

## Death-feigning behaviour in an *Erythrolamprus miliaris* (LINNAEUS 1758) water snake in Ubatuba, São Paulo, southeastern Brazil (Dipsadidae)

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Thanatosis is a defensive behaviour in which an animal adopts a posture that gives it the appearance of being dead, which may inhibit or deviate the attack of a potential predator (Honma et al., 2006). Apparently, it is a fear-mediated response that usually occurs following physical handling or restraint (Gallup, 1977; Misslin, 2003). This antipredator defensive behaviour is found in a wide variety of animals such as insects (Acheampong and Mitchell, 1997), mites (Ebermann, 1991), fishes (Howe, 1991), amphibians (Toledo et al., 2010), reptiles (Santos et al., 2010), birds (Sargeant and Eberhardt, 1975) and mammals (Francq, 1969).

In snakes, death feigning includes immobility and mouth gaping, often with the tongue hanging out and, in more dramatic situations, involves voluntary supination and/or lack of muscle tone (Greene, 1988; Gregory et al., 2007). This behaviour in snakes has already been observed both in Scolecophidia and Caenophidia (Gehlbach, 1970; Vogel and Han-Yuen, 2010). In this latter group, death feigning is widespread among colubrids and natricids, and also occurs in elapids (Bhosale and Thite, 2013; Gerald, 2008; Marques et al., 2013; Mirza et al., 2011; Sannolo et al., 2014). Nevertheless, in spite of the high diversity of Neotropical dipsadids, thanatosis has rarely been reported among members of this family (Vogel and Han-Yuen, 2010).

*Erythrolamprus miliaris* is a non-venomous mid-sized snake (Giraud, 2001). It has a wide geographic range,

occurring in most of South America east of the Andes (Dixon, 1983). The species has semi-aquatic habits and feeds mainly on anuran amphibians (Carreira-Vidal, 2002; Pombal, 2007; Sazima and Haddad, 1992; Vitt, 1983). It has both diurnal and nocturnal activity (Sazima and Haddad, 1992), favouring the action of visually oriented predators.

We found an individual of *E. miliaris* on 21st May 2014, at 09:28h, close to a trail's edge in low altitude Atlantic Forest during routine data collection in an ongoing fauna survey of a 131.6 hectare private conservation area belonging to a non-profit organization called Projeto Dacnis (-23.461944S, -45.133889W, Datum WGS-84, 22 meters above sea level), in Ubatuba, São Paulo state, Brazil. The specimen was crossing the trail when it was captured for identification and body measurements



**Figure 1.** Observed adult *Erythrolamprus miliaris* displaying a discreet dorsoventral body compression and hiding its head under its body as defensive behaviour. Photo by Edélcio Muscat.

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**Figure 2.** Observed adult *Erythrolampus miliaris* displaying a thanatosis defensive behaviour. Photo by Edélcio Muscat.

(total length 52.7 cm and snout-vent length 41.5 cm). We handled the animal to take a photograph when it hid its head under its body as defensive behaviour (Figure 1).

After biometry, the individual was released. That was when we first recorded thanatosis on *E. miliaris*. When released on the ground, the specimen turned almost its entire body exposing the ventral scales (Figure 2). During this moment the snake became flaccid, motionless, and did not defecate or open its mouth. After a few seconds, the snake tightened up and became alert again.

Most attacks on snakes by avian and mammalian predators are directed to the head of the prey (Curio, 1976; Smith, 1976; Jackson, 1979). Due to these, head hiding is a widespread behaviour on snakes (Araujo and Martins, 2006; Mori and Burghardt, 2004; Sazima and Abe, 1991; Tozzeti *et al.*, 2009), used to distract the predator's attack away from the (vulnerable) head by attracting it to the (less vulnerable) tail or midbody (Arnold and Bennett 1984; Greene 1988; Langkilde, Shine and Mason, 2004).

Thanatosis is a defensive behaviour to deprive the predator stimulus of moving potential prey and thus cause the suspension in predatory behaviour (Pasteur, 1982). Thanatosis is known in a large number of snakes species (Jelić and Vilaj, 2011; Marques *et al.*, 2013; Mirza *et al.*, 2011; Vogel and Han-Yue, 2010). However, this is the first record for *E. miliaris*. Future studies and more observations in the Projeto Dacnis reserve will help to elucidate the diversity in antipredator behaviours

that a single specimen or population is able to perform as responses to predator attack.

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## References

- Acheampong, A., Mitchell, B.K. (1997): Quiescence in the Colorado potato beetle, *Leptinotarsa decemlineata*. *Entomologia Experimentalis et Applicata* **82**: 83-89.
- Araújo, M.S., Martins, M. (2006): Defensive behaviour in pit vipers of the genus *Bothrops* (Serpentes, Viperidae). *Herpetological Journal* **16**: 297-303.
- Arnold, S.J., Bennett, A.F. (1984): Behavioral variation in natural populations. III. Antipredator displays in the garter snake *Thamnophis radix*. *Animal Behaviour* **32**: 1108—1118.
- Bhosale, H.S., Thite, V. (2013): Death feigning behavior in large-eyed false cobra *Pseudoxenodon macrops* (Blyth, 1854) (Squamata: Colubridae). *Russian Journal of Herpetology* **20**(3): 190-192.
- Carreira-Vidal, S. (2002): Alimentación de los ofidios de Uruguay. *Monografía de Herpetología*, volume 6. Barcelona, ESP, Asociación Herpetológica Española.
- Curio, E. (1976): *The Ethology of Predation*. New York, USA, Springer Verlag.
- Dixon, J.R. (1983): Taxonomic status of the South American snakes *Liophis miliaris*, *L. amazonicus*, *L. chrysostomus*, *L. mossoroensis* and *L. purpurans*. *Copeia* **1983**(3): 791-802.
- Ebermann, E. (1991): Thanatosis or feigning death in mites of the family Scutacaridae. In: *The Acari. Reproduction, development and life-history strategies*, p. 399-401. Schuster, R, Murphy, P.W., Eds., London, ENG: Chapman & Hall.
- Franco, E.N. (1969): Behavioral aspects of feigned death in the opossum *Didelphis marsupialis*. *The American Midland Naturalist Journal* **81**: 556-567.
- Gallup, G. (1977): Tonic immobility: The role of fear and predation. *Psychological Record* **27**: 316-317.
- Gehlbach, F.R. (1970): Death-feigning and erratic behaviour in leptotyphlopoid, colubrid, and elapid snakes. *Herpetologica* **26**: 24-34.
- Gerald, G.W. (2008): Feign versus flight: influences of temperature, body size and locomotor abilities on death feigning in neonate snakes. *Animal Behaviour* **75**: 647-654.
- Giraudó, A. (2001): *Serpientes de la Selva Paranaense y del Chaco Húmedo*. Buenos Aires, ARG, L.O.L.A.
- Greene, H.W. (1988): Antipredator mechanisms in reptiles. In: *Biology of the Reptilia*. Vol. 16, Ecology B, Defense and Life History, p. 1- 152. Gans, C., Huey, R.B., Eds., New York, USA, Alan R. Liss Inc.
- Gregory, P.T., Isaac, L.A., Griffiths, R.A. (2007): Death-feigning by grass snakes (*Natrix natrix*) in response to handling by human "predators". *Journal of Comparative Psychology* **121**: 123-129.
- Honma, A., Oku, S., Nishida, Y. (2006): Adaptive significance of death feigning posture as a specialized inducible defence against

- gape-limited predators. *Proceedings of the Royal Society of London* **273**: 1631-1636.
- Howe, J.C. (1991): Field observations of death feigning in the convict tang, *Acanthurus triostegus* (Linnaeus), with comments on the nocturnal color pattern in juvenile specimens. *Journal of Aquaculture and Aquatic Sciences* **6**: 13-15.
- Jackson, J.F. (1979): Effects of some ophidian tail displays on the predatory behavior of grison (*Galictis* sp.). *Copeia* **1979**, 169-172.
- Jelić, D. and VILAJ, I. (2011): Remarks on death feigning in *Coronella austriaca* (Laurenti, 1768), *Natrix natrix* (Laurenti, 1768) and *Natrix tessellata* (Laurenti, 1768). *Hyla* **2**: 31-33.
- Langkilde, T., Shine, R., Mason, R.T. (2004): Predatory attacks to the head vs. body modify behavioral responses of garter snakes. *Ethology* **110**:937-947.
- Marques, O.A.V., Banci, K.R.S., Strüssmann, C. (2013): Death-feigning behaviour in water snakes of the genus *Hydrodynastes* (Dipsadidae) from South America *Herpetology Notes* **6**: 95-96.
- Mirza, Z.A., Vaze, V.V., Sanap, R.V. (2011): Death feigning behavior in two species of the genus *Lycodon* of Asia (Squamata: Colubridae). *Herpetology Notes* **4**: 295-297.
- Misslin, R. (2003): The defense system of fear: Behaviour and neurocircuitry. *Clinical Neurophysiology* **33**: 55-66.
- Mori, A., Burghardt, G.M.. (2001): Temperature effects on anti-predator behaviour in *Rhabdophis tigrinus*, a snake with toxic nuchal glands. *Ethology* **107**:795-811.
- Pasteur, G. (1982): A classificatory review of mimicry systems. *Annual Review of Ecology and Systematics* **13**: 169-199.
- Pombal-Jr, J.P. (2007): Notas sobre predação em uma taxocenose de anfíbios anuros no sudeste do Brasil. *Revista Brasileira de Zoologia* **24**(3): 841-843.
- Sannolo, M., Gaati, F., Scali, S. (2014): First record of thanatosis behaviour in *Malpolon monspessulanus* (Squamata: Colubridae). *Herpetology Notes* **7**:323.
- Santos, M.B., Oliveira, M.C.L.M., Verrastro, L., Tozetti, A.M. (2010): Playing dead to stay alive: death-feigning in *Liolaemus occipitalis* (Squamata: Liolaemidae). *Biota Neotropica* **10**: 361-364.
- Sargeant, A.B., Eberhardt, L.E. (1975): Death feigning by ducks in response to predation by red foxes (*Vulpes fulva*). *The American Midland Naturalist Journal* **94**: 108-119.
- Sazima, I., Abe, A.S. (1991): Habits of five Brazilian snakes with coral-snake pattern, including a summary of defensive tactics. *Studies on Neotropical fauna and environment* **26**: 159-164.
- Sazima, I., Haddad, C.F.B. (1992): Répteis da Serra do Japi: notas sobre história natural. In: *História Natural da Serra do Japi. Ecologia e Preservação de uma área florestal no sudeste do Brasil*, p. 212-231. Morellato, L. P.C., Ed., Campinas, BRA, Editora da Unicamp/FAPESP.
- Smith, S.M. (1976): A study of prey-attack behaviour in young loggerhead shrikes, *Lanius ludovicianus* L. *Behavior* **44**: 113-141.
- Toledo, L.F., Sazima, I., Haddad, C.F.B. (2010): Is it all death feigning? Case in anurans. *Journal of Natural History* **44**: 31-32.
- Tozetti, A.M., Oliveira, R.B., Pontes, G.M.F. (2009): Defensive repertoire of *Xenodon dorbignyi* (Serpentes, Dipsadidae). *Biota Neotropica* **9**(3): 157-163.
- Vitt, L.J. (1983): Ecology of an anuran-eating guild of terrestrial tropical snakes. *Herpetologica* **39**: 52-66.
- Vogel, G., Han-Yuen, H.K. (2010): Death feigning behavior in three colubrid species of tropical Asia. *Russian Journal of Herpetology* **17**: 15-21.