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Title	NOTES ON THE BREEDING HABITS OF TAKYDROMUS TACHYDROMOIDES SCHLEGEL
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Citation	北海道帝國大學理學部紀要, 1(1), 33-43
Issue Date	1930-09
Doc URL	https://hdl.handle.net/2115/26933
Type	departmental bulletin paper
File Information	1(1)_P33-43.pdf



NOTES ON THE BREEDING HABITS OF
TAKYDROMUS TACHYDROMOIDES
SCHLEGEL¹⁾

BY
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With 1 Plate

The fauna of Japan is possibly divided into three divisions according to the geographical distribution of reptiles. The most northern division which contains Sakhalin and adjacent islands has many continental aspects, having *Lacerta vivipara* Jacq. and *Coluber berus* L. which extend from Kamchatka in the East to western Europe. In the second division which ranges from Hokkaido in the north to Kiushu in the south, the main island and Shikoku inclusive, a characteristic fauna of reptiles as well as of amphibians is developed. In the meantime the lizards, *Takydromus tachydromoides* Schlegel and *Eumeces latiscutatus* Hallowell together with several kinds of snakes of the genera *Elaphe* and *Natrix* are very common in this middle part of Japan. The third division which makes up the most southern region, including Riuku islets and Formosa, is much influenced by the subtropical fauna, the lizard of the genus *Jalapura* and many kinds of tropical snakes commonly inhabiting this division.

Looking through the fauna just referred to we see that a sharp line of demarkation should be drawn between the first and the second divisions with respect to the distribution of reptiles, namely the Soja Strait between Sakhalin and Hokkaido. However, there is a close relationship between the second and the third divisions. *Gekko*, for example, extends from Formosa to the main island and some other species either of *Takydromus* or of *Eumeces* are also found in the third

1) Contribution No. 5 from the Zoological Institute, Faculty of Science, Hokkaido Imperial University.

region. Accordingly it is clear that the common lizards in the second division belong rather to the southern type, whereas *Lacerta vivipara* of Sakhalin is a distinct northern representative.

As has been often reported before, *Lacerta vivipara* is viviparous in its breeding habits and in Sakhalin it bears from 1 to 8 young (Inukai 1927). The habits have been probably attained by this animal as a result of adaptation to the climate, protecting the young against the cold.

There is no satisfactory observation on the breeding habits of *Eumeces* species except the fact that the writer has once observed in Hokkaido a female digging the ground and covering the eggs with soil.

Now *Takydromus tachydromoides* deposits the eggs as *Eumeces*. However, as Tatsuta (1920) and the writer (1927) have already noted, the embryo in the egg at the time of spawning has developed as far as the stage with about 20 mesodermic somites on both sides of the medullary canal and with a small developed allantois. *Takydromus* is, therefore, in this respect half-viviparous. This is quite remarkable in connection with the fact that this kind of lizard is a northern inhabitant of southern relatives. It now becomes even more interesting to observe the breeding habits of *Takydromus* which have not been sufficiently studied.*

Formerly the writer (1927) described briefly the breeding habits in connection with embryological study of this lizard. Later Minobe (1927) touched on the problem in studying the food habits of this lizard.

Having since 1924 continual observation in respect to the general breeding habits of *Takydromus tachydromoides* either in nature or in captivity, I have been able to finish the study satisfactorily.

The materials for the present observation consisted of more than six thousand individual lizards in all. These animals were obtained

*The observations on the breeding habits of European lizards were partially done by some authors (Glückselig, v. Collin de Planey, Mortensen, Peracca. etc.) as Meisenheimer (1921) cited.

each year and raised for the purpose of embryological study principally. Most of them were from Matsumoto in the central plateau region of the main island and about one fourth of them came from Saitama Prefecture near Tokyo. In addition to these a good many specimens were collected in Hokkaido, namely in the Komagatake mountains and in the suburbs of the city of Sapporo.

The materials from Hokkaido always show an extraordinary large size, measuring more than 20 cm from the snout to the tip of the tail in the adult. Generally the female is a little smaller than the male, especially in the length of the tail. It is, however, worthy to notice that the tail of the female is more easily broken off than that of the male. This occurs particularly often in the female during the gestation period of the breeding season.

There is no difference in coloration between the sexes. Though Minobe (1927) observed that the female is tinted yellow beneath, especially becoming darker during the breeding season, whereas the male is not, I have found that the male also shows the yellowish abdomen during the sexual season. On the other hand, some females are found with a whitish ventral surface among the matured individuals. The only external difference is in the appearance of the swollen part at the base of the tail in the male as Stejneger described (1907) (Fig. 1). The swelling is caused by the development of the copulatory organs which are easily pulled out by pressing on this part and visible even in the unmatured male which is only 9 cm in body length (Fig. 2).

As soon as the animal comes from hibernation the sexual season commences, the exact time varying from year to year according to the meteorological conditions. In general the season begins at the end of April and lasts until the middle of August. The lizard is diurnal in its habits and quite sensitive to cold. Consequently it remains inactive on rainy, cloudy or windy days hiding itself out of sight. It happens very often that in the cold weather even after the hibernation, the lizards come together, the young and the adults, under some shelter, making a community which is sometimes composed of a few individuals, sometimes more than ten and oftentimes hundreds of them (Fig. 4). It

seems most probable that *Takydromus* as in the case of some snakes hibernates in a large association. In fact the collector in Saitama Prefecture found in 1925 more than five hundred *Takydromus* collected together in a great mass under a fallen tree and spending the winter. In the sunny and warm days they come out and crawl about. At this time the pairing takes place. In opposition to the amphibians which take no food during the sexual season, this kind of lizard feeds during the season as normal. Soon after the hibernation, the casting off the old epidermis in pieces (Fig. 6) or ecdysis takes place.

Naturally the mating occurs in the daytime, mostly during the morning hours of warm days. At the beginning of the action the male holds fast to any part of the female with its jaw. After some struggling and twisting about of the bodies with each other, the male ultimately catches hold of the waist of the female. Then by twisting and bending the tail innerwards the male genital organ hidden in the tail comes outside very easily. The pressure of the male on the waist line of the female causes the somewhat swollen aperture of the female to open. Thus the mating is brought about (Fig. 5).

The mating usually lasts for about 15 minutes but sometimes it lasts a whole day. As a result of the biting of the male during the action, the female which has been mated has in the abdominal part of the body the distinct prints of the jaw which often serve as the sexindicator of the animal at the breeding season (Fig. 3). Sometimes the mating occurs several times throughout the season so far as the female is concerned. The spawning of the eggs takes place in the daytime, especially during the morning of warm days. The eggs are laid on the ground under some shelter. It is seen that the animal at the time of spawning always selects a moist place to lay eggs, thus protecting them from drying up, though the animal seems to prefer living in a dry situation rather than a moist location. However, *Takydromus* neither digs the ground for the egg-deposition nor covers the eggs with soil or anything after spawning. It takes no further care of the eggs after deposition.

I have carried out a series of experiments on the breeding habits in order to ascertain the above facts. In the first experiment, the cage of *Takydromus* which had a wooden floor was separated into two parts, one half of which had the floor covered with well dried hay and the other half spread with soft moist soil of about 2 inches thickness. Then 30 pregnant females were put in there and observed. No females spawned the eggs in the part with moist soil but they deposited on the dry floor under the hay-cover, even though the eggs shrank from drying soon after the spawning. In the second experiment one half of the bottom of the cage was covered with sand and stone on which the hay was placed and the another half was covered with moist soil as the first. In this case the females preferred also the dry stony part under the hay for the spawning. Next a bundle of green grass or a mass of wet moss was thrown into both portions of the cage. In this case the animals deposited the eggs by choice either within it or on the floor under it. In nature the eggs of *Takydromus* are found under stones, the fallen plants, among the grass or on the ground in shaded places. It is true that the mating is repeated to some extent during the breeding season as mentioned above but the spawning of the eggs takes place just once throughout the season.

The number of eggs is quite variable, occurring from 1 to 9 in number in one individual. However, there is no close relation between the number of eggs and the body size of the animal since they vary independently. The eggs are soft at the time of deposition and become hardened by evaporation as time passes. They are ellipsoidal in shape measuring from 5 to 7 mm across the short axis and from 8 to 11 mm across the long axis.

The female deposits all the eggs contained in the uterus at one laying, unless the animal is seriously disturbed in some way. This is shown to be true since we always find in the ovary after egg laying as many corpus luteum as the number of eggs laid.

The number of eggs of 320 matured females were examined and the results tabulated (Table 1). The observation was made by dissecting the animal and by counting the eggs in the uterus. All the individuals

are divided into 18 classes according to the number of eggs contained in both sides of the uterus. There are, on the other hand, three distinct types among the classes which are expressed by A, B and C in the table, where A shows the type with an equal number of eggs in both sides, B the type in which more eggs are found in the right side than in the left, and C in which the reverse condition to B is shown.

TABLE I.

Number of class	Number of eggs			Number of individuals	Type of class	
	right	left	total			
1	1	0	1	1	1 (total)	B
2	1	1	2	1	1	A
3	1	2	3	1	24	C
4	2	1	3	23		B
5	2	2	4	103	112	A
6	3	1	4	8		B
7	1	3	4	1	101	C
8	3	2	5	94		B
9	2	3	5	6	46	C
10	4	1	5	1		B
11	3	3	6	43	24	A
12	4	2	6	3		B
13	4	3	7	15	9	B
14	3	4	7	9		C
15	4	4	8	6	2	A
16	5	3	8	3		B
17	5	4	9	1	1	B
18	4	5	9	1		C

Type A, 4 classes and 153 individuals

Type B, 9 classes and 149 individuals

Type C, 5 classes and 18 individuals

It is seen from the table that the class with 4 eggs and that with 5 eggs occur most frequently, having 112 and 101 individuals respectively. Next comes the class with 6 eggs, giving 46 cases. The classes with 3 eggs and that with 7 eggs are found in 24 cases respectively. The class with 8 eggs appears only in 9 cases among 320 animals. The extreme

number of eggs that is 1, 2 or 9 comes very rarely. According to the frequency of individuals in each class the following order of classes is obtained ; 5, 8, 11, 4, 13, 14, 6, 9 & 15, 12 & 16 and all the other classes.

Next we turn to examine the type of classes. Then we see that type A occurs almost in equal frequency with type B. In the meantime type C appears quite seldom, showing only 18 cases, that is less than 6 % of the total. Accordingly, both ovaries in one animal, broadly speaking, develop almost equally and when they differ the right side prevails a little over the left.

In *Takydromus tachydromoides* the length of gestation period and the length of incubation of the eggs as well, depend upon the environmental condition, particularly upon the temperature. So it happens that some females which have little chance to be exposed to the warm sunshine, contrary to the general habits of this lizard, spawn the eggs much later than normal. Sometimes the gestation period diverges more than one month among the individuals of the same group. In nature most of the eggs of *Takydromus* are laid in June and July and hatch in August. In our laboratory, for example, 5 eggs which were spawned on the 28th of June 1929 hatched between the 19th and the 23rd of August. So it took more than fifty days for the hatching.

Near the hatching time the eggs attain a very large size, about nine times as much as the original volume. The hatching takes place mostly in the early morning at sunrise. At this time the young lizard cuts open one end of the egg from inside by biting and creeps out (Fig. 8). The newly hatched young measures 57 mm from the snout to the tip of the tail (Fig. 9) and is possessed of a relatively big head. It moves very actively just like an adult animal.

By the end of October few *Takydromus* are found in nature as the hibernation of this animal begins at this season of the year.

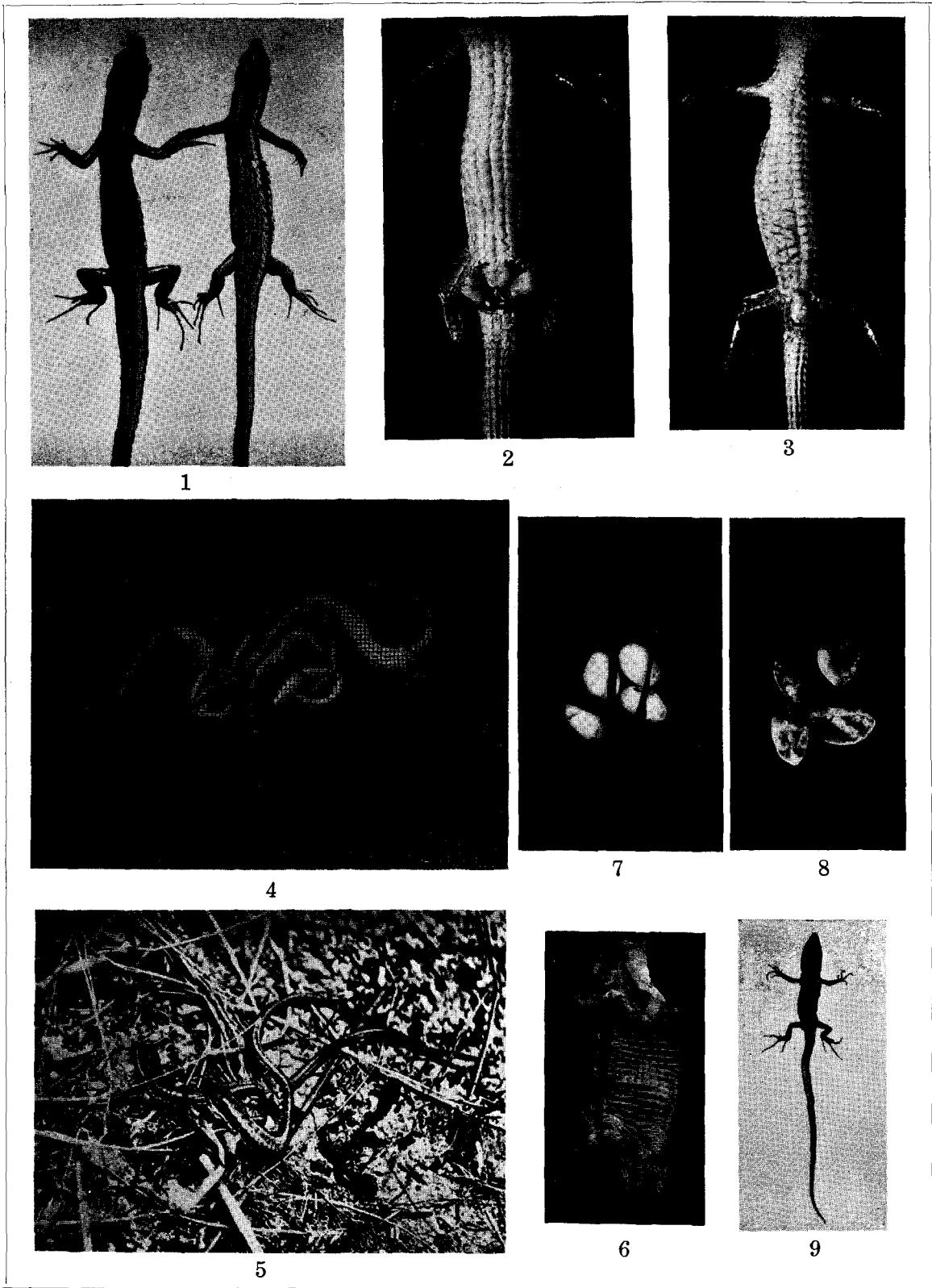
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Plate I

Explanation of Figures

- Fig. 1. Male (left) and female of *Takydromus tachydromoides*, showing particularly the swollen part at the base of the tail of the male. $\times \frac{3}{4}$
- Fig. 2. Male copulatory organ (penis) pulled out by pressing on the swollen part of the male (a little enlarged).
- Fig. 3. Female *Takydromus* with prints of the male jaw on the abdomen (natural size).
- Fig. 4. A community of *Takydromus* in a cold day in the cage. $\times \frac{2}{5}$. Taken from below.
- Fig. 5. *Takydromus* pairing in the grass during a fair day of 1925. $\times \frac{3}{5}$
- Fig. 6. A piece of epidermis cast from the ventral surface of the body (about natural size).
- Fig. 7. Egg-mass of *Takydromus* laid under hay. The cover was taken off (natural size).
- Fig. 8. Egg-shell after the hatching of the young (natural size).
- Fig. 9. Young *Takydromus* just hatched out. $\times \frac{5}{6}$



Inukai Photo.

T. Inukai : Notes on the Breeding Habits of Takydromus tachydromoides Schlegel.