



# HOKKAIDO UNIVERSITY

Title	Studies on the sex problem in toads : I. Comparative anatomy of the genital system in Japanese toads (With 27 Textfigures)
Author(s)	HORIÉ, Hidemitsu
Citation	北海道帝國大學理學部紀要, 6(2), 191-209
Issue Date	1938-08
Doc URL	<a href="https://hdl.handle.net/2115/27013">https://hdl.handle.net/2115/27013</a>
Type	departmental bulletin paper
File Information	6(2)_P191-209.pdf



Studies on the sex problem in toads<sup>1)</sup>  
I. Comparative anatomy of the genital system  
in Japanese toads

By

Hidemitsu Horié

Zoological Institute, Faculty of Science,  
Hokkaido Imperial University

(With 27 Textfigures)

Introduction

Recently Witschi ('33), who published a comparative work on the genital systems of various species of toads, divided the gonads into 12 gonomeres on the basis of the urogenital arteries supplying the gonads. According to him, the anterior one-third of the gonad is represented by the Bidder's organ, which consists of cortex only, in the male as well as in the female. Incidental to experimental studies on the sexuality in Japanese toads, the present writer studied the comparative anatomy of the genital systems of *Bufo sachalinensis*, *B. vulgaris* and *B. melanostictus*, which, respectively, represent the boreal, temperate and tropical forms in Japan.

Before proceeding further the writer wishes to acknowledge his deep indebtedness to Prof. Tohru Uchida for his constant guidance, and also to Messrs. M. Hori and G. Okada for their kind help in collecting materials in Saghalien, and to Mr. S. Kawai who kindly sent the materials from Formosa.

Material

Materials of *B. vulgaris*, the species of the temperate region, were secured from dealers of Tokyo and Sendai in the spring and summer of 1936. The toads from Tokyo were supposed to have been collected

---

1) Contribution No. 126 from the Zoological Institute, Faculty of Science, Hokkaido Imperial University.

in Saitama Pref. in March or April, and those from Sendai to have been caught in the vicinity of Sendai in July. Saitama toads and Sendai toads show a little different types in their gonads, although they are designated as the same species *B. vulgaris*<sup>1)</sup>. The boreal form, *B. sachalinensis*, was collected by the writer himself, at several places in Saghalien, when the animals gathered to spawn in the end of May and at the beginning of June, 1936. The tropical specimens of *B. melanostictus* were sent from Formosa by Mr. S. Kawai, who collected them in the neighborhood of Taihoku in September, 1936.

TABLE I

Species	Locality	♀		♂		Month fixed
		Ripe	Unripe	Ripe	Unripe	
<i>B. vulgaris</i>	Saitama	4		5		May
<i>B. vulgaris</i>	Sendai	16	7	16		August
<i>B. sachalinensis</i>	Toyohara	3		17		June
<i>B. sachalinensis</i>	Konuma	7		13		June
<i>B. sachalinensis</i>	Kushunnai	5		7		June
<i>B. melanostictus</i>	Taihoku	8	43	32	13	September

### Normal genital organs

a) *Bufo vulgaris*: In regard to the sex organs, the specimens seem to be somewhat different from the European forms, while in the Japanese toads there are a few differences between Saitama toads and Sendai toads.

*Female*: Fat bodies large and with few branches, or sometimes small and with many small secondary branches; yellow or sometimes reddish yellow in color. Bidder's organs yellowish red or rarely brown, leaf- or disc-shaped and not seldom tongue-shaped (in Saitama toads), in some cases bilobular, and attached to both the first ovarian lobes and the bases of the fat bodies; in young animals very large, and in old

1) In view of the distribution, according to Y. Okada ('31), Saitama toads probably should be identified with *B. vulgaris japonicus*, and Sendai toads with *B. vulgaris formosus*, morphological differences between the two varieties being very difficult for the writer on account of the occurrence of several intermediate forms.

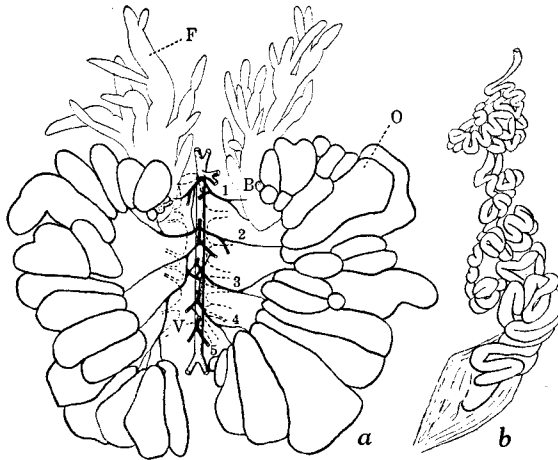


Fig. 1. *a* *Bufo vulgaris* (from Saitama), genital organs of the female. B, Bidder's organ; F, fat body; O, ovary; V, vena cava; 1-5, urogenital arteries. *b* Showing the oviduct of the left side.  $\times 1$ .

ones mostly rudimentary (in a few cases hardly observable) or sometimes containing only a few large, black pigmented eggs. This species has rather large ovaries, each generally composed of 12-15 lobes; in Sendai toads, less lobes in the young and more in the adult; but in Saitama toads, 10-12 lobes even in the adult. Oviducts well developed. The dorsal aorta gives rise to five pairs of urogenital arteries; of which the first artery sends branches to Bidder's organs, the fat bodies, a few anterior ovarian lobes and the kidneys (mesonephros), the second and the third to the middle and posterior

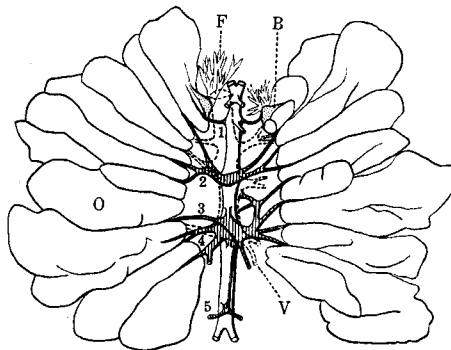


Fig. 2. *Bufo vulgaris* (from Saitama), genital organs of the female. B, Bidder's organ; F, fat body; O, ovary; V, vena cava; 1-5, urogenital arteries (hatched).  $\times 1$ .

parts of the ovaries, the fourth to the kidneys and also usually to the most posterior lobes of the ovaries, and the fifth more or less reduced, only to the kidneys. The fourth artery unites with the third.

*Male*: The fat bodies in the male resemble in appearance those of the female, the number of their branches being more numerous than in the European forms. Bidder's organs, leaf-shaped or irregularly discal mass in shape, brownish red in color, rarely having brown and white egg follicles (in Saitama toads); relatively large in size, and mainly attached to the crests of the testes. Testes sausage-shaped, often 30 mm in length, and frequently with notches apparently divided into 5-7 segments; greyish yellow in color, or pale yellow and partially pigmented black. Efferent ducts showing a complicated network on the mesorchis; therefore it was hard to reckon the testicular segments, even on the basis of the reconstructed figures from sections. Oviducts developed better than in the European forms, especially in Sendai toads, and possessed both the cranial part and the uterus, though

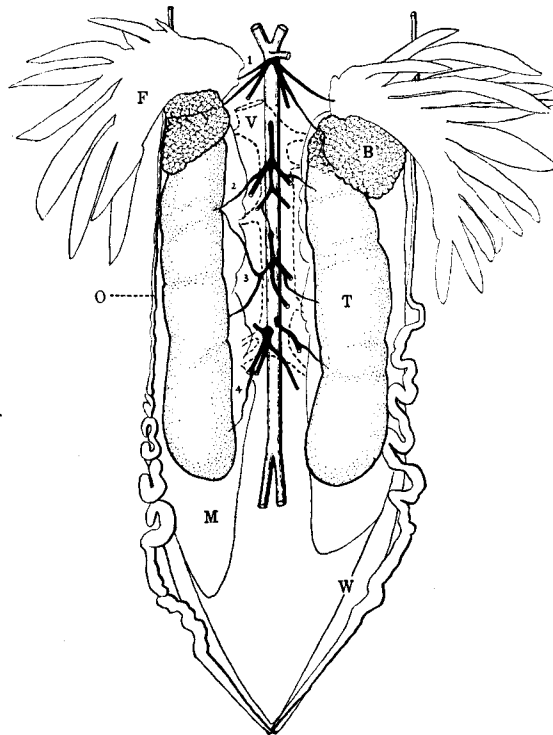


Fig. 3. *Bufo vulgaris* (from Sendai), urogenital organs of the male. B, Bidder's organ; F, fat body; M, kidney; O, oviduct; T, testis; V, vena cava; W, spermioduct; 1-4, urogenital arteries.  $\times 3$ .

strongly reduced. Spermi ducts (Wolffian ducts) normally developed. The first artery supplying the fat bodies, Bidder's organs, the anterior part of the testes and the kidneys; and the left and right branches of the first artery often separately branching off from the dorsal aorta, the second and third sending their branches to the testes and the kidneys, and the fifth to the kidneys only. The first, second and third arteries frequently send their branches to the testes through the kidneys, so it was hardly possible to pursue them.

b) *Bufo sachalinensis*: This boreal toad is small in size (80 mm in maximum body length of the female), and closely resembles *B. vulgaris*, especially specimens from Sendai, as regards the gonads. A few differences were observed among materials from the different localities.

*Female*: Fat bodies relatively small and with many fine branches, reddish yellow in color; and in sections containing meagre fat vacuoles. As in the female of *B. vulgaris*, Bidder's organs seem to exist throughout life; the writer could find no material without Bidder's organs even in old animals, though they were strongly reduced. Bidder's organs pinkish in color, always minute in size, and short tongue-shaped,

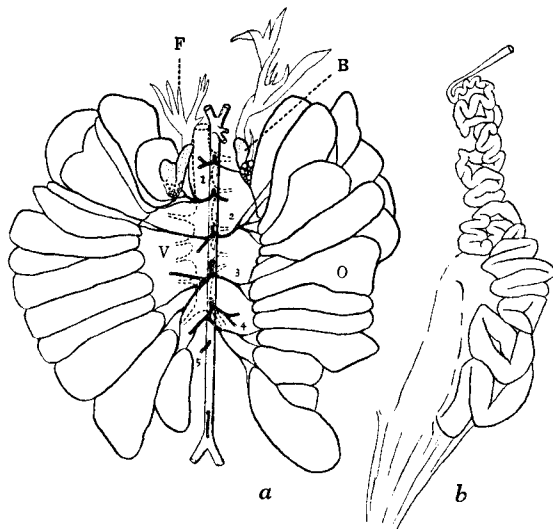


Fig. 4. *a* *Bufo sachalinensis*, genital organs of the female. B, Bidder's organ; F, fat body; O, ovary; V, vena cava; 1-5, urogenital arteries. *b* Showing the oviduct of the left side.  $\times 2$ .

or membranous in form spreading between the first ovarian lobe and the base of the fat body, and in some cases somewhat massive and irregular in shape. In a toad, Bidder's organs were bilobular. Ovaries long and having many lobes, which are variable in number and become small in the anterior and the posterior parts; in Kushunnai toads 11-12 lobes, in Konuma toads 13-14 lobes, and in Toyohara toads 16-17 lobes. Oviducts well developed, especially in the part of the uterus. Of the arteries, the first, second and third are frequently crowded in the anterior position, and in most cases a few branches of the fourth were observed to supply the most posterior part of ovaries. The fifth artery mostly reduced. In general, the vascularization is in the same condition as in *B. vulgaris*.

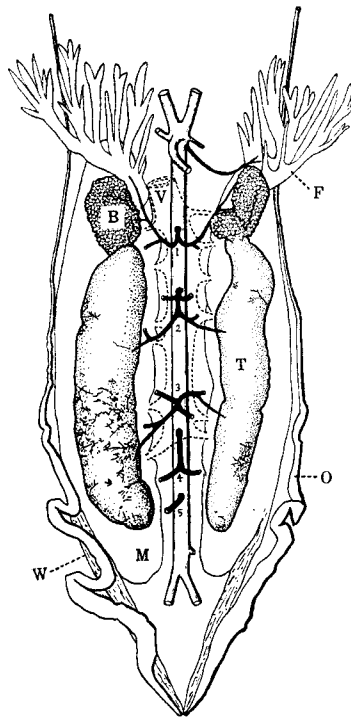


Fig. 5. *Bufo sachalinensis*, urogenital organs of the male. B, Bidder's organ; F, fat body; M, kidney; O, oviduct; T, testis; V, vena cava; W, spermioduct; 1-5, urogenital arteries.  $\times 3$ .

*Male*: Fat bodies similar to those of the female in size, in form and in color. Bidder's organs not so large in size, of a thin oval or irregular mass in shape and brownish red in color, being attached mainly to the bases of the fat bodies, but rarely fused to the testes. Egg follicles smaller than in *B. vulgaris*, but larger than those of the female of *B. sachalinensis* (Fig. 25). Testes relatively small, and slender sausage-shaped, often the right being larger than the left; pale yellow in color, and partially pigmented black. The notches on the surface of the testis showing 5-7 segments. Efferent ducts showing a net-work as in *B. vulgaris*. The mesonephric longitudinal canals barely reach the Bidder's organs and send off no efferent duct into them. Oviducts well developed as in Sendai toads, and more strongly than in Saitama toads. Spermioducts more slender than in *B. vulgaris*. Vascularization as seen in the arteries of *B. vulgaris*; frequently the left fat body is supplied with a small vessel branched off from the dorsal aorta independent-

ly of the first artery. The fifth artery united with the fourth, or rudimentary.

c) *B. melanostictus*: In consequence of having treated only fixed materials, the writer is not able to describe the sex organs of this species in the living state. These toads are rather small in size; the largest female examined by the writer measured 70 mm in body length, the male being smaller than the female. The genital organs of the male are nearly equal to those of *B. sachalinensis* in size.

*Female*: Fat bodies, though different in form by individuals, generally large and sparsely branched in the adult, while in the young smaller and much branched. In young animals Bidder's organs are

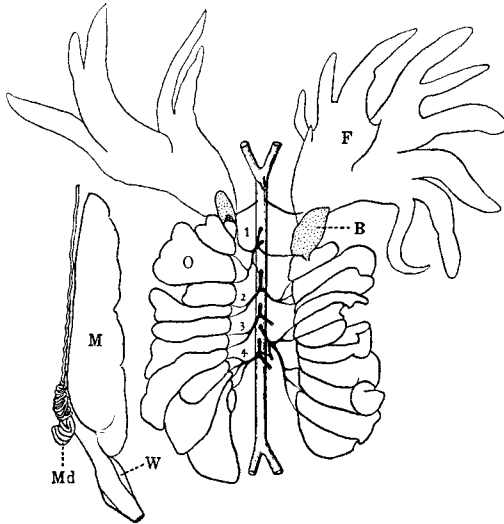


Fig. 6. *Bufo melanostictus*, urogenital organs of the young female. B, Bidder's organ; F, fat body; M, kidney; Md, oviduct; O, ovary; W, Wolffian duct; 1-4, urogenital arteries.  $\times 2.5$ .

relatively large bean-shaped or irregular in shape, attached mainly to the anterior ends of ovaries (rarely isolated from ovaries); but in older ones absent or rudimentary. The organ is frequently composed of two (or three) lobes. Ovaries rather long and composed of 15-16 lobes in the young, and of 17-19 lobes in the adult. Nothing noticeable in the vascularization; the fourth artery usually supplying ovaries, and the fifth almost reduced.

*Male*: Fat bodies similar in features to those of the female, but in the young usually relatively small in size. Specimens with long Bidder's organs always bear short testes. The organs are mostly irregularly massive or of a thin plate-shape. Three specimens having considerably large and weakly pigmented egg follicles within Bidder's organs, and seven specimens with bi- or trilobular (or duplicated) organs.

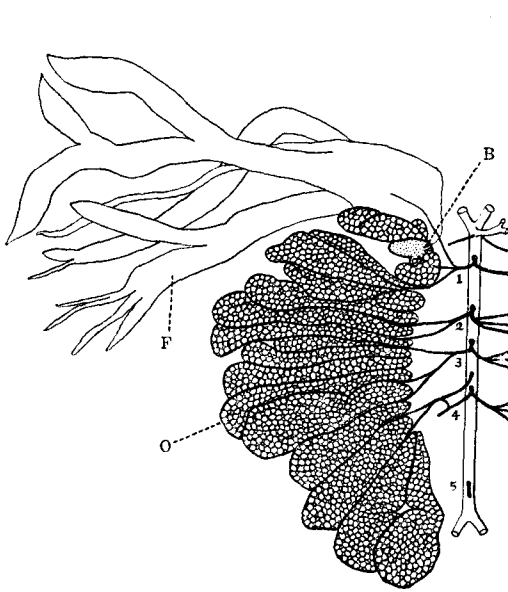


Fig. 7. *Bufo melanostictus*, genital organs of the adult female. B, Bidder's organ; F, fat body; O, ovary; 1-5, urogenital arteries.  $\times 2$ .

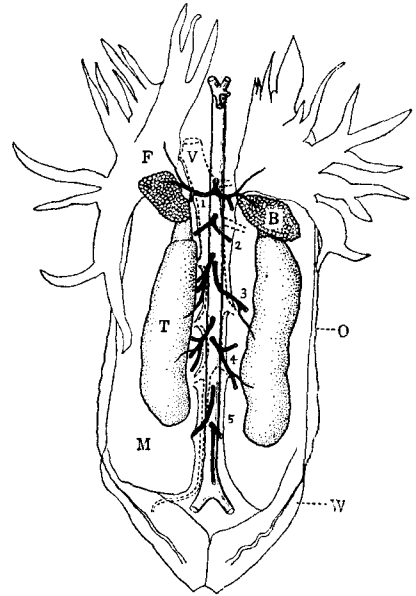


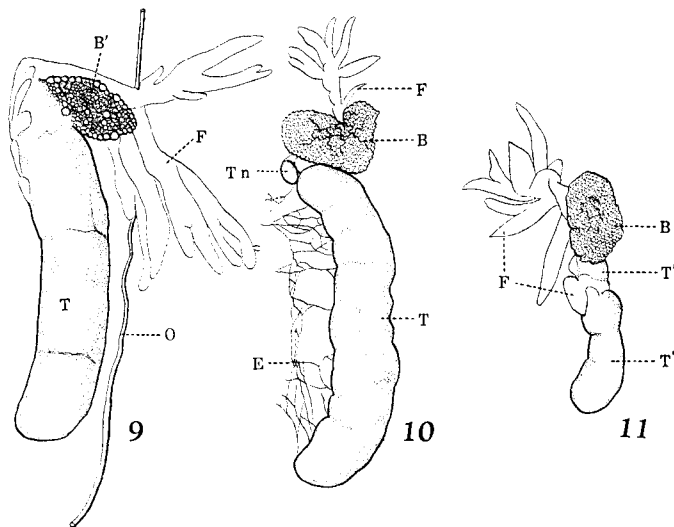
Fig. 8. *Bufo melanostictus*, urogenital organs of the male. B, Bidder's organ; F, fat body; M, kidney; O, ovary; T, testis; V, vena cava; W, spermioduct; 1-5, urogenital arteries.  $\times 3$ .

Testes small and rather short, cylindrical in form; with 5-7 segments in long testes, and with less segments in shorter ones. In five cases, testes were divided into two lobes. Oviducts scarcely developed, rudimentary, and often deficient in the cranial part and the uterus. Efferent ducts forming a network. It must be noted that the upper parts of the ducts sometimes run into Bidder's organs. Spermioducts developed strongly, expanded in the posterior part. The left and the right branches of the first artery are separately branched off from the dorsal aorta; the fifth artery more or less reduced.

## Atypical gonads

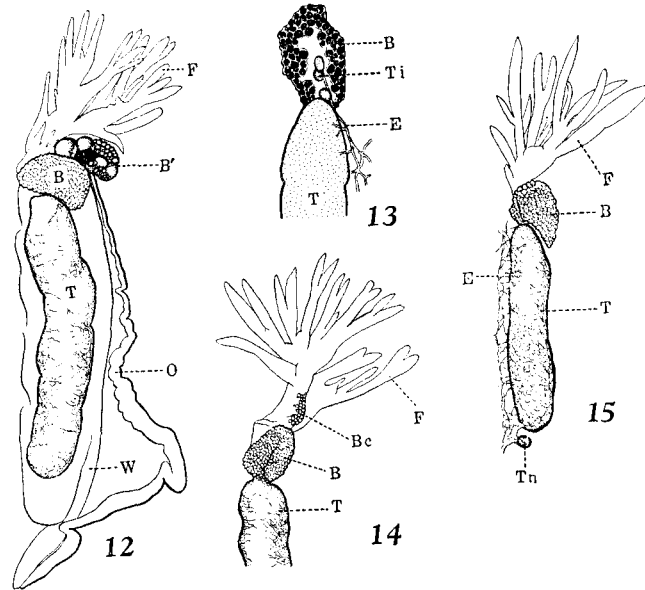
*B. vulgaris*: There has been observed no abnormal genital organ in the female, but three male specimens were found to have atypical gonads.

A Saitama specimen (No. 54) has Bidder's organs containing rather large egg follicles pigmented brown, and oviducts feebly developed (Fig. 9). A Sendai specimen (No. 67) has a testicular nodule on the top of the left testis. The nodule is connected with the testis only by the mesorchis (Fig. 10). In a Sendai specimen (No. 87) the right testis is divided into two lobes, between which lies a small fat body, and has four segments; while the left testis is composed of about six segments (Fig. 11).



Figs. 9, 10, and 11. *Bufo vulgaris*, atypical gonads of males. B, Bidder's organ; B', Bidder's organ with large egg follicles; E, efferent duct; F, fat body; O, oviduct; T, testis; T' and T'', separated testicular lobes; Tn, testicular nodule.  $\times 2$ .

*B. sachalinensis*: Only in male specimens were atypical gonads examined; No. 22 (Toyohara male) furnished with the left Bidder's organ, a part of which contains large eggs weakly pigmented, but the oviduct is normal (Figs. 12 and 16). In No. 34 (Toyohara spec.)



Figs. 12, 13, 14 and 15. *Bufo sachalinensis*, atypical gonads of males. B, Bidder's organ; B', Bidder's organ with large eggs; Bc, Bidder's cells on the fat body; E, efferent duct; F, fat body; O, oviduct; T, testis; Ti, testicular island in the Bidder's organ; Tn, testicular nodule; W, spermi duct.  $\times 3$ .



Fig. 16. *Bufo sachalinensis*, cross section through the left Bidder's organ of the same specimen as in Fig. 12. B, Bidder's organ; E, large eggs in the organ; F, fat body. Photomicrograph.  $\times 15$ .

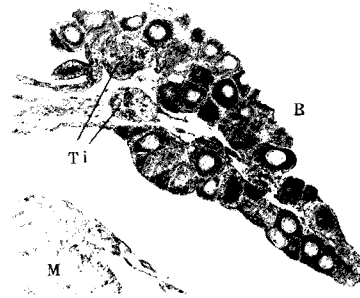


Fig. 17. *Bufo sachalinensis*, cross section through the Bidder's organ of the same specimen in Fig. 13. B, Bidder's organ; M, kidney; Ti, testicular islands in the Bidder's organ. Photomicrograph.  $\times 27$ .

Bidder's organs have a few testicular islands<sup>1)</sup>; on the left two testicular islands, and on the right three (Figs. 13 and 17). Their efferent ducts anastomose with those of the true testes. Three specimens, No. 29, No. 33 (Toyohara) and No. 49 (Kushunnai) have a small mass of Bidder's cells on the left fat body, in addition to the normal Bidder's organ (Fig. 14). No. 8 and 11 (Konuma) bear a small testicular nodule at the posterior end of the testis (Fig. 15).

*B. melanostictus*: Atypical gonads were observed in the male alone. In these specimens Bidder's organs often divided into two lobes; in four of these specimens the first lobe is always larger than the second one. In No. 123 Bidder's organs are duplicated on both sides, and the right testis is also divided into two lobes<sup>2)</sup> (Fig. 19). Testes with

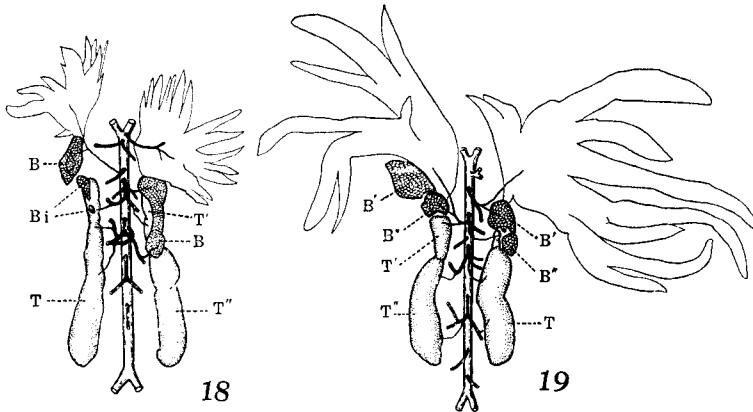


Fig. 18 and 19. *Bufo melanostictus*, atypical gonads of the specimens No. 166 and No. 123. B, Bidder's organ; B' and B'', separated lobes of the Bidder's organ; Bi, Bidder's islands on the testis; T, testis; T' and T'', separated lobes of the testis.  $\times 3$ .

two lobes were observed in four specimens; long stretched Bidder's organs as in No. 124 (Fig. 20) and No. 166 (Fig. 18), cover the anterior lobe of testes separated as a testicular island. Islands of Bidder's cells in testes were found in No. 124 (Fig. 20), No. 136 and No. 166 (Fig. 18). The "Bidder's island" closely resembles the "testis-ovum" in sections (Fig. 21). Specimen No. 124 has a block of large, degenerated

1) Witschi ('33) has made mention of the "testicular island" in *B. viridis*.  
2) Koch ('34) has described a similar case in the same species of Java.

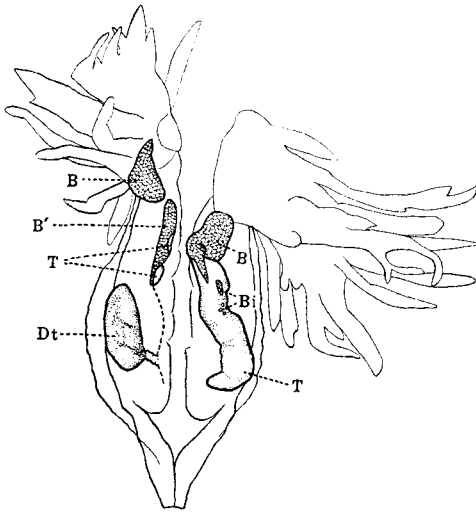


Fig. 20. *Bufo melanostictus*, atypical gonad of the specimen No. 124. B, Bidder's organ; B', secondary Bidder's organ; Dt, degenerated testicular block; T, testis.  $\times 3$ .

testis in the posterior position of the right gonad; and this block of the testis hangs on the free margin of the mesorchis only by a pedunculated tissue. This testicular block is black and brown in color,



Fig. 21. *Bufo melanostictus*, cross section through the Bidder's island in the left testis of the same specimen in Fig. 20.  $\times 60$ .

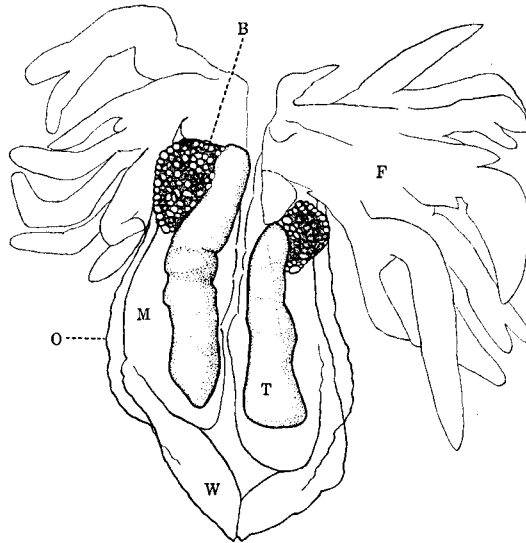


Fig. 22. *Bufo melanostictus*, No. 107 with large egg follicles in the both Bidder's organs. B, Bidder's organ; F, fat body; M, kidney; O, oviduct; T, testis; W, spermioduct.  $\times 3$ .

and the tissue observed in sections considerably degenerated. Bidder's organs with large egg follicles were found in five specimens, of which No. 107 (Fig. 22) has large egg follicles which contain more or less yolk and are 5-10 times as large as those of the normal Bidder's organ. The oviducts of these animals are not at all developed.

#### General observations and comparisons with former works

That the Bidder's organs, the ovaries and the testes are changeable in their activities by seasons, has been well known to many authors, Takahashi ('19), Harms ('26), Eggert ('26) etc; above all, Harms has shown the seasonal cycles of them with curves<sup>1)</sup>. Accompanied with these facts, it is obvious that the fat bodies and the oviducts also seasonally indicate morphological changes. In materials here treated fat bodies were variable regardless to the size of gonads, even in materials of the same season. Saitama toads (*B. vulgaris*) were fixed in May, Sendai toads (*B. vulgaris*) in August, *B. sachalinensis* in June, and *B. melanostictus* in September; that is, according to the curves of Harms, Saitama toads had the low activity in both Bidder's organ and the gonads, Sendai toads low in Bidder's organs and rather high in the gonads. In *B. sachalinensis* the breeding time occurs generally in May, therefore applying the curves, the toad has the low power in the gonads and high in Bidder's organs, in June. In *B. melanostictus* the breeding time is probably in February, so the activity is low in Bidder's organs and high in the gonads, in September.

*Bidder's organ*: The female of *B. vulgaris* is known to possess Bidder's organs throughout its life. In the writer's materials also all specimens had Bidder's organs; but some old females bore strongly reduced Bidder's organs. However, on the contrary, Bidder's organs larger than those of the young, could often be observed even among old females in the same season and locality. In the adult female Bidder's organs are more or less transformed into ovarian lobes. The female of *B. sachalinensis* was observed always to have Bidder's organs as in *B. vulgaris*. Bidder's organs were sometimes not found (Fig. 23), in old female specimens of *B. melanostictus*. In opposition to the report of Koch ('34), however, Bidder's organs are often found in the female even after the maturation, even though they may have modified largely

---

1) Curves of Eggert ('26) are somewhat different from those of Harms.

(Fig. 7). In young or immature females of *B. melanostictus* Bidder's organ was more or less in transformation; 28 cases in 43 young individuals transformed in the posterior part of Bidder's organ, 10 in the anterior part, and 3 in both parts. In sections, Bidder's cells and young egg cells lie adjoining each other (Fig. 24). So far as observed in the three species Bidder's organ of the female is more compact than that of the male, and its egg follicles are smaller than in the male.

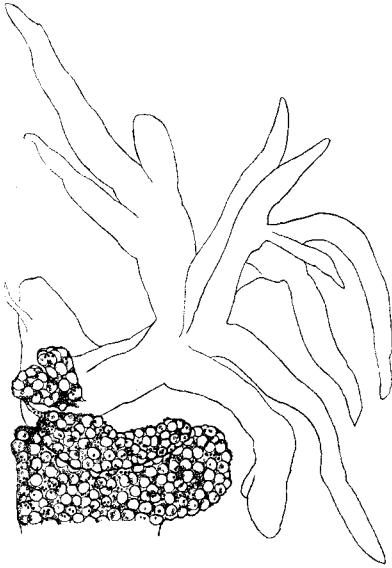


Fig. 23. *Bufo melanostictus*, an adult female, showing the Bidder's organ completely transformed into two ovarian lobes.  $\times 2$ .

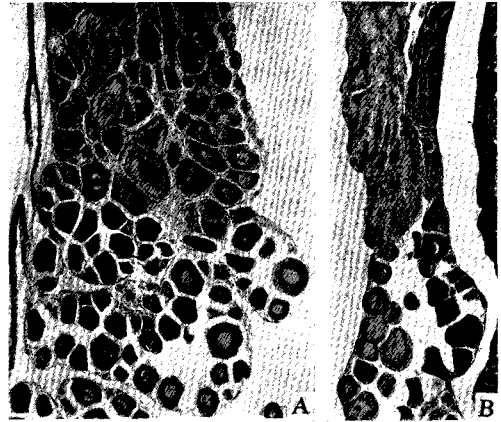


Fig. 24. *Bufo melanostictus*, young females, longitudinal sections through the Bidder's organs. The posterior parts of the organs have been transformed into the ovarian lobes. The cavity of the organ continues to the ovarian cavity (B). Photomicrographs.  $\times 24$ .

Bidder's organ of the male and egg follicles are the largest in *B. vulgaris* (Figs. 25A and 27). As to the position, to which Bidder's organ attaches, Takahashi ('19) and Witschi ('33) pointed out for *B. vulgaris* that Bidder's organ is isolated from the testis, while Takashima ('32) using the same species stated that the organ is always fused to the testis. So far as the writer's observations go, the organ mostly attaches to the crest of the testis rather than to the fat body, and in a Sendai toad especially the organ extends over the anterior half of the testis. Bidder's organ of the male of *B. melanostictus*,

though smaller, resembles in appearance that of *B. vulgaris*, besides, the organ of the former has the tendency of isolation from the testis comparing with the latter (Fig. 27). The male Bidder's organ of *B. melanostictus* is similar in size to that of *B. sachalinensis* (Fig. 27), but seems to be more closely connected with the testis than in *B. sachalinensis*. The organ is often as long as the testis. Koch ('34) reported that in the adult males of *B. melanostictus* (from Ceylon)

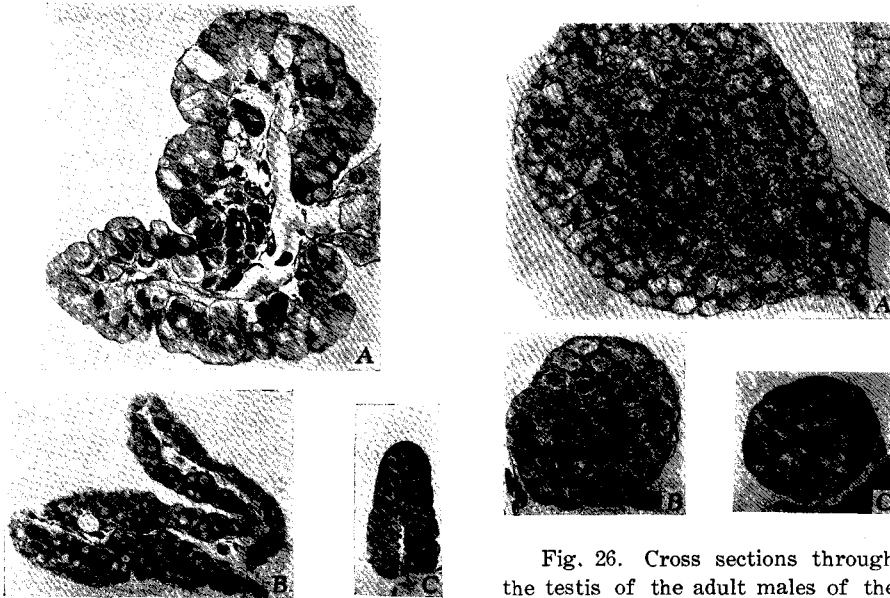


Fig. 25. Cross sections through the Bidder's organ of the adult males of the three species. A, *Bufo vulgaris*; B, *Bufo sachalinensis*; C, *Bufo melanostictus*. Photomicrographs.  $\times 15$ .



Fig. 26. Cross sections through the testis of the adult males of the three species. A, *Bufo vulgaris*; B, *Bufo sachalinensis*; C, *Bufo melanostictus*. Note the similar width of the seminiferous tubules in the three species. Photomicrographs.  $\times 13$ .

Bidder's organ is absent, but Formosan males were always provided with the organ. It is noticeable that efferent ducts were sometimes found in Bidder's organ of *B. melanostictus*. *B. vulgaris* with the largest egg follicles has the widest cavity in Bidder's organ (Fig. 25A). Egg follicles in *B. sachalinensis* and *B. melanostictus* are small in size. In the organs of these two species young Bidder's cells were found in many masses on the periphery (Fig. 25 B and C). The organ is more compact in *B. melanostictus* than in *B. sachalinensis*.

*Gonads*: The three species referred to in this paper are different from European toads, at least in the possession of ovarian lobes of an exceeding number. Of *B. vulgaris* Witschi ('33) stated that the female has 7-8 ovarian lobes. In Japanese materials, however, the species has 10-15 ovarian lobes; the number being variable according to age and locality, less in the young of Sendai toads and in Saitama toads, and more in the adult of Sendai toads. The ovary contains many black and large eggs in the adult of the Sendai toads, small and white eggs in Saitama toads. Ovarian lobes of *B. sachalinensis* are variable in number as follows; in Kushunnai toads 11-12 lobes, in Konuma toads 13-14, and in Toyohara toads 16-17. All the females have rather small weakly pigmented eggs in the ovaries. In *B. melanostictus* there are 15-16 ovarian lobes in the young, and 17-19 lobes in the adult; the ovary has large and black eggs in the adult. In the point that the ovarian lobes are exceedingly numerous, the three Japanese species resembles *B. fowleri*,<sup>1)</sup> but *B. vulgaris* and *B. sachalinensis* are quite different from *B. fowleri* by possession of the Bidder's organ.

*B. vulgaris* has the testis of the largest size, i.e., 30 mm in length in an adult male of 130 mm body length; *B. sachalinensis* has a testis of median size; and *B. melanostictus* has that of the smallest size (Fig. 27). Throughout the three species, the testis is composed of about six segments, but *B. melanostictus* seems to show a tendency of shortening in the testis.

*Gonotomes and vascularization*: Witschi ('33) divided the gonad of toads into a progonad and 12 gonomeres.

In the case of the male the writer's observations agree with those of Witschi, but in the female, if one ovarian lobe is reckoned as one segment, the existence of 10-17 or more segments in the ovary of all the Japanese toads must be admitted; and then summing up the segments of Bidder's organ and the fat body, 19 or more segments are found in the female gonad. Moreover, the youngest specimen of *B. melanostictus* possessed 15 or more ovarian segments, and further Bidder's organ covers at most only three ovarian lobes (Figs. 7 and 23), then the female organs of *B. melanostictus* must have certainly 18 or more gonomeres at least. And the fact, that the branches of the fourth

1) According to Witschi ('33), *B. fowleri* (from Woods Hole) possesses long ovaries with about 16 lobes.

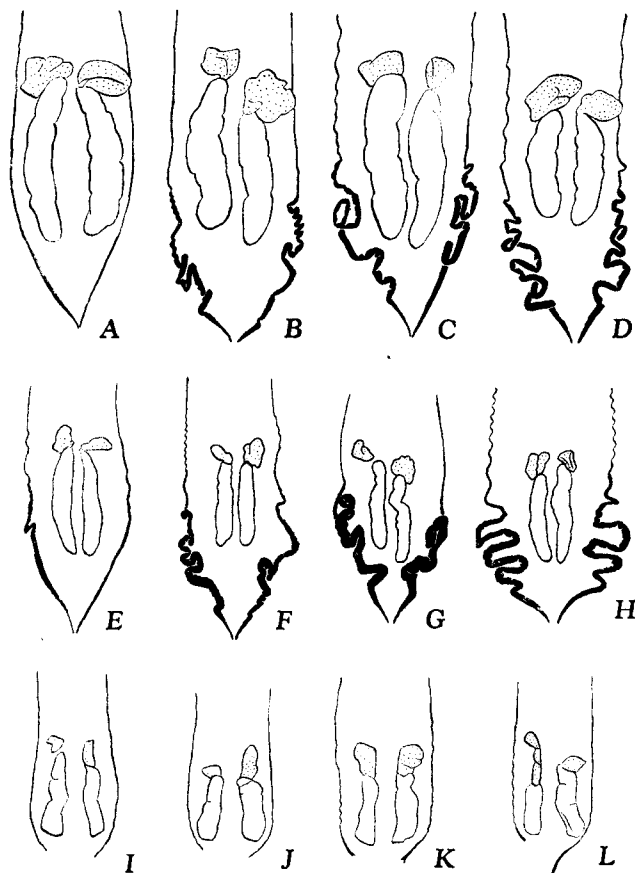


Fig. 27. Several types of the male gonads in the three species, showing Bidder's organ, testis and oviduct.  $\times 1$ .

A-D, *Bufo vulgaris*: A, Saitama race; B, C and D, Sendai race.

E-H, *Bufo sachalinensis*: E, F and G, Toyohara and Konuma race; G and H, Kushunnai race.

I-L, *Bufo melanostictus*, Taihoku race.

artery always supply the ovaries, probably proves that the writer's materials possess more gonomeres than Witschi counted.

*Oviducts in the male*: Witschi ('33) reported the relationships between Bidder's organs and oviducts, i.e., toads with large Bidder's organs possess well developed oviducts (relationship I), and also the species, of which the male has Bidder's organs of the more ovarian

character, possesses the more developed oviducts (relationship II). In the writer's materials, *B. vulgaris* has developed oviducts better than European forms<sup>1)</sup>; there is a difference in the degree of the development of oviducts between Saitama toads and Sendai toads (Fig. 27 A-D); *B. sachalinensis* has well developed oviducts as in Sendai toads, though different in degree in the development among toads from different localities (Fig. 27 E-H); and *B. melanostictus* has the least developed oviducts, which are mostly reduced in the cranial part and the uterus (Fig. 27 I-L).

The first relationship is hardly found in the Japanese materials, specimens with large Bidder's organs often possess poorly developed oviducts, and even those with small Bidder's organs frequently have well developed oviducts. That Saitama toads in May, which must have active Bidder's organs<sup>2)</sup>, possessed poor oviducts, and that Sendai toads in August, which must have inactive Bidder's organs, possessed more developed oviducts, seem not to coincide with Witschi. In *B. sachalinensis*, there is a similar case.

The second relationship is observable in Japanese specimen; i.e., *B. vulgaris* and *B. sachalinensis* with Bidder's organs of the more ovarian character, have the more developed oviducts, and *B. melanostictus* with the more compact Bidder's organs has the less developed oviducts.

### Summary

The comparative anatomy of genital organs of *B. vulgaris* (temperate form), *B. sachalinensis* (boreal form) and *B. melanostictus* (tropical form) was studied.

i) *B. vulgaris* having rather large Bidder's organs throughout its life in both sexes. Ovaries, composed of 10-15 ovarian lobes; testes, large and composed of about 6 segments. Oviducts in the male well developed. Atypical gonads, rare.

ii) *B. sachalinensis* having small Bidder's organs throughout the life in both sexes. Ovaries, with 11-17 ovarian lobes; testes, small, with 5-7 segments. Oviducts in the male well developed. In one case, the testicular islands within Bidder's organs. Atypical gonads, rare.

1) According to Eggert ('26), *B. vulgaris* from Koenigsberg possesses the well developed oviducts.

2) The curves of Eggert ('26) show the lowest activity of Bidder's organ in May, and high activity in August.

iii) *B. melanostictus* having small, but sometimes long Bidder's organs in the male, but no Bidder's organ in the adult female. Ovaries, with 15-19 ovarian lobes; testes, small, with 6 or less segments. Oviducts in the male strongly reduced. Spermi ducts well developed. Efferent ducts sometimes running into Bidder's organs. Atypical gonads occurring frequently, such as, bilobular testes and Bidder's islands in the testis.

iv) Having ovarian lobes in exceedingly large numbers, the female gonads of the three species can not be submitted to Witschi's gnotome theory.

v) *B. vulgaris* and *B. sachalinensis* with Bidder's organs of strongly ovarian character, possess developed oviducts in the male.

### Literature

- EGGERT, B. 1926. Die Geschlechtsmerkmale im Lebenszyklus der maennlichen und weiblichen Kroeten (*Bufo vulgaris*). I. Biddersches Organ, Keimdruesen und Muellerscher Gang. Zeitschr. f. Anat. u. Entwgesch., Bd. 79.
- HARMS, J. W. 1926. Koerper und Keimzellen. I.
- KOCH, M. 1934. Ueber das Urogenitalsystem der Bufoniden, im Eesonderen ueber die Histologie des Eidderschen Organs. Jenaische Zeitschr., Bd. 68.
- OKADA, Y. 1931. The tailless batrachians of the Japanese Empire.
- STOHLER, R. 1931. Das Vorkommen des potentiellen Ovars bei den Bufoniden. Verhandl. d. Natforsch. Gesellsch. in Basel, Bd. 42.
- TAKAHASHI, N. 1919. Biologische, histologische und anatomische Studien der Keimdruese und des Bidderschen Organs bei *Bufo japonicus*. Mitt. d. med. Gesellsch. zu Tokyo, Bd. 22.
- TAKASHIMA, R. 1932. Untersuchungen ueber das Biddersche Organ. I. Ueber das Biddersche Organ bei den japanischen Kroeten (*Bufo formosus*). Folia Anatomica Japonica, Bd. 10.
- WITSCHI, E. 1933. Studies in sex differentiation and sex determination in amphibians. VI. The nature of Bidder's organ in the toad. Am. J. Anat., vol. 52, no. 3.