Jordan Journal of Natural History, 9 (1), 2022 Pages: 19-23

Notes on Captive Breeding of Three Snake Species (Colubridae) from the Russian Far East

Nikita E. Pokhilyuk

Kamen-Rybolov 692682, Primorsky Krai, Russian Federation

Received: January 7, 2022; Revised: March 5, 2022; Accepted: March 12, 2022

Abstract: *Rhabdophis tigrinus, Elaphe schrenckii*, and *Elaphe dione* are three common snake species in northeast Asia. The present work focuses on the reproductive biology of the snake populations inhabiting Primorye (the southern Russian Far East). Over the period from 2019 to 2021, the researcher incubated five clutches of snake eggs which were either found in the wild or obtained from wild-caught individuals. Herein, the results are presented concerning the clutches' size, duration of incubation, and thermal conditions for each species. During the study, the researcher observed a correlation between the snakes' body length and the clutch size in *E. schrenckii* and a correlation between thermal conditions and the duration of the incubation period in *R. tigrinus.* Higher thermal conditions resulted in reducing the length of the incubation period.

Key words: breeding; incubation; Russian Far East; *Elaphe schrenckii; Rhabdophis tigrinus; Elaphe dione.*

Introduction

Rhabdophis tigrinus (Boie, 1826), *Elaphe schrenckii* (Strauch, 1873), and *Elaphe dione* (Pallas, 1773) are snake species inhabiting the Korean Peninsula, northeastern China, and the Russian Far East (Dunaev and Orlova, 2014). Despite being common and abundant species, there is little scientific literature on the reproduction of these snakes. In Russia, the data concerning these species are especially sparse due to their limited distribution across the country. Primorsky Krai (hereafter, Primorye) is the area where these three species are most abundant, unlike all other parts of the Russian Far East. Here, the bulk of herpetological studies on local snakes were conducted by A. A. Emelianov (1878–1946) and Yu. M. Korotkov (1935–1996). The interspecific and geographical variation of different reproductive traits (e.g. clutch size) for reptiles has already been observed in lizards (Wang, *et al*., 2011) and snakes (Tryon and Murphy, 1982; Zuffi, *et al.,* 2007; Klenina, 2013). Thus, clutch sizes in the northern populations of *Hierophis viridiflavus* were significantly larger than those in the southern ones (Zuffi, *et al.,* 2007). This study compares the resulting data and findings with the existing information from different literature sources.

Field work for this study took place in western Primorye, which is comprised of two districts adjoining the Chinese–Russian border. These notes are an attempt to summarize the sporadic field observations and the experience in incubating wild snakes' egg clutches and to contribute additional data to the knowledge of these species' reproductive biology.

Materials and Methods

All wild individuals and egg clutches, presented herein, except for *Elaphe schrenckii,* were found at a small quarry (44.936841 N, 131.711838 E), 12 km northeast of the village of Dvoryanka (Khankaysky District, Primorye). The site is located on the northern side of a hill (157 m asl) covered with Quercus mongolica and surrounded with crop fields. A pile of construction waste at the quarry provides local snakes with shelter and a suitable place for

*Corresponding author: hitcher11111@gmail.com

laying eggs. Two *E. schrenckii* were found in the Upper Komissarovka valley (44.742719 N, 131.404069 E) west of Barabash-Levada (Pogranichny District, Primorye). All captive snakes were temporarily kept in two plywood enclosures (70 x 40 x 40 cm and 100 x 39 x 39 cm) at ambient temperatures. Provided with different prey items, water, and hiding places, the animals were kept for two or three weeks until they laid eggs. After that, all of them were returned to their habitats. During the course of the study, five snake clutches representing different species (fifty-five eggs in total) were incubated.

All eggs were put into round plastic containers filled with damp vermiculite. The containers had ventilation holes and were placed next to a heat source. The temperature measurements were taken by means of an alcohol thermometer. The eggs were incubated at fluctuating temperatures. To sustain a high humidity level, the walls of the containers and the vermiculite around the clutch were sprayed with water, at least, twice a week.

In most cases, the eggs were stuck together. No attempt was made neither to separate them nor to change their position. After the snakes hatched, they were fed and released back into the wild.

Results

The tiger keelback (*Rhabdophis tigrinus*)

On July 5, 2019, a clutch of sixteen eggs (30 x 15 mm) were found in the pile of construction debris (Figure 1A). A few meters away, the researcher also found a large female, *Rhabdophis tigrinus* , which is thought to have laid those eggs the night before. One egg was damaged and, accordingly, it was separated. The clutch was taken for further incubation. The eggs were incubated at 26–29 °C. The first egg hatched at 23:00 h on August 5, and the last snake emerged on the night of August 7. All fifteen hatchlings were alive. The incubation success rate was 100%. The incubation period, starting from finding the eggs till the first snake's emergence, lasted thirty-two days.

On June 30, 2020, a gravid female of *R. tigrinus* was caught (blue morph) (Figure 1B). The snake took shelter in a plywood enclosure (70 x 40 x 40 cm) where it was hiding most of the time, and feeding on live frogs. . On the morning of July 12, a clutch consisting of fourteen eggs was found (Figure 1C). They were incubated at 29–30 °C. On August 9, the first cut on one egg was observed at 14:20 h. Nevertheless, the hatchlings remained inside the eggs until night. The next evening, the last of the fourteen snakes hatched out. The hatchlings were 215–225 mm (average = 218.93 mm) in total length with SVL ranging from 170 to 184 mm (average = 176.79 mm) and the tail length ranging from 35 to 47 mm (average = 42.14 mm). The incubation success rate was 100%. None of the hatchlings inherited the blue coloration. The incubation period lasted twenty-nine days.

The steppes rat snake (*Elaphe dione*)

On August 10, 2019, a clutch of eggs was discovered under an old wooden board (Figure 1D). Later, when the incubation ended and the hatchlings emerged, the clutch proved to belong to *Elaphe dione.* There were six eggs (50 x 18 mm), out of which only two were taken. The eggs were incubated at 27–29 °C, and both rat snakes emerged on August 26. Unfortunately, the exact duration of incubation period could not be provided. Given the fact that no eggs were found during the previous visit (July 25, 2019), it was assumed that the incubation period may vary from eighteen to thirty-two days.

The Amur rat snake (*Elaphe schrenckii*)

On June 22, 2021, two gravid female *E. schrenckii* were caught. Both snakes (approximately 135 cm and 145 cm in total length) were housed in the enclosures, depending on their size. The larger female fed exclusively on quail eggs, ignoring any live prey, while the other, on the contrary, ignored the eggs and fed on live mice and sparrows. On July 21 at 19:30 h, the larger

snake began laying eggs (Figure 1E). There were thirteen eggs in the clutch. They were incubated at 27–29 °C, and the first cut on one egg was seen at 16:00 h on August 31. Four hours later, the first hatchling emerged from the egg. A total of ten snakes hatched successfully, and three embryos were found dead inside their eggs, providing an incubation success rate of 76.9 %. The incubation period lasted forty-one days.

On the morning of July 25, a clutch (eleven eggs) of the smaller female was discovered (Figure 1F). Being incubated at 26–29 °C, the first snake cut its egg on the evening of September 3. Next morning, all eggs were cut (one was cut by the researcher), and all eleven hatchlings left their eggs. The incubation success rate was 100%. The incubation period lasted forty-one days.

Discussion

The number of eggs in a clutch is known to differ significantly in every species. The clutch size of *R. tigrinus* can reach up to twenty-five (average = 10.9) eggs (Korotkov, 1985). The two clutches in this study consist of sixteen and fourteen eggs respectively, which is slightly above the average for Russian populations. Webb (1962) reported the clutches of nine, eleven, and thirteen eggs from Korea, while Won (1971; cited by Szyndlar and Hung Dam, 1987) reported eight-thirty-two eggs for Korean populations. According to Sura (1981), a specimen from Korea laid a total of twenty-seven eggs over the period from June 13 to July 18. Two females of less than 72 cm (SVL) examined by Pope (1929) in China contained five and nine eggs.

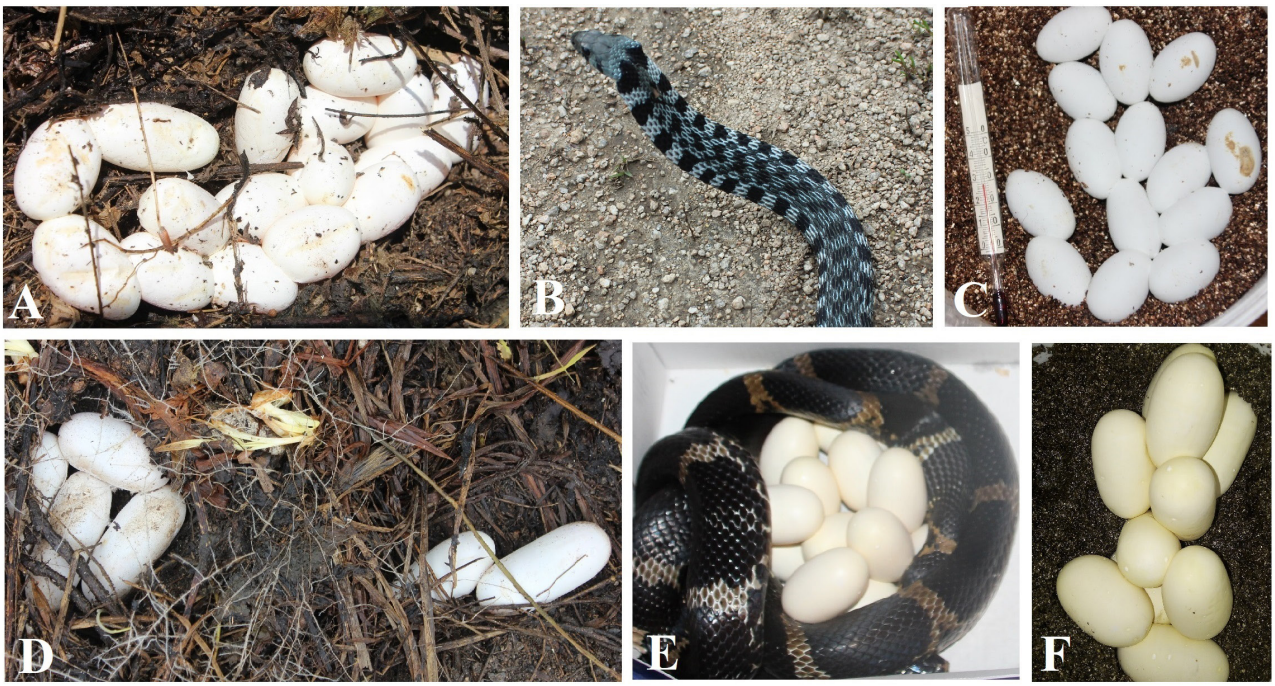

Figure 1. A) The *Rhabdophis tigrinus* clutch found on July 5, 2019; B) The 'blue' female *R. tigrinus* found on June 30, 2020; C) The *R. tigrinus* clutch of 2020 during incubation; D) The clutch of *Elaphe dione* found on August 10, 2019; E) The larger female of *Elaphe schrenckii* laying eggs on July 21, 2021; F) The clutch of the smaller *E. schrenckii* during incubation.

The clutches of *Elaphe schrenckii* in this study consisted of thirteen and eleven eggs. Korotkov (1985) wrote that *E. schrenckii* can lay from seven to twenty-four eggs (average = 10.7 eggs for individuals of over 130 cm in SVL); Tagirova (2009), who had been studying the northern populations of these snakes in the Amur basin, reported 12–13, 14, and 16 eggs for individuals of 124–130, 136–150, and 167 cm in total length respectively. Emelianov documented thirty eggs as the maximum number (Emelianov, 2018). Both of the studied female *E. schrenckii* were not less than 130 cm in total length, and the

size of their clutches corresponds with the average number for Russian populations. The difference in the number of eggs depending on snakes' size has also been observed.

The clutch of *Elaphe dione*, found by the researcher, contained only six eggs. Unfortunately, the size of the female that laid the eggs is unknown, and a single clutch is not sufficient to draw any conclusions. The size of *E. dione* clutches in Primorye can vary from twelve (Emelianov, 2018) to twenty-four eggs (Korotkov, 1985) which is significantly higher than the researcher's observations. In European Russia, Klenina (2013) recorded the clutch sizes of 5–14, 10–16, 8–11 and 5–11 eggs for the Volga basin. Her studies took place in Samara Oblast, Ulyanovsk Oblast, Saratov Oblast, and Volgograd Oblast respectively. In Korea, Webb (1962) reported a female (915 mm in total length) containing nine eggs, and Szyndlar and Hung Dam (1987) reported six to eight eggs.

The incubation temperature can affect not only the duration of the incubation period but also the incubation success rate and physical characteristics of hatchlings (Chen and Ji, 2002; Blouin-Demers and Patterson, 2008; Mengjie, *et al.,* 2012). According to Chen and Ji (2002), *R. tigrinus lateralis* eggs incubated at 24, 27, and 30 ºC hatched after 45, 32, and 27 days, respectively. The hatchlings incubated at lower temperatures proved to be bigger, heavier, and had much lower mortality rate than the ones from thermal conditions of 33 ºC (Chen and Ji, 2002). Sura (1981) incubated his clutch at fluctuating temperatures (20–30 ºC) for thirty-four days. Emelianov (2018) confirmed incubating eggs of *R. tigrinus* for about forty-five to fifty days at 20–25 ºC; Won (1971) mentioned thirty-five to forty days without specifying any thermal conditions. The increase of temperatures in the present study has reduced the duration of the incubation period for *R. tigrinus* clutches from thirty-two to to twenty-nine days. This vividly demonstrates the connection between the temperature conditions and the duration of the incubation period.

Conclusions

The data obtained from the observations in this study vividly demonstrate that the duration of snakes' eggs incubation period is strongly affected by thermal conditions. In fact, an increase in temperature shortens the incubation period.

The clutches' size in *Elaphe schrenckii* and *Rhabdophis tigrinus* from western Primorye is similar to the average values known for both Russian and Korean populations. The clutch size of *Elaphe dione* is closer to the ones of the Korean specimens but requires further studies and a larger sample size.

Acknowledgements

The researcher would like to thank his father, Evgeny P. Pokhilyuk, for his help and support during the field work. Gratitude is also extended to the anonymous referees for their help in improving the manuscript.

References

Blouin-Demers, G and Patterson L. 2008. The effect of constant and fluctuating incubation temperatures on the phenotype of black ratsnakes (*Elaphe obsoleta*). *Canadian Journal of Zoology,* **86**: 882-889.

Chen, HL and Ji X. 2002. The effects of thermal environments on duration of incubation, hatching success and hatchling traits in a colubrid snake *Rhabdophis tigrinus lateralis* (Boie). *Acta Ecologica Sinica,* **22**: 1850-1858.

Dunaev EA and Orlova VF.2014. **Zmei. Vidy fauny Rossii. Atlas-opredelitel'** (**Snakes. Species of Russian fauna. Field Guide**). Moscow: Fiton, 120 pp. [In Russian]

Emelianov, AA.2018. **Amfibii i reptilii Sovetskogo Dal'nego Vostoka** (**Amphibians and reptiles of the Soviet Far East**). Vladivostok: Dalnauka, 416 pp. [In Russian]

Klenina AA. 2013. The reproductive biology of Pallas coluber *Elaphe dione* in the

Volga River basin. *Izvestia of Samara Scientific Center of the Russian Academy of Sciences*, **15** (3/7): 2210-2213.

Korotkov, YuM. 1985. **Nazemnyye presmykayushchiesya Dal'nego Vostoka SSSR** [**Terrestrial reptiles of the USSR Far East**]. Vladivostok: Far Eastern Publishing house, 136 pp. [In Russian]

Mengjie, C, Si, Zh, Ruoru, C, Fei, M and Longhui, L. 2012. Effect of incubation temperature on behavior and metabolism in the Chinese cornsnake, *Elaphe bimaculata*. *Acta Ecologica Sinica,* **32**: 6836-6841.

Pope, CH. 1929. Notes on reptiles from Fukien and other Chinese provinces. *Bulletin of the American Museum of Natural History,* **58**: 335-487.

Sura, P. 1981. Captive breeding of *Elaphe rufodorsata* and *Rhabdophis tigrinus* from the Korean People's Democratic Republic. *The British Herpetological Society Bulletin,* **3**: 20-24.

Szyndlar, Z and Hung Dam O. 1987. Reptiles of the Democratic People's Republic of Korea. Part 1. Serpentes. *Chinese Herpetological Research,* **1**: 22-59.

Tagirova, VT. 2009. **Zhizn' Priamuskikh amfibii i reptilii** (**The life history of amphibians and reptiles in Priamurye**). Khabarovsk: Priamurskie vedomosti, 208 pp. [In Russian]

Tryon, BW and Murphy JB. 1982. Miscellaneous notes on the reproductive biology of reptiles. 5. Thirteen varieties of the genus *Lampropeltis*, species *mexicana, triangulum*, and *zonata*. *Transactions of the Kansas Academy of Science,* **85**: 96-119.

Wang, Y, Weihong, J, Wei, Zh, Yu, N and Liu, N. 2011. Geographic Variation in Clutch and Egg Size for the Lizard *Phrynocephalus przewalskii* (Squamata: Agamidae). *Asian Herpetological Research*, **2**: 97-102. 10.3724/SP.J.1245.2011.00097

Webb, RG, Knox, JJ and Byers, GW. 1962. Some reptiles and amphibians from Korea. *University of Kansas Publications, Museum of Natural History,* **15(2)**: 149-173.

Won, HK.1971. **Amphibian and reptilian fauna of Korea**. Pyongyang: Kwahagwon Chulpansa, 170 pp. [In Korean]

Zuffi, M, Fornasiero, S and Bonnet, X. 2007. Geographic variation in reproductive output of female European whip snakes (*Hierophis viridiflavus*). *The Herpetological Journal*, **17:** 219-224.