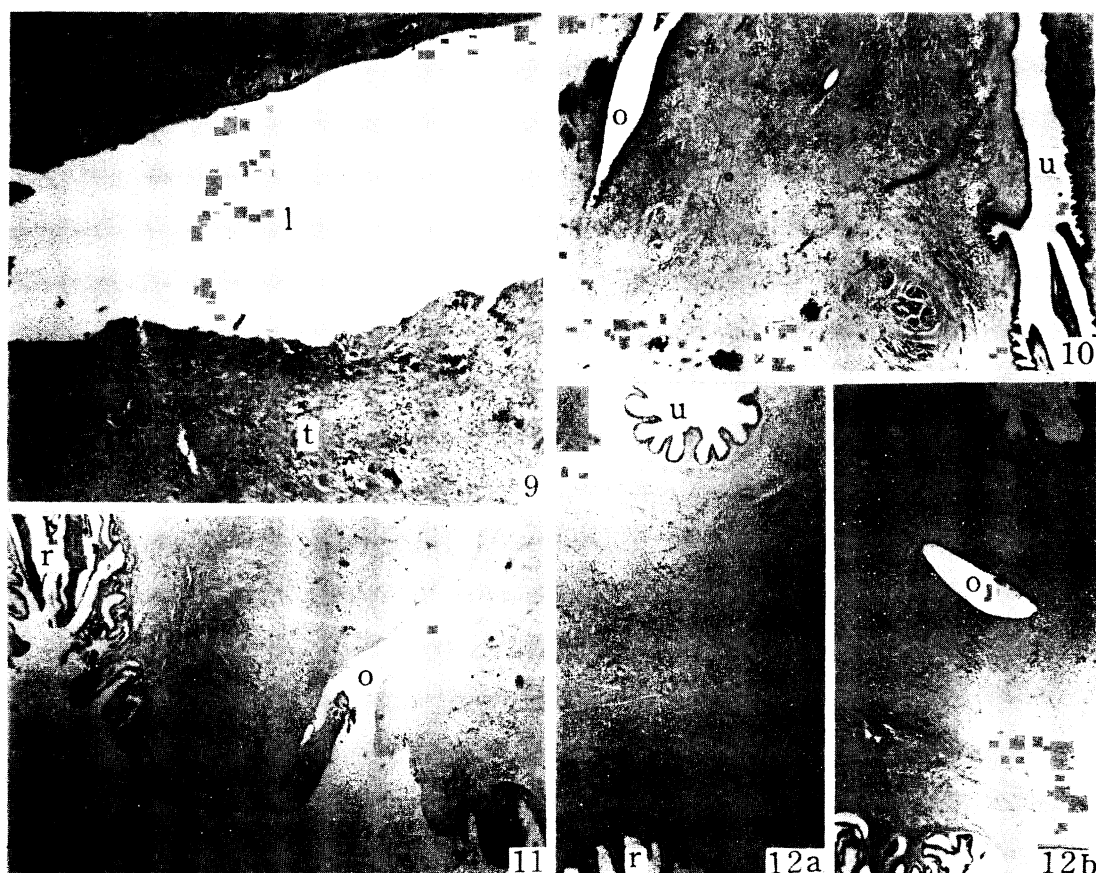


Fig. 2. Histomicrograph of oviduct of *Lateolabrax japonicus*. 9, Cross section of the organ of a fish collected on January 13, 1967 ( $\times 80$ ); 10, Longitudinal section through the ventral midline of a fish obtained on December 8, 1967 showing the oviduct terminated incompletely ( $\times 20$ ); 11, The same section of a fish collected on January 10, 1968 to show the oviduct opened directly to body surface ( $\times 20$ ); 12a, Cross section of anus and its adjacent tissue showing the two ducts, rectum and urinary duct, but oviduct lacked ( $\times 20$ ); 12b, Cross section of the same preparation as 12a, but showing the oviduct located between rectum and urinary duct ( $\times 20$ ). See Fig. 1 for symbols used.

orifice (Figs. 1-4). Neither secretory cell nor ciliated cell is distinguishable in the epithelial cell layer or in the tunica propria throughout the year, which suggest the least possibility of the spermiduct itself secreting mucous substance. Accompanied with the maturation of testis, numerous spermatozoa come in sight in the lumen of the duct, and they increase in number with the advancement of maturation (Fig. 1-1). After the spawning time the folded condition is noted provided with well developed blood vessels in the tunica propria, especially a sample fixed in April showing the feature very clearly (Fig. 1-6 and 7). Many spermatozoa still remain in the duct for an extended period after the spawning time, but their number decrease gradually, and they are replaced by slightly larger cells which show weaker affinity to haematoxylin than the former (Fig. 1-8). In summer these cells are exclusively found in the duct of some specimens. Though there is no clear evidence to explain where these cells have derived from, it appears highly probable that they are remnants of degenerated spermatozoa which are placed in the fate of absorption rather than the exfoliation from the epithelial cell lining. The incidental vanishment of spermatozoa with the appearance of these larger cells will make it plausible to arrive the deduction as such. If that is true, the blood rich condition in the tunica propria extended for a time after the spawning season is believed to play a role in the process.

The oviduct is not so well folded and epitheliated on its inner surface as observed in the spermiduct (Fig. 2-9). Few cyclic changes in this condition are found by seasons with the exception of a fact that the blood cells become more predominant during the time of ovulation. Secretory cells and ciliated cells are also indiscernible in the indistinct epithelial cell lining. Of particular interest is the microscopical structure of the tissue in the anus and surrounding regions observed in the specimen obtained just before spawn-

ing. A series of longitudinally sectioned preparations of the tissue show that the oviduct does not open directly to the body surface but terminates on the way (Fig. 2-10). The same picture was confirmed on other specimen of a female collected during the same period. As shown in Fig. 2-12a and b, the two ducts, rectum and urinary duct, are found to locate near the body surface, whereas the oviduct is visible near the posterior end of ovaries located between the two ducts. On the contrary, the duct in the fully mature specimen, which served successfully in the artificial fertilization, opens as expected to the body surface (Fig. 2-11). The observation as such will show clearly that the oviduct is closed on its way in immature fish and even in adult female when she is not in reproductive activity. The duct probably opens to the surface just before ovulation, and its orifice, developing just before ovulation, is also located between the anal and the urinary orifices (Fig. 2-11). The mechanism to function the opening and closing of the oviduct, not clarified at this moment, will be left to further study.

### Discussion

The reproductive ducts of vertebrates with the exception of bony fish are ordinarily epitheliated with secretory cells in their inner surfaces. Smooth muscle fibers surrounding the tunica propria are also numerous, arranged in the inner layer circularly and in the outer layer longitudinally. These microscopical structures of the duct strongly suggest that various functions are assigned to the duct including the secretion of various mucous substance and the conveyance of the gametes from the gonad to the extremity. A partial specialization of those functions is also guessed from somewhat ubiquitous arrangement of those type of epithelial cells (Kendall, 1940; Ham, 1965; Maximow et al, 1957).

On the contrary, both spermiduct and oviduct of *L. japonicus* are single, short organs which are characterized by the folded con-

dition of tunica propria with a single epithelial cell lining on its surface. Yamamoto (1963) also observed that the oviduct of stickleback, *Pungitius tymensis* shows plenty of folds of tunica propria lined with a distinct epithelial cell layer mainly consisting of columnar cells. According to his observation these cells did not show any morphological changes with the advancement of ovarian maturation. From these facts it may be stated that the duct of the bony fish serves exclusively as a pathway of gametes from the gonad to the extremity but bearing no other possible functions as those supposed to be conducted by the organ in other vertebrates. The author has observed in this study, however, that the spermatozoa remained in the duct for a time after spawning gradually decrease in number, not only that, they are replaced by the cells which are slightly larger and show somewhat weaker affinity to haematoxylin. If these cells are remnants of the degenerated spermatozoa, it is highly probable that the spermiduct has something to do with the degenerating process of the spermatozoa not discharged but remained in the duct.

The author further observed that the oviduct does not open to the exterior in immature females and even adult females during intervening period between spawning seasons. These conditions were actually witnessed by the experience that there were a few cases in which the fish were hardly ovulated by pressing on the abdomen even they were fully mature females. Yamamoto (1963) and Parker (1942) observed similar happening on the stickleback and yellow perch, *Perca flavescens*, respectively. According to Parker (1942) no oviduct is present and there is no connection between the reproductive and urinary systems in the adult female of yellow perch. But with the maturation of ovary the tissue covering the extremity of the urogenital papilla becomes so thin as to be easily ruptured by the pressure from inside, resulting the eggs discharged from the ovary through the orifice. Further he added that the orifice

thus formed would close rapidly after oviposition and would in time disappear. As mentioned above, the opening mechanism of oviduct in *L. japonicus* female was not fully observed in this study. Nevertheless, the present author is inclined to believe that the orifice in the Japanese sea bass is not caused by the rupture of the thinned tissue due to the pressure by the ovulation, but is brought about by the other mechanisms just prior to the oviposition, since he detected a few fully mature females with the orifice on their abdomens and yet carrying overflowing eggs in their ovaries.

Parker (1942) further stated that the plugging mechanism of the spermiduct was also perceptible at the portion where the duct unites with the urinary duct just above the urinary orifice except when the fish is ready for the discharge of the spermatozoa. So far as the present study is concerned, however, such a plugging mechanism of spermiduct was not found by any mean. Though the satisfactory observations in this respect were not accomplished in the study on account of the lack of well-conditioned preparations, the fact that the milts are easily discharged with tender pressure on the abdomen even long before spawning time speaks eloquently of little possibility of the mechanism different from that working in oviduct.

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スズキ *Lateolabrax japonicus* (Cuvier and Valenciennes) の生殖輸管の形態について 林 勇夫

スズキの生殖輸管は生殖腺の後端から延びる短い管で、その断面は裂口状を呈する。管壁は厚い結合組織からなり、その外層を筋肉繊維が取巻き、管の内面は単層の上皮細胞層でおおわれている。上皮細胞層は主として

立方上皮細胞または扁平上皮細胞からなり、分泌細胞や繊毛細胞は認められない。産卵期に管壁に血球の分布が著しくなる点と輸精管の上皮層に部分的な肥厚が認められた点を除けば、とくに顕著な季節変化は観察されなかった。生殖輸管はその形態からみて、他の脊椎動物において考えられているような特別な機能はなく、生殖物質の通路としての役割がそのほとんどであろう。ただ産卵期前後に輸精管内に認められる多量の精子が、産卵期を過ぎた後次第に消失し、代りに比較的大形のヘマトキシリン親和性の弱い細胞が認められるようになるが、これらが精子の崩壊過程にあるものと考えれば、輸精管にある程度の機能を想定することも可能であろう。輸卵管は産卵期以外の時期には体外に開口しておらず、産卵直前になって開くようであるが、この開口機構については本研究では確かめられなかった。

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