A STUDY ON THE BREEDING HABITS OF *HYLA ARBOREA JAPONICA* GUENTHER[1), 2)]

BY

Tetsuo INUKAI and Seikichi OCHIAI

Of amphibia, *Hyla arborea japonica* Guenther, one of the tree-frogs, is the most widely distributed in Japan, covering Kyushu, Shikoku, Hondo and Hokkaido. It also extends into Chosen. No other species of amphibia in Japan occurs so abundantly or is distributed so extensively beyond the distinct lines of demarkation of animal distribution such as the Chosen Strait or the Tsugaru Strait (Blakiston's line). The Japanese toad, *Bufo vulgaris* for example, is restricted to Japan proper with the exception of the southern part of Hokkaido, where it has appeared due to accidental introduction from Hondo for the last twenty-five years. As to *Rana*, it is represented in Hokkaido merely by *Rana temporaria* L. which is a common species in Sakhalin and also in the northern Eurasiatic continent, while in Hondo *Rana japonica* Guenther, *Rana nigromaculata* Hallowell, *Rana rugosa* Schlegel and allied species occur. *Rhacophorus* is only found in Hondo and southern Japan. It is well known that the fauna of *Urodela* is quite different in Hokkaido from Japan proper and Chosen.

In spite of the very common occurrence of *Hyla* almost nothing has been known of its habits. The animal inhabits abundantly the vicinity of Sapporo though it is not found generally in the high mountainous districts of Hokkaido. For several years in Sapporo we have continued the observation on the breeding habits of the frog together with the study of its development.

---

1) Contribution No. 17 from the Zoological Institute, Faculty of Science, Hokkaido Imperial University.

2) The observation has been carried out since 1923 in Sapporo by Inukai and more precise data have been added by Ochiai who has also studied the subject in Sapporo since 1930.

In Hokkaido the snow which covers the ground to a depth of about one meter throughout the winter melts first at the end of March. After this *Hynobius* spawns during the first of April, being followed soon after by *Rana* (Inukai 1922). The breeding season of the latter lasts until the end of the month except in the mountains where it breeds even in the middle of July every year.

In Sapporo we hear the first sex call of *Hyla* at the end of April generally, but the exact time varies every year of course according to the meteorological conditions. Differing from *Rana* the breeding season of *Hyla* lasts very long, occurring from the last of April until the middle of September, thus covering almost five months. During the early months of the breeding season the animal migrates to breed only during a warm night or on a dark rainy day, but towards the end of the season it breeds exceptionally in the daytime. Accordingly no individual could be seen around the breeding place on fair days even in the prime of the breeding season. It was observed however that most of the animals breed at night during May, June and July.

The spawning place selected by the frog is water which is clear and not too deep. Therefore, rice fields which are usually irrigated at this season with water to a depth of about 10 cm. are most frequently chosen by the animal. Besides this the favorite place for the deposition of the eggs is a pond, a ditch, a swamp, a pool or water which is not running (Figs. 1 and 2), the place being apparently conditioned by the temperature of the surrounding water. In fact the water in which the eggs are laid by the frog is always stagnant and shows a temperature of 10°–23°C in this season of the year.

The body size of the adult female of *Hyla* is a little larger than that of the male, the former measuring about 40–47 mm. and the latter about 35–40 mm. in length from the snout to the body end. During the breeding season the ventral side of the body of the male exhibits a darker colour than that of the female. Particularly the underside of the throat which is swollen by the vocal sac is pigmented much darker in the male so that it often serves as a distinct sex indicator of the frog. The colour of the male however faints gradually after the mating

Fig. 1.

Fig. 2.

Figs. 1 and 2. A pond and a ditch where *Hyla* spawned.

season is over. Moreover, the male differs from the female in having well developed II digitus and a pad at the base of the first finger (Stejneger, 1907).

During the breeding season the male *Hyla* repeats in a peculiar voice "Guaco guaco guaco-guaco" from evening until the midnight.

The animals congregate around the spawning place in considerable numbers in the earlier part of the night croaking noisely but by morning the majority of them have disappeared. The number of females at the breeding place is remarkably small as compared with that of the male. Observations seemed to show not more than one female to fifteen males.

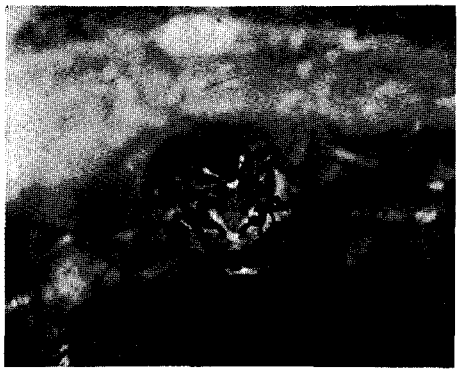

Fig. 3. Pairing of *Hyla* seen from front. (about natural size)

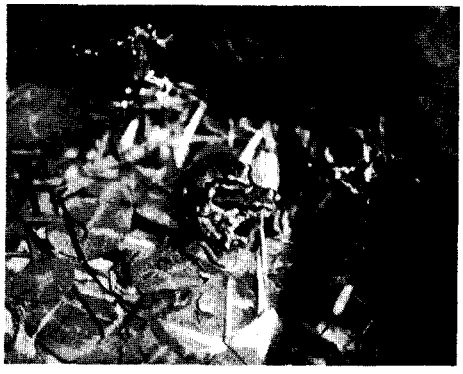

Fig. 4. The pair seen from side. (about ½ of natural size)

The pairing occurs as in *Rana* and the male grasps the female from behind with the arms tightly around the breast (Fig. 3 and Fig. 4). When the mating instinct appears we see first of all the males migrating in great numbers or floating on the surface of the water making all the while a great noise. After a time the female appears quietly at the place. As soon as the male finds the female he suddenly approaches her and tries to join her. Then after a short struggle which often continues until about mid-night the pair swim about together on the surface of the water.[1] Consequently it is easy to collect male specimens if a string is tied to the leg of a female and the animal set at liberty in the breeding place.

Generally the spawning of the eggs occurs at dawn. However, sometimes the pairing lasts for several days until the eggs are expelled. A female which was paired during the night of June 3 was

1) We observed it twice taking place at 10 o'clock at night.

observed depositing the eggs at the dawn of June 6, and another female which was mated on July 30 spawned in the morning of July 31. At first the eggs extrude and then the discharge of the seminal fluid follows. Thus fertilization is carried out in the water. However, the deposition of the eggs does not take place simulteneously as in *Rana* but lasts at least 2 or 3 hours since the animal spawns only 5–30 eggs in succession. After one spawn it removes soon to another place to make another deposition. Accordingly the eggs so deposited are scattered in the water, sometimes directly on the bottom, sometimes on the grasses or on the fallen twigs instead of in clumps (Fig. 5).

Fig. 5. Eggs of *Hyla* deposited on the aquatic plants. Seen from above. (About natural size)

The total number of eggs from one female varies from 250 to 500 according to the body size. As the jelly envelope of the egg has a great viscosity the egg deposited is often found coated with the mud of the bottom or attached closely to anything in the water (Fig. 5).

The size of the egg is variable fluctuating from 1.3 to 2 mm. in diameter. The fresh spawned egg is light brownish on the animal pole and yellowish white on the vegetative pole, the former covering about three tenths of the whole surface area of the egg. The thickness of the gelatinous substances around the egg is 1.5–2 mm. when completely swollen with water. It is peculiar that there is always some space which measures 0.8 mm. in thickness between the chorion and the vitelline membrane of the egg in the fresh condition. This gives a great advantage for embryological research on which we are going to report later.

A question arises naturally whether the animal takes food during so long a sexual season. According to our observation the frogs found without any food in the stomach make up two fifths of the total number which were caught in one pairing place. Consequently it is understood that the animal feeds even in the breeding season. There are all sorts of green insects and small animals either aquatic or land species to be caught by the frog.

The larvae are hatched out in four or five days and we find every stage of development of the tadpole in the same water. After the pairing is over the frog spends most of its time in the summer and in the early autumn in trees or in grasses where it also utters occasionally a few insignificant notes. It often happens in Hokkaido that the frog hibernates in the tadpole stage when the egg is deposited in late summer.

LITERATURES

GADOW, H. 1901. Amphibia and Reptiles. London.

HATTA, S. 1910. *Bufo* in Hokkaido. Dobutsugaku Zasshi. Vol. 24.

——— 1913. Zur Tiergeographie von Hokkaido. Zool. Anz. Bd. XLIII, Nr. 1.

HOLMES, S. 1918. The Biology of the Frog. New York.

INUKAI, T. 1922. Experimental Studies on the Developing Eggs. Jour. Coll. Agr. Hokkaido Imp. Univ. Vol. 11.

NOBLE, K. 1931. The Biology of the Amphibia. New York.

OKADA, Y. 1924. The Egg-Deposition of *Hyla arborea japonica*. Dobutsugaku Zasshi. Vol. 36.

——— 1931. The Tailless Batrachians of the Japanese Empire. Imp. Agr. Exp. Station. Tokyo.

STEJNEGER, L. 1907. Herpetology of Japan and Adjacent Territory. Smith. Inst. U. S. Nat. Mus. Bull. 58.
