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Study of Reproductive Traits and Mating Behaviour of *Mabuya multifasciata* through Ethogram

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

*Mabuya multifasciata*is a skink found in temperate and tropical Asia, Australia, and central and southern Africa.It is unique in reproductive traits as it gives birth to live one for example viviparous.During its breeding cycle the sexes develop attractive colouration to attract its mate.It is studied under the reproductive traits under the original research study.The present study is a part of original research which was conducted during 2011-2014 in Assam , focusing on the behavior of the mates during reproduction. Greer [1] divided Scincidae family into four subfamilies *viz.*Scincinae, Acontinae, Feyliniinae, and Lygosominae. TheLygosominae contains over 600 species distributed mainly. The present study deals with the specific behavioural trait with reference to mating behavior. *Mabuya multifasciata* develops bright and beautiful skin colour during the reproduction period.

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Keywords: Behaviour; colouration; mating; Mabuya multifasciata.

1. INTRODUCTION

The skinks have served as suitable research models in a wide range of ecological and evolutionary disciplines [2,3]. The classical work of Trillmich KGK [4] on mating behaviours in Anolis lizards and studies of several species of reptiles seem to suggest that many reptiles lend themselves very well to field studies of sexual selection and related questions (e.g. Cooper & Vitt 1993).

Mabuya multifasciata is unique in reproductive traits as it gives birth to live one. The present study is a part of original research which was conducted during 2011-2014 in Assam, focusing the behaviour of the mates during reproduction. Greer [1] divided Scincidae family into four subfamilies *viz.*Scincinae, Acontinae, Feyliniinae, and Lygosominae. TheLygosominae contains over 600 species distributed mainly. The present study deals with the specific behavioural trait with reference to mating behavior. *Mabuya multifasciata* develops bright and beautiful skin colourduring the reproduction period.

2. METHODS

Mabuya multifasciata display some special courtship behavior which is being studied by ethogram.An outdoor arrangement was made to study mating behavior. The terrarium was of *(*120cm $_x$ 100cm $_x$ 80cm). It was made ofiron net.It was placed in the outdoor natural habitat in an undisturbed area covered with shadow and little jungle. Inside the terrarium materials such as plants,broken pots, water bowl and food were provided. The lizards were provided with insect materials like cockroach,grasshoppers etc.

Two pairs of *Mabuya multifasciata* were placed in the terrarium of both sexes. The SVL of female was 140±0.15 mm and body mass was 230 ± 0.80g.The mature male measured 95 ± 0.04 mm in snout vent length (SVL) and weighed 200 ± 7 g. For two years courtship and mating behavior was observed. Bright orange- red colouration was exhibited in neck and head region of the male. But the colouration of the male lizards are only seen in the adult stage. The colouration of the male is duller than the female during the breeding season.Observations were made as handwritten notes.

2.1 Study of Mating Behaviour

We followed the Carpenter and Ferguson protocol.

Aggression: Agonistic or dominating actions performed by male.

Approach: Males approach towards females.

Body-wrap: Male with neck bite hold and tail twist, body arched over female with fore-leg hold on female"-s trunk and hind leg hold onto the base of the female"-s tail.

Chase: Rapid pursuit of one individual by another that is retreating from the former.

Copulation: Intromission of the hemipenis into the vent of the female, stationary for 5-9 s before withdrawal of hemipenis.

Flee: Rapid retreat by a lizard after approach of another lizard.

Follow: Male follows the retreating female.

Four-leg push-up: Rapid raising and lowering ofthe body on all four legs.

Grip release: Male releases the neck-bite and leg-hold on the female.

Limp: Submissive body condition of female dragged by the male with neck-bite hold.

Neck-bite hold: Male grasps on the skin of the neck of female with its jaws.

Push-up: Rapid raising and lowering of the anterior region of the body with fore legs.

Stationary: No body movements for 5-6 s when male is mounted on female.

Straddle: Male holds female with neck-grip and partly embracing with limbs, climbs onto the back of the female.

Tail up at base: Tail lifted at base, mid portion up and tip touching the substrate displayed by female.

Tail twist: Male"-s tail twisted underthe female"-s tail bringing the cloaca close to that of female.

The sequences of courtship and mating behaviour are represented as a flow chart in Fig. 1:

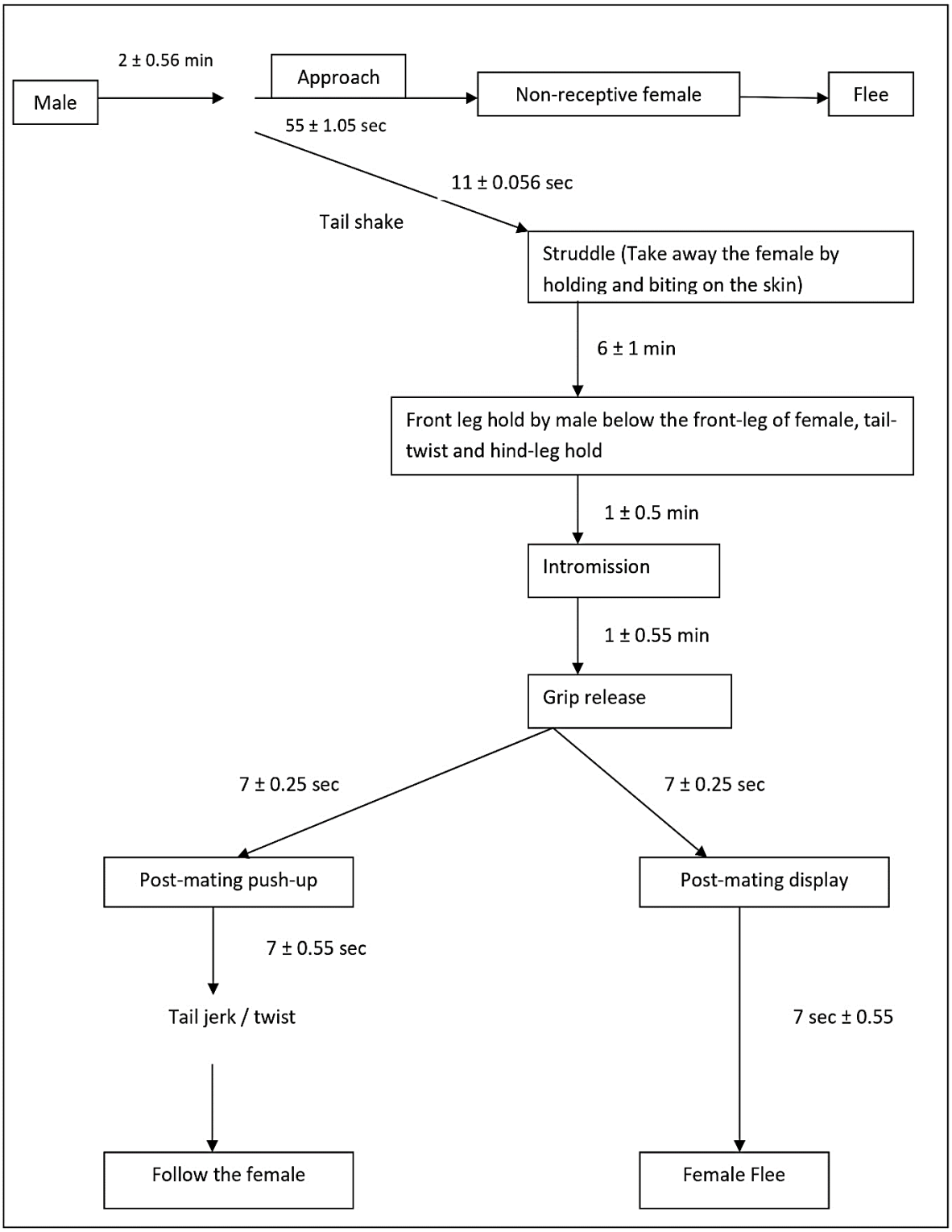

Fig. 1. Summary ofsequences of courtship and mating behaviour of *Mabuya multifasciata* is represented in flow-chart

3. RESULTS

Summary of sequences of courtship and mating behaviour of *Mabuya multifasciata*is represented in flow-chart:

A. Approaching male

B. Aplproaching male

C. Male mounting on the female

D. Male with neck-bite hold on female

E. Male separate, post-mating behaviur

Photo plate 1. Sequences of events in mating and coupulation of *M. multifasciata*(A-B) approaching male; (C) male mounting on the female; (D)male with neck-bite hold on the female; (E) male separate- post mating behaviour

One can divide successful mating behaviour of a male *Mabuya* into 16 traits which are described in Photo plate 1, Fig. 1 and Table 1. The following discussion generalizes the variation observed in all populations, and concerns successful mating only. Several features varied geographically.

A male often performs an aggressive display before he begins to approach a female. This display includes arching his back, compressing his body laterally, expanding his throat, and performing a series of push-up. Following this, some males rush toward the female without pausing and bite her flank vigorously. Such a male releases the flank hold after a few seconds, takes a neck hold, and completes the mating sequence. However, most males approach the female more slowly and usually relax the aggressive posture (Table 1, Photo plate 1, Fig. 1). Females flee after the copulation and shows post copulative behavior like tail twist.

Table 1. Statistics of mating behavior of *Mabuya multifasciata*

		Observation Number (N) X ± S .D. (N)				
Character description	**Character no**	**1**	**2**	**3**	**4**	**5**
Aggression	1	60 (10)	80 (10)	40 (8)	60 (11)	58 (12)
Approach	2	16 ± 9 (9)	07 ± 8 (8)	05 ± 8 (8)	07 ± 7 (7)	03 ± 1 (5)
Body-wrap	3	90 ± 5 (5)	91 ± 6 (6)	82 ± 5 (5)	84 ± 5 (5)	100 ± 7 (7)
Chase	4	17 ± 09 (10)	19 ± 09 (10)	25 ± 09 (10)	19 ± 09 (12)	20 ± 09 (12)
Copulation	5	13 ± 06 (12)	12± 05 (13)	17 ± 06 (7)	14 ± 05 (4)	18 ± 05 (7)
Flee	6	15 ± 07 (8)	18 ± 06 (8)	13 ± 05 (7)	15 ± 05 (6)	18 ± 08 (7)
Follow	7	10 ± 02 (5)	12 ± 03 (5)	12 ± 02 (5)	11 ± 04 (5)	08 ± 01 (5)
Four-leg push-up	8	23 ± 10 (9)	33 ± 15 (9)	07 ± 07 (6)	13 ± 17 (7)	27 ± 11 (7)
Grip release	9	20 ± 10 (8)	22 ± 12 (8)	19 ± 9 (9)	21 ± 10 (10)	8 ± 02 (3)
Limp	10	18± 06 (7)	19 ± 07 (7)	18 ± 05 (5)	15 ± 2 (4)	18 ± 05 (5)
Neck-bite hold	11	10 ± 05 (5)	12 ± 07 (7)	13 ± 06 (6)	13 ± 05 (5)	10 ± 05 (5)
Push-up	12	18 ± 05 (7)	19 ± 07 (10)	18 ± 06 (8)	17 ± 07 (10)	16 ± 05 (8)
Stationary	13	10 ± 02 (10)	08 ± 02 (10)	12 ± 04 (12)	10 ± 02 (8)	9± 03 (9)
Straddle	14	22 ±08 (20)	22 ± 10 (20)	18 ± 10 (10)	18 ± 08 (8)	21 ± 09 (10)
Tail up at base	15	15 ± 07 (10)	14 ± 06 (10)	15 ± 06 (10)	18 ± 10 (10)	15 ± 06 (6)
Tail twist	16	16 ± 02 (10)	15 ± 01 (10)	16 ± 02 (9)	15 ± 01 (10)	16 ± 02 (10)

With the onset of the breeding season the male and female both develop colouration at their ventral side and dorsal side. The coloration of the dorsal side is bright and shiny in the females compared tothe males. But the ventral side coloration of the female is duller than the males. It is particularly developed in the breeding season. A light blue color was developed in the neck.

A total of 16 traits were being observed and studied.

It was observed that female choose male partners with bright colour than the dull male.

4. DISCUSSION

We studied the ethogram whose prime role is to facilitates comparison among species. Among the other lizards a variety of data are available, but little can be seen about *Mabuya multifasciata*. Sexual dimorphism of *Mabuya multifasciata* in China shows bigger head in male than female, but the abdomen is bigger in female than male [5]. Our discussion is speculative and mainly based on a comparative study of P.B Truong et al. [6]. They mention changes in the colour of the body of the males as the prime step towards courtship. Whereas the female produces colour particularly during the egg bearing season. However in case of other skinks this particular mating behavior may not be observed.

Indirect evidence suggests that Texas *Mabuya* are more aggressive than other lizards [7].

The present ethogram mentioned here shows the simple sequences of events during courtship of

Mabuya multifasciata.However to know better and to understand more visual cues have to correlate with a wide range of data of phylogenetically similar species. It will help to understand the mating behaviourof *Mabuya multifasciata* on evolutionary scale. We hope that our study will provide a baseline for study more on this topic in the future.

The females during the time of September and October are making moves away from their terrain and in natural habitat they were making their move away from their burrows. This behavior was not observed in any other months and in the males. For *Mabuya multifasciata*, September to October is a high time for mating and reproduction. The female movements suggests that their function is to attract male mating partners [8].

Females in the present study are having a relatively larger value of SVL,which produces heavier clutches. Earlier reportes in some lizards like orientalLeaf-Toad Gecko Hemidactylus bowringii(Xu and Ji, 2007) showa negative correlation between clutch mass and female size, which is smaller better explains female SSD in the two viviparopus species, as the energy allocation was preferable for production of offspring rather than growth of the offspring.

5. CONCLUSION

The reproductive pattern of the lizards is the most frequent topic of study during the recent past. But skinks dominate the most area of study among the lizards. *Tropiduruscatalanensis*–formerly*T. torquatus*,Ortiz et al. [9], *Kentropyxviridistriga*,Ortiz et al. [10], *Ophiodes intermedius*,Ortiz et al., [10] *Amphisbaena mertensii*,Aguirre et al., 2017 are the few species studied till date [11-13]. This current article is a part of original research done during 2011-2017 in Assam, India. But there is enormous future scope to study about the reproductive pattern of *Mabuya multifasciata* regarding the beautiful colour being developed during the breeding season [14-16]. The genes involved in the breeding colouration has the enormous scope to study in details in a controlled experiment and its genotypic and phenotypic effect of the environment [17]. It will enhances our area of knowledge regarding the unique species of skinks relating its phylogeny. We hope that these observations may also help resolve the taxonomic intricacies within the genus *Mabuya* [18-20].

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of this manuscript. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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