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A brief review of the origin and use of '*stellio*' in herpetology and a comment on the nomenclature and taxonomy of agamids of the genus *Agama* (sensu lato)

(Squamata: Sauria: Agamidae)

Kurzübersicht über die Herkunft und Verwendung von "*stellio*" in der Herpetologie und Kommentar zur Nomenklatur und Taxonomie von Agamen, Gattung *Agama* (sensu lato)

(Squamata: Sauria: Agamidae)

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ABSTRACT

The name 'stellio' has received a wide and variable application in herpetology. Its use antedates modern nomenclature. The name was applied mainly to various agamid and gekkonid species. In modern usage, confusion exists primarily with its use as a genus, i. e., *Stellio*. To solve this problem, STEJNEGER (1936) designated *Stellio saxatilis* of LAURENTI, 1768 which is based on a figure in SEBA (1734) as the type species. This species is unidentifiable.

In an unpublished thesis, MOODY (1980) split the genus *Agama* (s. l.) into six genera. He overlooked STEJNEGER's (1936) designation and reused *Stellio* for the *stellio*-group of agamid lizards. Many authors followed MOODY (1980). Recently, some authors pointed out that *Stellio* is unavailable but did not fully discuss the implications for agamid nomenclature. It is argued that a satisfactory nomenclature is difficult with current knowledge of agamid taxonomy. It is suggested to restrict *Laudakia* to *L. tuberculata* and to use *Plocederma* for the *stellio*-group (sensu stricto).

KURZFASSUNG

Der Name "stellio" sah eine breite und vielfältige Verwendung in der Herpetologie, die weit über die moderne Nomenklatur zurückreicht. Vorwiegend wurden mit diesem Namen verschiedene Gecko-Arten und Agamen der Gattung *Agama* (sensu lato) bezeichnet. Verwirrung entstand bezüglich der korrekten Verwendung als Gattungsname. Zur Lösung der Probleme designierte STEJNEGER (1936) *Stellio saxatilis* LAURENTI, 1768 als Typusart, ein auf einer Abbildung von SEBA (1734) basierendes, nicht identifizierbares Taxon.

In einer unveröffentlichten Doktorarbeit unterteilte MOODY (1980) die Gattung *Agama* (s. l.) in sechs eigenständige Gattungen. Er übersah STEJNEGER's (1936) Festlegung der Species typica und brachte *Stellio* wieder in Gebrauch für Agamen der *stellio*-Gruppe. Viele Autoren folgten ihm. Nur vereinzelt haben Autoren darauf hingewiesen, daß *Stellio* nicht verfügbar ist, aber die Konsequenzen für die Nomenklatur von Agamen unvollständig diskutiert. Es wird aufgezeigt, daß beim gegenwärtigen Wissensstand der Taxonomie von Agamen eine befriedigende Nomenklatur schweirig ist. Als Vorschlag wird unterbreitet, den Gebrauch des Gattungsnamens *Laudakia* auf *L. tuberculata* zu beschränken und den Namen *Plocederma* für die *stellio*-Gruppe im engeren Sinne zu verwenden.

KEYWORDS

Stellio: availabilty, type species; *Agama, Laudakia, Plocederma*: nomenclature, taxonomy, phylogeny

THE USE OF '*STELLIO*' IN HERPETOLOGY

The name 'stellio' is one of the oldest vernacular names known for any lizard. It has received a widespread and varying application both in pre-Linnean and post-Linnean times. Currently, most authors use the generic name *Stellio* for agamids of the *stellio*-group of the formerly more inclusive genus *Agama* (e. g., SCHÄTTI 1989; ANANJEVA & al. 1990; CORBETT 1990; JOGER 1991). Few authors differ: ARNOLD (1986) retains the genus *Agama* (sensu lato) but recognized *Stellio* as a subgenus. BAIG & BÖHME (1991) also use *Agama* (s. l.); they point out that *Stellio* is not available as a generic name. LEVITON & al. (1992) also briefly state that *Stellio*

is unavailable but suggest to call agamids of the *stellio*-group *Laudakia*. They are followed by others (e. g., FRANZEN & SCHMIDTLER 1993). As none of these authors explain in detail why the name is unavailable and only partly discuss the ensuing consequences, it is of general interest to briefly review the use of the name *stellio*. The more so, as BAIG & BÖHME (1991) and LEVITON & al. (1992) arrive at different conclusions.

The name 'stellio' has a Latin origin and appeared for the first time in the Latin literature around the first century a. d. (BYL 1986, 1987). Most etymologists agree that the animals in question were named 'stellio' because of their colour pattern resembling stars, though other explanations exist (e. g., SCHNEIDER [1811] believes that 'stellio' alludes to dorsal tubercles in addition to white spots; see also BYL [1987]). Philologists discuss at length the possible idendity of the animals and arrive at different conclusions. Whereas some argue that scorpions are the appropriate candidates others regard lizards and generally geckos as the correct animals (see LEITNER 1972; BYL 1987 - and literature cited therein). Etymological explanations are generally neglected in attempts to identify the animals in question.

Most philologists use PLINIUS as the prime source of information about 'stellio' as do later zoologists (e. g., GESNER 1554; PAOLI 1771; CETTI 1777; SCHNEIDER 1811; BONAPARTE 1835; DUMÉRIL & BIBRON 1836). These zoologists agree that PLINIUS called geckos 'stellio' while the Greek folk used the name 'ascalabotes' for these reptiles. Most of these zoologists, though not all, also believe that the species in question is *Tarentola mauritanica*. Their arguments are based on the use of the name 'stellio' in concurrent vernacular language. Latins and people in many places in Toscany called geckos 'stellio'. Rural Sards called geckos 'pistilloni' (CETTI 1777). Currently, 'lo stellione' (and 'lo scarpino') is still used by some Sicilians for *T. mauritanica* (HENLE - unpubl. pers. experience). However, elsewhere in Italy, geckos usually were called tarentola.

According to ARISTODELES, the animals in question which he called 'ascalabotes' live primarily in Thrace and Nikandro but also in Sicily. He, and PLINIUS, regard their biology as considerably different in the two areas; e. g., they believe that Greek animals are harmless but Italian ones are venomous. The mentioned Greek area is outside the current distribution of *T. mauritanica* (RIEPPEL 1981) and all other geckos except of *Cyrtopodion kotschyi* (see BÖHME 1981). It is partly covered by the range of *Agama stellio* (BEUTLER 1981). In Sicily, only geckos are found. Above arguments demonstrate that geckos must have been included in the name 'stellio', and that it is likely that agamids were included as well.

The continued confusion of geckos and agamids into the post-Linnean time adds support for this hypothesis: e. g., RAFINESQUE-SCHMALTZ (1810) names *T. mauritanica* from Segesta, Sicilly, *Agama scarpina*. Nevertheless, it is very likely that PLINIUS is talking mainly about geckos as he knows that 'stelliones' eat their own slough and informs us that the slough was used as a remedy against epilepsy. He also writes that the animals are found mainly on doors and windows of buildings and in graveyards - common habitats of *T. mauritanica* in southern Europe (HENLE - pers. observ.); only graveyards would be possible habitats of *A. stellio*. Also, PLINIUS lived predominantly in southern Italy and thus his personal experience must relate mainly to *T. mauritanica*.

Confusion surrounding the correct use of *stellio* in modern nomenclature starts right from the beginning. LINNAEUS (1758) uses *stellio* as the specific epithet of his *Lacerta stellio*. While there never has been any doubt that his *L. stellio* refers to the European agamid species *A.* [s. l.] *stellio*, trouble begins with LAURENTI's (1768) introduction of *Stellio* as a generic name. He includes eight species in his genus *Stellio* all based on figures and descriptions of SEBA (1734). Creating *Stellio*, LAURENTI deviated from his usual habit in the creation of new genera by not using a specific name introduced by

LINNAEUS as a new generic name. Instead, he omits *L. stellio* from his treatise. This certainly fooled many modern authors.

LAURENTI (1768) does not designate a type species, and because of the lack of tautonymy, none could be fixed automatically. Of the eight species included in *Stellio*, one is a skink, 3 or 4 are varanids (opinions differ on this point), and the remaining 3 to 4 remain unidentifiable (see STEJNEGER 1936).

Stellio is commonly used by zoologists of the 18th and 19th century but never in the sense of LAURENTI. Some argue that the name *Stellio* applies to geckos and use it for various genera (e. g., *Gekko*, *Uroplatus*) but do not include any of the species of LAURENTI's genus *Stellio*. SCHNEIDER (1792, 1811) is the prime advocate of this opinion (see above for further authors). In contrast to SCHNEIDER, LATREILLE (in SONNINI & LATREILLE 1801), DAUDIN (1802), MERREM (1820), and WAGLER (1830) apply *Stellio* to various agamids (mainly *Agama* s. l. but also *Uromastyx*). They also do not include any of LAURENTI's (1768) taxa. GRAY (1825) even derives a family name from *Stellio* and includes various agamid, iguanid, and cordylid genera in his Stellionidae. MERREM (1820) makes matters worse by substituting *Gecko stellio* for *Tarentola mauritanica* and *Agama tetradactyla* for LAURENTI's *Stellio saxatilis*. Fortunately, his action did not receive any wide application. For unknown reasons, the use of *Stellio* for geckos is abandoned in the second half of the 19th century, but remains in use for various agamids. It is applied primarily to agamids belonging to the genus *Agama* s. l., particularly to species in the *stellio*-group.

Because of the confusion surrounding the name *Stellio* and to stabilize well-established names (*Varanus* or *Eumeces*), STEJNEGER (in SMITH 1933) designates the taxon *Stellio saxatilis* as the type species which he believes to be unidentifiable. With STEJNEGER's action, *Stellio* falls into disuse until MOODY (1980) resurrects the genus in an unpublished thesis to accommodate agamids of the *stellio*-group. MOODY (1980) neither reviews the nomenclature of this or any of the other five genera into which he splits *Agama* s. l. nor formally diagnosed his genus *Stellio*. He and authors following him overlook STEJNEGER's type designation. Because of the continuing use of *Stellio* and the difficult accessability of SEBA (1734), it seems to be advisable to include SEBA's description together with a reprint of his figure (fig. 1):

'Tecoixin, seu Lacerta saxatilis, spinosa, cauda crassula.

Squamulae diluté cinereae, ex russo obumbratae, spinis horrent albicantibus, quarum quaelibet è macula nigro-fusca, tanquam basi, porrigitur. Neque spinis caret ipsum caput, nec femora. Cauda crassula squamulis tenuibus, cinereo-luteis, tantum vestitur. Quini sunt pedum posticorum digiti, anticorum quaterni. In locis saxosis Americae degit.'

As can be seen from this description and the accompanying figure (fig. 1), the name cannot be attributed to any known species with certainty. Returning to my earlier argument, I regard it as very likely that SEBA (1734) also combined geckos and agamids in his Lacerta saxatilis. Noteworthy, the figure is much more stylized than most others in SEBA (1734), making it likely that he and/or the artist did not have a reference individual available. The colouration could well be that of *A. stellio* though it may also apply to some species of *Gekko*. The general body form and the shape of the regenerated tail also could make this genus a candidate for Lacerta saxatilis, particularly, if one considers that in the Dutch version of SEBA, four claws instead of four digits are mentioned (KLAVER, pers. comm.). However, the toes definitely exclude geckos of the genus *Gekko*. In any case, an unequivocal species identification is impossible. Importantly, the depressed body and the regenerated tail definitely excludes agamids of the genus *Agama* s. l. Thus, *Stellio* must be regarded as a nomen dubium and remains certainly unavailable for the *A. stellio*-group.

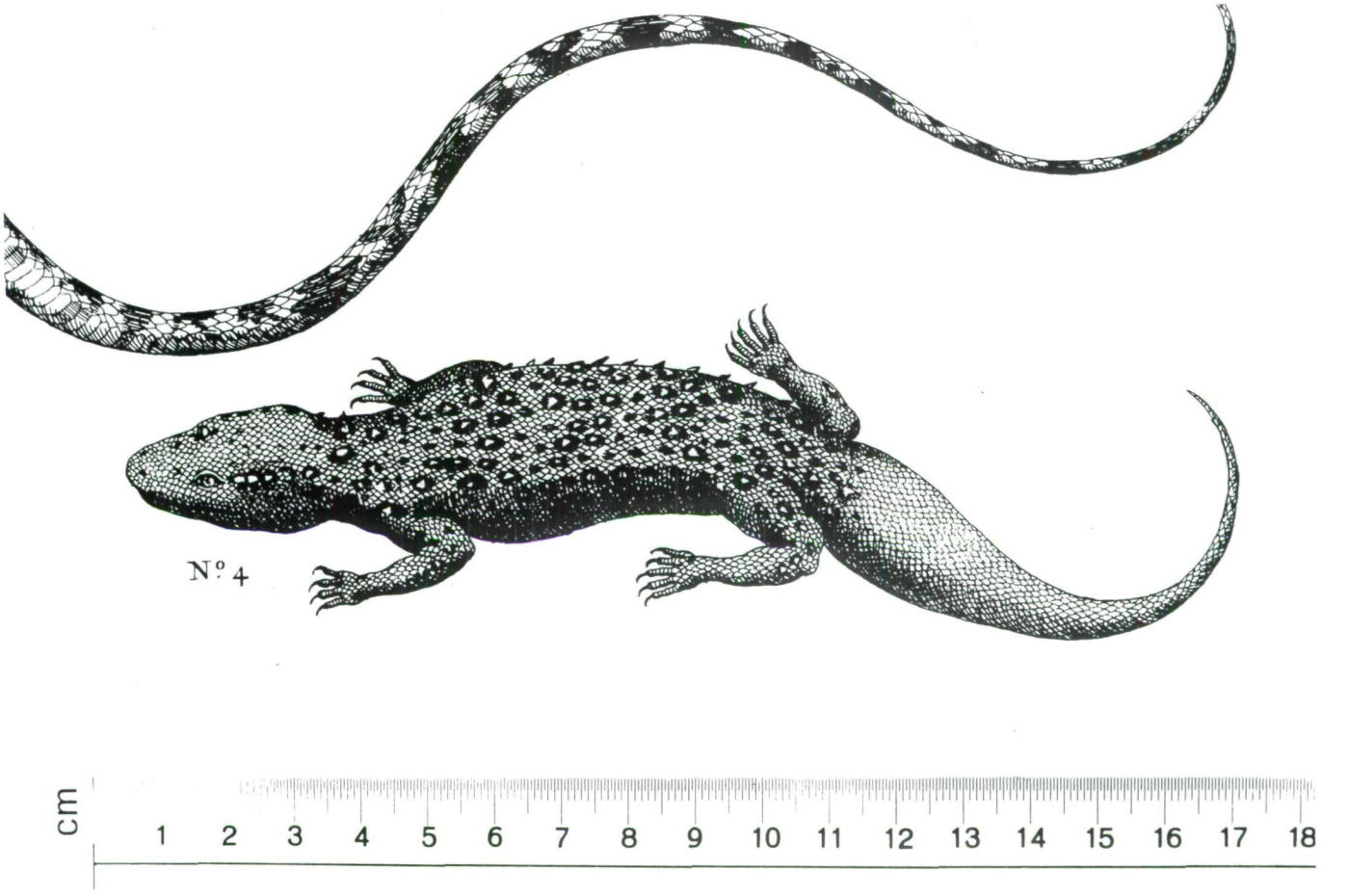

Fig. 1: Tecoixin, seu Lacerta saxatilis of SEBA (1734: plate 79, fig. 4): type species of the genus *Stellio*. Reproduced with permission of the Landesbibliothek Stuttgart.
Abb. 1: SEBAs (1734: Tafel 79, Figur 4) Tecoixin, seu Lacerta saxatilis: Species typica der Gattung *Stellio*. Wiedergabe mit Genehmigung der Landesbibliothek Stuttgart.

IMPLICATIONS FOR AGAMID NOMENCLATURE

Two possible consequences for the nomenclature of Western Palearctic agamids follow from above conclusion: either retaining all species groups within the genus *Agama* s. l., or, if one prefers to elevate them to full genera, one has to find another name for the *stellio*-group. None of the two approaches is completely satisfactory in view of our current knowledge of the phylogeny of agamids. ANANJEVA & SOKOLOVA (1990) and JOGER (1991) provide biochemical evidence that *Phrynocephalus* is more closely related to the *stellio*-group than the latter is to the *mutabilis*-group (but see MOODY's 1980 phylogram). Therefore, *Phrynocephalus* should be incorporated in *Agama* s. l., if one accepts the first approach. Furthermore, the first approach would conceal the advances gained in understanding the phylogeny of agamids.

Discussing the problems of the second approach, we first have to summarize briefly the results of MOODY (1980). MOODY splits the formerly more inclusive genus *Agama* into six species groups which he elevates to genus level: *Agama, Trapelus, Pseudotrapelus, Stellio, Xenagama*, and *Brachysaura* (his group VI). Within this group, the first three taxa are characterized by a derived karyotype (2n = 44 - 48 chromosomes) while *Stellio* retains the ancestral karyotype (2n = 36 chromosomes). *Xenagama* and *Brachysaura* have not yet been examined. *Trapelus* is further characterized by a small and deeply sunken tympanum forming an external auditory tube-like meatus, and *Pseudotrapelus* by a swollen tail base due to the presence of keratinized coarse scales. *Xenagama* is unique in having the traverse processes of the first caudal vertebrae projecting perpendicular to the longitudinal axis (versus projecting slightly posteriorly in all others). *Stellio* is the only genus having the derived characters of several spinous scales located immediately behind the orbit and/or in the region between the ear as well as a nuchal crest. Thus, using the data presented by MOODY (1980), it appears sufficiently justified to accept his taxonomic units as genera, as has been done by most later authors.

Finding a new generic name for the *stellio*-group, and some of the other groups, causes considerable problems. The next oldest names, *Cyclosaurus* WAGLER in MICHAHELLES 1833 (based on *A. hispida*) and *Saura* WAGLER in MICHAHELLES 1833 (based on *A. agama* + *A. atra*), are synonyms of *Agama* s. str. The same holds true for *Podorrhoa* FITZINGER 1843 (based on *A. agama*) and *Psammorhoa* FITZINGER 1843 (based on *A. aculeata*). *Eremioplanis* FITZINGER 1843 (based on *A. mutabilis*), *Trapeloides* FITZINGER 1843 (based on *A. sanguinolenta*), and *Planodes* FITZINGER 1843 (based on *A. agilis*) all are synonyms of *Trapelus*. *Acanthocercus* FITZINGER 1843 is based on *Stellio cyanogaster*, a member of the African clade. This clade, however, certainly is not congeneric with the Palaearctic clade (JOGER 1991). According to JOGER's phylogenetic tree, it may be regarded as congeneric with *Pseudotrapelus* FITZINGER 1843 (both described on the same page) or as a sister genus to the latter.

The next available name within *Agama* s. l., *Laudakia* GRAY 1845, has been used by LEVITON & al. (1992) for the *stellio*-group. The type species of *Laudakia*, *A. tuberculata*, is a member of the Palearctic clade and may be used for the *stellio*-group (sensu lato). However, problems remain with this approach as *L. tuberculata* differs considerably in hemipenial characters (apomorphic characters: divided hemipenes, forked sulcus, and transversal division of the apex) from the *stellio*-group (sensu stricto) which is closer to *Agama* (sensu restricto) (BÖHME 1988). Furthermore, it has a derived karyotype (2n = 34 versus 2n = 36 - ancestral karyotype of the *stellio*-group sensu stricto) (GORMAN 1973) lacking one pair of microchromosomes. Although the karyotype of *L. tuberculata* should be reexamined as microchromosomes may be overlooked (GORMAN 1973), it should be pointed out that *Pseudotrapelus* is also

Table 1: New generic allocation of species formerly included in '*Stellio*'.
Tabelle 1: Neue Gattungszuordnung für Arten, die seither zu '*Stellio*' gerechnet wurden.

Plocederma	*Plocederma/Laudakia* incertae sedis	*Laudakia*	*Acanthocercus*
melanura	*agroensis*	*tuberculata*	*cyanogaster*
caucasia	*badakshana*		*adramitanus*
erythrogastra	*chernovi*		*annectens*
himalayana	*kirmanensis*		*atricollis*
lehmanni	*microlepis*		*phillipsii*
nupta	*nuristanica*		*yemenensis*
stellio	*pakistanica*		*zonura*
	sacra		
	stoliczkana		
	tarimensis		

characterized by 22 micrichromosomes (GORMAN & SHOCHAT 1972). Finally, based on albumin antisera and isozymes, the genus *Phrynocephalus* is a sister group of the *stellio*-group (sensu stricto) (JOGER 1991). Unfortunately, JOGER (1991) had no data available on *L. tuberculata*, and its relative phylogenetic position to *stellio* (sensu stricto) and to *Phrynocephalus* remains unknown. *Phrynocephalus* also has a derived karyotype (2n = 46 - 48) (BÖHME 1981) like *Agama, Trapelus,* and *Pseudotrapelus* but different from *Laudakia*. In *Phrynocephalus helioscopus persicus*, the only species within the genus for which the hemipenes are known, they also are highly derived (divided, forked sulcus, large calyces). However, it remains unresolved whether the similarities between *Phrynocephalus* and *L. tuberculata* (and *Trapelus*) is a synapomorphy or is due to convergence (BÖHME 1988).

Until the discussed phylogenetic problems are resolved by studying additional species and by combining morphological, karyological, and biochemical approaches, I regard it as the best solution to restrict the use of *Laudakia* to *L. tuberculata*. This approach leaves open the question of a genus name for the *stellio*-group. *Plocederma* BLYTH 1854 (based on *A. melanura*) is the oldest available name for the *stellio*-group (sensu stricto) and should be used for it. Species for which it is not known whether they are closer related to the *stellio*-group or to *L. tuberculata* may be referred to either cf. *Laudakia* or cf. *Plocederma* (see tab. 1 for a list of species).

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