Natural History Studies of Chinese Endemic Amphibians

I. Life History of Wood frogs in Shandong Peninsula

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Abstract: Natural history observation can provide information for phylogenetic analysis and are critical for development of conservation and management strategies. There are two wood frogs Rana kunyuenesis, and *Chensinis distributed at Kunyu and Laoshan mountains separately in Shandong Peninsula. Their life history mainly including the distribution, breeding activity, tadpole characters and development and hibernation were reported according our works from 1997 to 2006 by surveys and laboratory observation.

Key words: life history; wood frog; Rana kunyuenesis; Rana chensinis

中国特有两栖动物研究 1. 山东半岛林蛙的生活史

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摘要：生活史的研究可以为系统发育研究和珍稀濒危物种的保护和管理对策的制定提供参考资料。林蛙是我国分布比较广泛而复杂多样的一个类群，在山东半岛的昆嵛山和崂山，分别分布有昆嵛林蛙（Rana kunyuenesis）和中丘林蛙（R. chensinis）。本文报道我们从1997年到2006年对这两种林蛙在山东半岛的地理分布、繁殖习性、蝌蚪特征和生长发育以及冬眠等的调查和观察研究结果。结果表明昆嵛林蛙和分布于崂山的中丘林蛙尽管栖息地生境方面比较相似，但在生活史方面表现出较大的不同。

关键词：生活史；林蛙；昆嵛林蛙；中丘林蛙

Many taxonomic and phylogenetic problems regarding the amphibians of Asia remain unresolved and the tadpoles of a number of species of anurans remain unknown. Knowledge of the basic natural history of

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Chinese amphibians is even more scare. Natural history observation are time intensive and often not considered worthy to publication (Greene, 1993). Nevertheless, they may provide informative characters for phylogenetic analysis (de Queiroz and Wimberger, 1993) and are critical for development of conservation and management strategies (Mendelson, et al., 1999).

Wood frogs, also known as brown frogs, are a group of frogs—\textit{Temporaruae} which are widespread, complex and diverse. There are about thirty species existing in Europe, Asia and the northern part of North America, mostly in Eurasia and of which thirteen species known in China, ranging over thirty Provinces, Cities and Autonomous Regions, and southward to the north slope of Mt. Nanling, but except Hainan Province (Li, et al., 2005, Lu and Li, 2005).

Shandong Province is a part of the area around Bohai and three species of wood frogs—\textit{Rana kunyuensis}, \textit{R. cheninensis} and \textit{R. j. japónica} (known as \textit{R. zhenhaiensis} now) collected with narrow distributions in the province (Li, et al., 2005; Lu, et al., 2005). \textit{Rana kunyuensis} only was found at Mt Kunyu, \textit{R. cheninensis} at Mt. Laoshan, and \textit{R. zhenhaiensis} at Mt. Culai. Mt. Kunyu and Laoshan belong to Shandong peninsula (or Jiadong peninsula) and the former at the north of the peninsula and the later at the south. Mt. Culai is near Mt. Taishan in the middle of Shandong Province. Although \textit{R. cheninensis} is a common wood frog with a wider distribution in the north part of China, and much works have done in this species, it is isolated in a small area focused in Mt. Laoshan of Shandong Province, the most east distribution, and no life history data was reported to the author's knowledge. \textit{R. kunyuensis} is a new wood frogs reported closed to \textit{R. cheninensis} (Lu and Li, 2002) and only brief reports were published on postembryonic development and comparison of its tadpoles with \textit{R. cheninensis} from our laboratory (Sun, et al., 2002; Lu, et al., 2002). \textit{R. kunyuensis} is similar to \textit{R. cheninensis} in external morphology (Lu and Li, 2002). The species allied to \textit{R. cheninensis} is quite similar in morphology and are very difficult to indentify (Kim, et al., 2002). The present study of the life history, carried on from 1999 to 2005, show some data and verify the distinct differences between \textit{R. kunyuensis} and \textit{R. cheninensis}. (Plate IV, V)

1 Kunyu wood frog \textit{R. kunyuensis} Lu and Li, 2002

\textit{R. kunyuensis} is found in margin of forests, bushes and meadow near river and stream. Occasionally it could be observed in water after reproduction and before hibernation. The coloration of the adults varies according to their surroundings and seasons. After hibernation, they generally have a dark brown color on the dorsal side, the dorso-lateral sides of the body and the dorsal sides of the limbs. When found in summer and in meadow, the color of the frogs is usually yellowish brown. A remarkable appearance is that the upper jaw with long golden bar. Before hibernation, the throat and belly of the female become reddish orange in cloudy spots.

The breeding season of \textit{R. kunyuensis} is from the end of February. The frogs were collected from meadow near the stream of Shen-jin-shan at 2nd of July, 1999. At Kunyu forestry centre, tadpoles with hind-legs fully developed were found in an artificial pond at hillside on 20th of May, 2000. The tadpoles were nearly in the same development stage in one place. Eggs were found in the pool of stream of Shen-jin-shan as early as 28th of February, 2005. At the middle of March, the masses of egg in the cleavage stages were collected at the place above. These facts indicate that the breeding season of this frog is from March to June. As its developmental process is slow the breeding season start as early as from the end of February when the water temperature is above 8°C.

The grasping is the axillary type with figures curved up at the posterior-lateral corner of the coracoid of the male. Before egg-laying, the body cavity of female is bulged large with eggs and the abdomen seems dark. During hibernation, some male frogs may grasp female for preparing breeding. In Laboratory, at the middle of December, the male was
found moving slowing and grasping the female as in breeding condition. Sometimes, tow or more male could be found grasping one female. When putting R. kunyuensis and R. chensinensis in a water box, a case was observed that a male R. chensinensis grasped a male R. kunyuensis.

Eggs mass of R. kunyuensis were found on the surface of water bodies of small mountain streams or ponds. The most favorable site for egg-laying is in the lentic area and s'vag of stream. It is hard to observe the egg-laying process in nature because the frog lays eggs at lobster shift time. Under artificial condition, the frog lays eggs at sunrise. The egg-laying process is very interesting. When egg-laying, the female stand on the water, and the male on the back of female move his legs regularly and after laying, the male move from the female, swim to the underside of the egg mass and use its legs churning up under the egg mass to form some air bubble in the mass. It can make the egg mass floating on the surface of the water and the eggs develop more quickly by sunlight irradiation. From the observation in laboratory, the frogs lay eggs before daybreak, different from Rana nigromaculata and Bufo gargarizans, of which the females lay eggs while moving at daytime.

The shape of egg mass is rather uniform, mostly in spherical. Ten masses were measured with an average diameter of 125 mm, thickness of 40 mm. Four masses of eggs were counted (300, 800, 1072, 1500). Eggs are absolutely black at animal pole and yellowish gray at plant pole, with a diameter of 1.5–2.0 mm (mean 1.77 mm).

The incubation period is 11 days. The early cleavage processed normally taking 6 hours from one to sixteen cell stage, and about 12 hours to morula. It is easy to incubate the eggs at laboratory, and they developed normally and the incubation period was from 7 to 9 days to the time of hatching. Just after hatching, the embryo is still in a helpless condition. It cannot swim around but attaches itself on the vegetable leaf or lies down flat sidewise on the bottom of the water. It is absolutely black.

Coloration of the tadpoles are dark gray, and become brown latterly. The body is ovoid in dorsal view and eyes direct dorsilaterally. The spiracular is sinistral, ending with a tube which is visible from above and below and much nearer to the base of the tail than to the snout. The tail is one and three fourths the length of the body. The Vent is dextrally ending with a short tube.

The mouth is ventral in position. A single row of completely marginal papillae are found on the lower lip, and more lateral submarginal papillae can be visible. No pigments were visible on the papillae. Most of labial tooth row formula is 2 (2) / 3 (according to Altig and McDannid, 1999) or 1: 1 + 1/III (according to Daoos, 1995), or I: 1-1/III (according to Liu, 1940).

The froglet is 9 mm from snout to vent and its leg is 11.3 mm in length.

From October, the frog move to the edge of river and water and the dorsal coloration becomes dark. On 11th of November, 2004, several frogs were found under the floating leaves in lentic area or mild section of river. After capture, the frog climb slowly showing in a condition for preparation of hibernation. The frogs hibernate at the bottom of the river hidden in silt or under the leaf.

2 Chinese wood frog Rana chensinensis David, 1875 at Qindao

R. chensinensis is similar to R. kunyuensis in external morphology and living habitat. The distinct differences between these two frogs are as follows in morphology: no golden strip on the upper jaw in R. chensinensis and no reddish orange belly in female R. chensinensis, as well as no internal vocal sacs in male R. chensinensis. The head length of R. chensinensis is slightly longer than the width, while that of R. kunyuensis is shorter than the width. On the other hand, the body and legs of R. kunyuensis is longer than those of R. chensinensis.

This wood frog becomes to dark gray dorsally around the period of hibernation in coloration. At other times, its coloration is brown on the dorsal view. The ventral side generally is creamy and with some gray dots in the female. The bars on the dorsal side of limbs are dark gray and much more distinct tant
R. kunyuensis.

The breeding season of R. chensinensis also starts at the end of February, 2003. The eggs sunk at the bottom of water, because the depth of the lentic area of the stream is fleet (70 ~ 100 mm in depth), the eggs on the superficial part of the egg mass died by icing on 2nd of March, 2005. Most of the females lay eggs during the middle of March to April.

The shape of egg mass is more spherical than that of R. kunyuensis. Mass is about 150 mm in diameter and 100 mm in thickness. The number of eggs in a mass is less than R. kunyuensis, from 700 to 1973. Eggs are similar to R. kunyuensis in color, with a larger diameter of 2 ~ 2.5 mm (mean 2.12 mm).

The egg-laying behavior is similar to R. kunyuensis. The conspicuous difference of R. chensinensis is the behavior of males after egg-laying. No care of egg mass was done by the male.

Several frogs grasping together was found in R. chensinensis. On 2nd of March, 2005, one female grasped by four males was captured from the bottom silt of the stream at Mt. Laoshan.

Its tadpole is larger than that of R. kunyakensis at the same stage and have a similar morphological characters. And the most of labial tooth row formula is 4 (2-4) / 4 (1) or 1 · 3 + 3 / III : I-1 (Dubois, 1995). The froglet is 9 mm from snout to vent and its leg is 11.3 mm in length.

From October to November, the frog move to the edge of river and water and the dorsal coloration becomes dark. The frogs hibernate at the bottom of the river.

3 Reference


Kunyu wood frog *Rana kunyuensis* A, B and D: females in ventral, dorsal and lateral view; C: egg-case; E, F and H: males in ventral, dorsal and lateral view; G: frogs in grasping
Chinese wood frog *Rana chensinensis*  A, B and D: females in ventral, dorsal and lateral view; C: egg-case; E, F and H: males in ventral, dorsal and lateral view; G: male in hibernation