

On the taxonomy of the *Xenochrophis piscator* complex (Serpentes, Natricidae)

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Abstract. In this paper, we present the preliminary results of our revision of the Asian natricid snakes currently known as *Xenochrophis piscator* / *Xenochrophis flavipunctatus*. We divide this complex into eight taxa, of which seven are given a specific status; the status of eighth one is still provisional. *Xenochrophis flavipunctatus* is shown to be clearly distinct from *Xenochrophis piscator* auctorum. The taxa *melanzostus*, *schnurrenbergeri* and *asperrimus* are also shown to be distinct species. The population of the Andaman Islands belongs to a distinct species, for which the combination *Xenochrophis tytleri* is available. Specimens of “*X. piscator*” from Sri Lanka (others than *X. asperrimus*) and extreme southern India belong to an undescribed species. The distribution, based on materials examined by us and basic ecology of all these taxa are summarized.

Introduction

Malnate (1960) split the genus *Natrix* into five genera and choose the genus name *Fowlea* Theobald, 1868 for the species treated here. Later the name was changed to *Xenochrophis* Günther, 1864 to include the species *Psammophis cerasogaster* Cantor, 1839 (Malnate & Minton, 1965). The genus description was mainly based on the structure of the hemipenes and the number and form of the maxillary teeth as well as on the position of the nostrils (Malnate, 1960, Malnate & Minton, 1965).

The taxonomy of the Asian natricid species related to *Xenochrophis piscator* (Schneider, 1799), widespread throughout tropical Asia, has long been controversial. Whereas Boulenger (1896) recognized (in the genus *Tropidonotus*) the validity of three species, namely *Xenochrophis piscator* (Schneider, 1799), *Xenochrophis asperrimus* (Boulenger, 1891) and *Xenochrophis sanctijohannis* (Boulenger, 1890), Smith (1943) admitted, in the genus *Natrix*, the validity of a single species, *Natrix piscator*, with four subspecies (*piscator*, *flavipunctata*, *melanzostus* and *asperrimus*). This taxonomy was accepted until Taylor (1965) showed that two of the subspecies recognized by Smith, *piscator* and *flavipunctata* respectively were living in sympatry in northern Thailand. For the eastern species, Taylor

used the name *Natrix flavipunctata* (Hallowell, 1860), whereas the specific nomen *piscator* was retained for the western species.

This position has been variously accepted (Cox, 1991, Manthey and Grossmann, 1997, Pauwels et al., 2003) or refuted (Tweedy, 1983, Karsen et al., 1986, Zhao and Adler, 1993, Cox et al., 1998) by recent authors. Population from Indonesia were treated as a subspecies and named *X. piscator melanzostus* (Gravenhorst, 1807) in most publications (Welch, 1988; David and Vogel, 1996), but also regarded as full species in some (Iskandar and Colijn, 2001, Whitaker and Captain, 2004). In order to clarify these taxonomical problems, we investigated the morphological variation in the *X. piscator* complex on the basis of about 450 specimens from the whole range of the complex.

Materials and methods

In this first step, only univariate analyses on main morphological characters, scalation and pattern, were conducted. Measurements on bodies were made to the nearest millimeter. The number of ventral scales was counted according to Dowling (1951). The terminal scute, present, is not included in the number of subcaudals.

Abbreviations: Sc: number of subcaudal plates. - TaL: tail length. - TL: total length. - TaL / TL: ratio tail length / total length. - Ven: number of ventral plates.

Results

Results of the preliminary analyses are presented in Table 1. In a quite unexpected way, these preliminary data revealed eight clearly defined groups. Seven of these groups, of which the distribution overlap but for which morphological characters are well separated without or with little overlapping, are here recognized as distinct species. The status of the last

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Data	n	Ve	Sc	TA/TL	TL max	Nuchal mark
Males						
<i>flavipunctatus</i>	34	122-130	78-91	0,289-0,348	784	V like
" <i>sanctijohannis</i> "	6	139-140	88-94	0,276-0,325	862	None
<i>schnurrenbergeri</i>	10	132-139	71-80	0,257-0,283	700	Crossbar
<i>piscator</i>	10	132-143	85-99	0,293-0,329	947	Inverted V
<i>Xenochrophis</i> sp.	9	125-132	88-93	0,303-0,353	629	Inverted V
<i>melanzostus</i>	6	128-134	79-83	0,286-0,302	549	Wide V
<i>asperrimus</i>	2	127-132	77-89	0,290-0,314	612	Crossbar
<i>tytleri</i>	6	135-138	---	---	---	Wide V
females						
<i>flavipunctatus</i>	35	131-143	70-87	0,256-0,306	974	V like
" <i>sanctijohannis</i> "	2	148-154	84-87	0,266-0,270	637	None
<i>schnurrenbergeri</i>	20	141-152	61-70	0,215-0,236	895	Crossbar
<i>piscator</i>	22	136-151	68-87	0,264-0,290	1020	Inverted V
<i>Xenochrophis</i> sp.	6	131-138	79-91	0,284-0,305	714	Inverted V
<i>melanzostus</i>	11	136-142	66-77	0,233-0,254	975	Wide V
<i>asperrimus</i>	7	132-140	75-83	0,257-0,283	890	Crossbar
<i>tytleri</i>	5	144-145	77-79	0,279	920	Wide V

Table 1. Main morphological characters of the *Xenochrophis piscator* complex.

one, *X. sanctijohannis* auctorum, is still doubtful and requires further research.

The seven species defined here are easily distinguishable by a combination of meristic characters, if sexes are considered separately, and of their pattern. The pattern is especially important in this complex. Some characters, very easy to identify, are absolutely constant among several tens, if not hundred of specimens.

One character that has seemingly been overlooked by all previous herpetologists is the shape of the nuchal marking. Either it is absent, a common case in *X. piscator* and *X. "sanctijohannis"*, or only four shapes are present, as follows:

- 1) An inverted V, namely the marking opens posteriorly when seen from above.
- 2) A direct V, namely the marking opens anteriorly on the nape.
- 3) A straight, broad, often subrectangular crossbar.
- 4) A widely open U or even a double YY, present in populations from Indonesia and the Andaman Islands.

This character may seem to be trivial, but we could not identify any exception but two specimens of *X. flavipunctatus* among our 450 examined specimens. Beside the differences in pholidosis, there are also differences in biology especially in the mainland species. For example, *Xenochrophis piscator* often occurs close to water, but is not strongly aquatic. In contrast, *X. flavipunctatus* and *X. schnurrenbergeri* are more strongly aquatic, spending a large part of their time in water to which they retreat swiftly when threatened (Taylor, 1965, Kramer, 1977, our unpublished observations).

From our results, we recognize the species listed above. In this preliminary paper, we put emphasis on readily visible characters, especially the pattern.

Xenochrophis piscator (Schneider, 1799)

As we define it, this species occurs in the western part of the complex and is distributed throughout India, Pakistan, Nepal, Bangladesh, much of Myanmar, northern and northwestern Thailand and northwestern Laos. It barely enters China in



Figure 1. Distribution of the species of the *X. piscator* complex. Blue: *Xenochrophis piscator*; Red: *X. flavipunctatus*; Yellow: *X. tyleri*; Green: *X. melanzostus*; Violet: *X. schnurrenbergeri*; Pink: *X. asperrimus* and *Xenochrophis* sp.

southwestern Yunnan Province and in western Guangxi Province.

This is the largest of all species of this complex, with a total length up to 947 mm in males and 1020 mm in females. It is characterized by (1) a chess-like pattern on the body, sometimes with broad blotches and very conspicuous (northeastern India), sometimes with smaller blotches; (2) large, more or less diffuse (“cloudy”) cream or pale grey dorsolateral blotches; (3) a nuchal marking often absent, if not always present as an inverted V; (4) subocular streaks faint, reduced to a blotch or absent; (5) a venter uniform, with the ventrals darker only on the outermost edges; (6) a high number of ventral and subcaudal scales in males.

It is mostly a lowland species.

Xenochrophis asperrimus (Boulenger, 1891)

This form was accepted as a valid species by most recent authors (de Silva, 1990, Das, 2005). Nevertheless Wall (1921) regarded it as a colour variation of *X. piscator*, and Smith (1943) as a subspecies of this species. Our data suggest that this taxon deserves a distinct specific status.

It is living on Sri Lanka sympatrically with *Xenochrophis* sp. (see below).

This species is characterized by (1) a peculiar dorsal pattern made of broad, dark, confluent blotches on a paler background anteriorly, separated blotches posteriorly; (2) a broad, subrectangular crossbar on the nape, as in *X. schnurrenbergeri* but even wider; (3) two narrow subocular streaks; (4) a venter uniform, with the ventrals darker only on the outermost edges or their tips; (5) a high number of ventrals in both sexes.

Furthermore it differs from *Xenochrophis* sp. by a higher number of ventrals in males and by a lower number of subcaudals and a shorter tail in females.

Xenochrophis flavipunctatus (Hallowell, 1860)

This species inhabits the eastern and northern part of the range of this complex. It is sympatric with *X. piscator* in northern Thailand, southern Myanmar, northwestern Laos and extreme southern China. It is the sole species present in Cambodia, Vietnam and West-Malaysia. It is also found throughout Thailand, Laos and southern China.

This species is characterized by (1) a dorsal pattern made of small dark blotches and streaks, larger on the sides; (2) small, white or yellow dorsolateral dots; (3) a well-defined nuchal marking, always appearing as a direct V (at the exception of two specimens from North Thailand); (4) two well-defined subocular streaks, the posterior one extending from the eye to the corner of the mouth then meeting the V-marking; (5) ventral and subcaudal scales all with entire, broad, dark margins; (6) a rather low number of ventral scales in males. The number of ventrals in males is lower than in *X. piscator*, but there is a wide overlap in females.

X. flavipunctatus is very variable in colouration and in dorsal pattern, but this variability is not geographically correlated. The colouration of a specimen found in Singapore may have the same colour than one from South China. There are often some red or yellow hues on the forepart of the body.

It is mostly a lowland species.

Xenochrophis melanzostus (Gravenhorst, 1807)

This species has mostly been regarded as a subspecies of *X. piscator* in the literature. According to our data, there is little doubt about the distinct specific status of this form. It is more similar to *X. flavipunctatus* than to *X. piscator*.

X. melanzostus is probably endemic to Java. It has been mentioned for Sulawesi and Borneo, but these records are erroneous (Stuebing and Inger, 1999, Lang and Vogel, 2005). Its occurrence in Sumatra has yet to be confirmed. The population from the Andaman Islands is here referred to a distinct species (see below).

This species is characterized by (1) two different dorsal patterns: (a) a blotched form, characterized by elongated blotches, and (b) a striped form, with

broad dark longitudinal stripes; (2) a well-defined nuchal marking, always appearing as a direct, widely open V or U; (3) two well-defined subocular streaks; (4) ventral and subcaudal scales all with entire, broad, dark margins; (5) a high number of ventral scales in males; (6) a tail shorter in females than in other species of the complex; (7) a lower number of subcaudal scales than in other species of the complex.

The number of ventrals in males is higher than in *X. flavipunctatus*, with some overlap. *X. melanzostus* also differs from *X. flavipunctatus* by its colouration. It differs from *Xenochrophis schnurrenbergeri* by a longer tail.

It is a lowland species, but little is known on its ecology.

Xenochrophis schnurrenbergeri Kramer, 1977
new combination

This taxon has obviously been overlooked by most herpetologists. It occurs at the northern limits of the range of *X. piscator*, with which it lives in sympatry over most of its range. Smith (1943) misidentified a specimen from Assam as *X. flavomaculatus*. This species was first known as *Xenochrophis flavipunctatus schnurrenbergeri* Kramer, 1977, described from Nepal. Beside Nepal, we identified as such many specimens from Pakistan and northern India, close to the Himalayas.

This species is characterized by (1) a dorsal pattern chess-like, but made of small dark blotches; (2) a broad, straight crossbar on the nape; (3) two well-defined subocular streaks, the posterior one extending from the eye to the corner of the mouth but not meeting the nuchal crossbar; (4) ventral and subcaudal scales all with entire, broad, dark margins; (5) a low number of subcaudals in both sexes, lower than in the other species; (6) a lower relative tail length than in *X. piscator* or *X. flavipunctatus*. There is no overlap if the sexes are considered separately. Lastly, this species is a little bit shorter than *X. piscator* or *X. flavipunctatus*.

It is both a lowland and hill species. In ecology it is close to *X. flavipunctatus* with which it is parapatric.

Xenochrophis tytleri (Blyth, 1863)

This species has variously been cited as *X. piscator melanzostus* (Das 1999) or *X. melanzostus* (Whitaker and Captain, 2004) in the literature. Our data

suggest that this taxon deserves a specific status, for which the binomen *Tropidonotus tytleri* Blyth, 1863 is available. It is endemic to Andaman Islands and possibly Nicobar Islands. It is not sympatric with any other species.

This species is characterized by (1) a dorsal pattern made of much elongated, dark blotches, sometimes producing stripes; (2) a well-defined nuchal marking, appearing as a broad, direct, widely open U, connected to the dorsolateral stripes; (3) two broad subocular streaks (broader than in any other species of the complex), the posterior one extending from the eye to the corner of the mouth then meeting the nuchal U; (4) ventral and subcaudal scales entirely uniform or only darkened on their tips; (5) a higher number of ventrals in both sexes than *X. melanzostus*, the sole species sharing a similar pattern.

It is a lowland species, but nothing is known on its ecology.

Xenochrophis sp.

This form has been called *X. piscator* until now. We regard it as a new, undescribed species, sharing characters of both *X. piscator* and *X. flavipunctatus*, but not of *X. asperrimus* with which it is sympatric in Sri Lanka.

This species is characterized by (1) a pattern similar to *X. piscator*, with small blotches; (2) an inverted V like pattern; (3) two narrow subocular streaks; (4) a venter uniform, with the ventrals darker only on the outermost edges or their tips; (5) a lower number of ventrals than *X. piscator* in males, but about the same as in *X. flavipunctatus*. The females have more subcaudals than other species of this complex and thus are easy to tell apart.

Xenochrophis “*sanctijohannis*” (Boulenger, 1890) We cannot yet conclude about the status of this taxon. Although typical *X. sanctijohannis* differ from typical *X. piscator*, there are several intermediate morphs. This taxon is known from higher elevations in Nepal, northern India and northern Myanmar.

It differs from *X. piscator* especially by a patternless body and a slightly higher number of ventral scales. However, the dark patternless body may be an adaptation to the ecological conditions of high mountains rather a taxonomical difference.

This paper is a preliminary step towards a revision

of the *Xenochrophis piscator* complex. Some specimens could not be assigned to any species yet, for example animals from Indonesia and South India. These populations will be discussed in a subsequent paper.

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References

- Boulenger, G.A. (1896): Catalogue of the Snakes in the British Museum (Natural History). Volume III. Containing the Colubridae (Opisthoglyphae and Proteroglyphae), Amblycephalidae and Viperidae. London, British Museum (Natural History).
- Cox, M.J. (1991): The snakes of Thailand and their husbandry. Malabar, Florida, Krieger Publishing Co.
- Cox, M.J., van Dijk, P.P., Nabhitabhata, J., Thirakhupt, K. (1998): A Photographic Guide to Snakes and other Reptiles of Peninsular Malaysia, Singapore and Thailand. London, Cape Town, Sydney, Singapore, New Holland Publishers.
- Das, I. (1999): Biogeography of the amphibians and reptiles of the Andaman and Nicobar Islands, India. In: Tropical Island Herpetofauna: Origin, Current Diversity, and Conservation, 43-77. Ota, H., Ed, Elsevier, Amsterdam.
- Das, I. (2005): Snakes and other reptiles of Sri Lanka. New Holland Publishers, London, Cape Town, Sydney, Singapore.
- David, P., Vogel, G. (1996): The Snakes of Sumatra. An annotated checklist and key with natural history notes. - Edition Chimaira, Frankfurt am Main.
- de Silva, A. (1990): Colour guide to the snakes of Sri Lanka. Avon, R & A Publ. Ltd., Portishead.
- Dowling, H. G. (1951): A proposed standard system of counting ventrals in snakes. Brit. J. Herpet., London, 1 (5): 97-99.
- Iskandar, D.T., Colijn, E. (2001): A checklist of Southeast Asian and New Guinean Reptiles. Part I: Serpentes. Biodiversity Conservation Project (Indonesian Institute of Sciences - Japan International Cooperation Agency - The Ministry of Forestry), The Gibbon Foundation and Institute of Technology, Bandung.
- Karsen, S.J., Lau, M. W.-n., Bogadek, A. (1986): Hong Kong amphibians and reptiles. Urban Council, Hong Kong.

- Kramer, E. (1977): Zur Schlangenfauna Nepals. *Rev. suisse Zool.*, **84** (3): 721-761.
- Lang, R. de, Vogel, G. (2005): The snakes of Sulawesi. Edition Chimaira, Frankfurter Beiträge zur Naturkunde, **25**, Frankfurt am Main.
- Malnate, E. V. (1960) Systematic division and evolution of the colubrid snake genus *Natrix*, with comments on the subfamily Natricinae. *Proc. Acad. nat. Sci. Philadelphia*, **112** (3): 41-71.
- Malnate, E. V., Minton, S. A. (1965): A redescription of the natricine snake *Xenochrophis cerasogaster*, with comments on its taxonomic status. *Proc. Acad. nat. Sci. Philadelphia*, **117** (2): 19-43.
- Manthey, U., Grossmann, W. (1997): Amphibien und Reptilien Südostasiens. Natur und Tier-Verlag, Münster.
- Pauwels, O.S.G., David, P., Chimsunchart, C., Thirakhupt, K. (2003): Reptiles of Phetchaburi Province, Western Thailand: a list of species, with natural history notes, and a discussion on the biogeography at the Isthmus of Kra. *The Natural History Journal of Chulalongkorn University* **3**: 23–53.
- Smith, M.A. (1943): The Fauna of British India, Ceylon and Burma, including the whole of the Indo-Chinese Sub-region. Reptilia and Amphibia. Vol. III. Serpentes. Taylor & Francis, London.
- Stuebing, R.B., Inger, R.F. (1999): A fieldguide to the snakes of Borneo. Natural History Publications, Kota Kinabalu.
- Taylor, E.H. (1965): The serpents of Thailand and adjacent waters. *Univ. Kansas Sci. Bull.* **45**: 609-1096.
- Tweedie, M.W.F. (1983): The snakes of Malaya. 3rd edition. Singapore National Printers, Singapore.
- Wall, F. (1921): *Ophidia taprobanica*, or the snakes of Ceylon. H. R. Cottle, Colombo.
- Welch, K.R.G. (1988): Snakes of the Orient: a checklist. Robert F. Krieger Publ. Co., Malabar, Florida.
- Whitaker, R., Captain, A. (2004): Snakes of India. The field guide. Draco Books, Chennai.
- Zhao, E.M., Adler, K. (1993): Herpetology of China. Society for the Study of Amphibians and Reptiles, *Contrib. Herpetol.* **10**, Athens, Ohio.