CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Thirty-three meeting of the Animals Committee
Geneva (Switzerland), 12 - 19 July 2024

MORPHOLOGICAL IDENTIFICATION GUIDE TO THE ASIAN NEWT GENERA *ECHINOTRITON*, *LAOTRITON*, *PARAMESOTRITON* AND *TYLOTOTRITON*

1. This document has been submitted by Germany in relation to agenda item 19 and to Decision 19.144 on *Materials for the identification of specimens of CITES-listed species* encouraging Parties to provide information on available identification and guidance materials that are used by Parties to facilitate implementation of the Convention.*

2. At COP18 and COP19 numerous species of four Asian newt genera (namely *Tylototriton* spp., *Paramesotriton* spp., *Echinotriton* spp. and *Laotriton laoensis*) were listed in the CITES Appendices II and III, which increased the number of CITES listed Caudata taxa over six-fold. These genera include a number of cryptic taxa that makes species identification challenging, even for experts. The conservation status, the protection status and the availability in international trade differs between taxa of the same genus.

3. To support the implementation and enforcement of CITES listings of Asian newt species, the Scientific Authority of Germany at the Federal Agency for Nature Conservation (BfN) has been working on a morphological identification guide for live specimens after metamorphosis of East Asian newts of the family Salamandridae, which is found in the Annex to this document. This guide aims to assist CITES authorities and custom officers to determine whether or not a specimen belongs to a CITES listed genus and further aims to provide as much guidance as possible to identify the taxon to species level, based on morphological traits. However, in a number of species molecular analyses and the consultation of experts is recommended.

4. Parties are welcome to make use of this document.

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Morphological identification guide to the Asian newt genera *Echinotriton, Laotriton, Paramesotriton* and *Tylototriton*

Report compiled for:

Federal Agency for Nature Conservation

Morphological identification guide to the Asian newt genera *Echinotriton, Laotriton, Paramesotriton* and *Tylototriton*

(FKZ: 3520 53 2055)

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Cover picture (top left to bottom right): *Echinotriton chinhaiensis* by A. Hernandez; *Laotriton laoensis* by P. Bachhausen; *Paramesotriton hongkongensis* by F. Pasmans; *Tylototriton kweichowensis* by K. Neubauer.

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Introduction

Amphibians are the most threatened class of vertebrates, with a higher number of species in peril than in mammals, birds, reptiles or fishes (IUCN 2024). Salamanders make up 9% of all current known amphibian species (Frost 2024). A main threat to salamander species is the destruction of their habitats (Bernardes et al. 2013; IUCN 2024; Nishikawa et al. 2013b), but also collection for the international pet trade (Phimmachak et al. 2015b; Rowley et al. 2016), local use (Stuart et al. 2004; Rowley et al. 2010), as well as emerging diseases (Martel et al. 2013; Pasmans et al. 2014).
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) regulates the international trade in threatened species with varying degrees of protection. Species included in Appendix I are considered to be under threat of extinction and international trade in wild specimens for primarily commercial purposes is entirely prohibited. Species included in Appendix II are considered to be threatened or potentially threatened by international trade, so that trade needs to be regulated in order to maintain their survival in the wild and prevent the species to become eligible to be listed in Appendix I.
In the last couple of years alone, the number of salamander species included under international legislation by CITES has increased in over six fold (see Annex). These additions cause challenges to national and international authorities who need to be able to discriminate between species, in order to effectively enforce the appropriate regulations. Species distinction is especially important in the case that different species within a genus are listed in different Appendices with different protection statuses (like in the case of *Echinotriton*, included below). Furthermore, regarding the trade in wild specimens, identification to species level is essential for Scientific Authorities in order to assess if they are dealing with a rare, small distributed, threatened species, or not, which is crucial for evaluating, if the off-take has been non-detrimental to the survival of the species (Non-Detriment Finding).
The order Caudata is represented in East Asia (here from India and Nepal, through South East Asia, and China until Japan) by four families: Cryptobranchidae, Hynobiidae, Salamandridae and Plethodontidae. The CITES Appendices currently include the taxa *Andrias* spp. (Cryptobranchidae), *Hynobius amjiensis* (Hynobiidae), and *Echinotriton* spp., *Laotriton laoensis*, Paramesotriton *spp*. and *Tylototriton* spp. (Salamandridae). The genera *Paramesotriton* and *Tylototriton* have been listed in CITES Appendix II as higher taxa listings with the acknowledgement of the difficulty associated with discriminating species solely based on their

morphology, without locality information or genetic analyses. Furthermore, new species are continuously being described within these genera.

The aim of this guide is to support CITES authorities and custom officers to distinguish East Asian genera of the family Salamdridae found in the international pet trade that were recently added to the CITES Appendices (i.e. genus *Echinotriton*, genus *Paramesotriton*, genus *Tylototriton* and *Laotriton laoensis*) from non-listed taxa, and further assist with species identification where possible, providing valuable assistance in decision making. Thereby, this guidance focuses on trade in live specimens (which is mainly the pet trade). The (domestic) trade in species for traditional medicine (like Traditional Chinese Medicine), including trade in dried or otherwise processed specimens falls beyond the scope of this guide. Furthermore, this ID guide focuses on the identification of individuals post metamorphosis only, while the identification of eggs and larvae requires consultation with experts. While larvae are fully aquatic, post metamorphs are mainly terrestrial and usually have resorbed the prominent external gills (for additional information on larvae and clutches see Bernardes et al. 2017).

Given the high description rate of the genera in question, the high number of species involved, and the fact that the data provided herein was obtained from literature, some shortcomings are inherently present in this guide, and current data may be refuted with future species descriptions, new population discoveries, and analyses. In many cases molecular analysis and the consultation with experts is recommended alongside this morphological guide for definite species identification. Furthermore, it has to be noted that while new species are steadily being described to science, CITES nomenclature remains a bit more conservative. The actual legally binding CITES references can be found in Res. Conf. 12.11 (Rev. CoP19)* and on https://speciesplus.net/. At time of writing, CITES references for the species treated herein were based on time-specific versions of the online database Amphibian Species of the World by S.R. Frost. However, we still included species that have been discovered during times of writing and after the CITES listing of respective taxa came into force.

How to use this guide?

Identify to which of the seven existing genera of the family Salamandridae occurring in East Asia the specimen of subject may belong, using the “Key to the East Asian salamandrid genera” (p. 8). Distinguish between genera that are included in the scope of this guide (CITES listed species),

and for which more information will be presented to aid with morphological identification, and genera that are not.

Each genus that contains CITES listed species is introduced individually in more detail, by presenting a morphological key to help the identification of single species, followed by a list with more detailed description of further morphological characters for each species.

Each species will have additional information to our best knowledge regarding its presence in the international pet trade based on past evidence.

For questions regarding technical morphological terms, check the scheme on the morphology of salamanders (p. 5) and the glossary (p. 6).

In-depth information on breeding ability and information on natural history of the genera *Tylotriton*, *Paramesotriton* and *Echinotriton* is found in Langner et al. (2022).

Morphology of salamanders

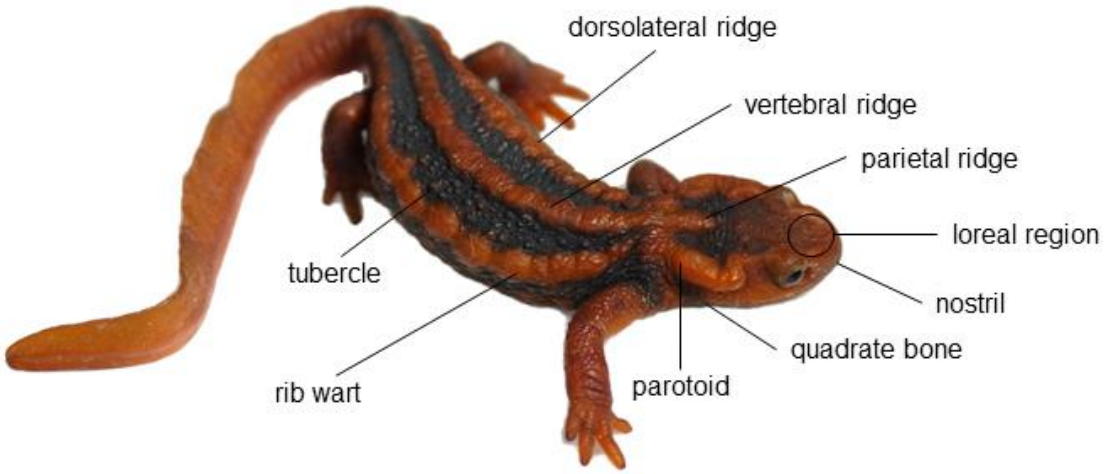

Figure 1. Schematic figure of *Tylototriton pseudoverrucosus* with morphological explanations. (Foto Axel Hernandez)

Glossary

Term	Definition
branchial	relating to the gills; located in the neck region
cloaca	posterior orifice that serves as the only opening for the digestive, reproductive, and urinary tracts of many vertebrate animals
costal/rib nodes/warts	distinctly protruding, often differently colored, glandular elevations on the end of the ribs of certain species
dorsal	referring to the back or upper side of an animal
dorsal ridge	same as vertebral ridge
gular fold	skin fold at the ventral side of throat
interorbital	between the eyes
loreal region	the region between the eyes and the nostrils
maxilla	the upper bone of the jaw
neoteny	the retention of larval traits in sexually mature individuals
parietal region	located on the back and top of the head
parotoids	external glands on the head and back region of some amphibian species
quadrate	the quadrate bone forms the upper part of the jaw joint
ridge(s)	raised part
rostrally	near or toward the head, specifically the front of the head
snout	the projecting nose and mouth of an animal
species groups	group of closely related species that are morphologically similar, which makes them difficult to distinguish from each other
striae	some salamanders are characterized by dense tubercles on the lateral trunk that form continuous nodule like warts, with thin transverse striae present between these warts
snout-vent length, SVL	length between the tip of snout and the cloacal fissure
tubercles	any round nodule, small eminence, or warty outgrowth on the skin
total length, TL	length between the tip of snout to tip of tail
ventral	anatomical term of location referring to the abdominal or lower side of an animal

Symbols

Visual, self-descriptive symbols were used to present a fast and intuitive support to the text.

This genus is listed in CITES Appendix I, II or III.

This genus is not listed in CITES.

This species is/has been recorded in the international pet trade (mainly based on information contained in the listing proposals).

This species is expected to have entered the international pet trade (e.g. split-out species of a species found in trade).

At the time of writing, there are no available records to the authors that this species is subject to the international pet trade.

Key to the East Asian salamandrid genera

1a ventral side of body with irregular colorful patterns; tail high and laterally compressed **2**

1b ventral side of body without irregular colorful patterns; tail thin and laterally compressed **5**

2a lateral borders on top of head clearly raised into ridges (i.e. parietal ridges); skin rough with large tubercles **3**

2b parietal ridges mostly indiscernible; skin granular to smooth with small tubercles **4**

3a dorsal ground color black, with three yellow to orange longitudinal stripes, with various degrees of fusion among each other. The middle stripe is narrower and extends from the snout to the base of the tail ..... ***Laotriton*** (page 12)

(the genus currently comprises 1 species)

CITES App. II *

* subject to a zero annual export quota for wild-taken specimens traded for commercial purposes

3b dorsal color uniformly dull (with exception of *P. zhijinensis* with non-continuous yellow mottling, and *P. longliensis* with yellowish dorsal ridge and occasionally yellow or orange discontinuous stripes on dorso-lateral ridge); rough skin (with exception of *P. maolanensis*); prominent vertebral ridge, often with a lateral ridge along each side of the back ..... ***Paramesotriton*** (page 13)

(the genus currently comprises 15 species)

CITES App. II

4a skull long and thin; parotoids very prominent; skin very granular without distinct warts; vertebral ridge prominent …….. ***Cynops*** (Fig. 2)

(the genus currently comprises two species. The genus has been recently divided and most species passed to the genus *Hypselotriton* [Dubois & Raffaëlli 2009; Dubois et al. 2021; Yuan et al. 2022]).

Non-CITES listed

4b skull thin and flat; parotoids slightly prominent; skin smooth to very granular without distinct warts; vertebral ridge almost absent …….. ***Hypselotriton*** (Fig. 3)

(the genus currently comprises 10 species)

Non-CITES listed

4c skull wide and flat; parotoids prominent; skin smooth; vertebral ridge absent…… ***Pachytriton*** (Fig. 4)

(the genus currently comprises 10 species)

Non-CITES listed

5a quadrate bone with anteriorly curved spine; the ribs of the middle trunk region are elongated and curved; the distal tips of the ribs are sharp-tipped and often penetrate the skin through the primary warts …… ***Echinotriton*** (page 22)

(the genus currently comprises 4 species)

CITES App. II and III

5b quadrate bone without spines; the ribs of the middle trunk region are approximately the same length and only slightly curved; the distal tips of the ribs do not penetrate the skin …….…… ***Tylototriton*** (page 25)

(the genus currently comprises 40 species)

CITES App. II

Non-CITES listed genera of East Asian newts

Figure 2. Examples of species from the genus *Cynops*: A) *C. orientalis* (Author: Henk Wallays); B) *C. cyanurus* (Author: Henk Wallays); C) *C. glaucus* (Author: Axel Hernandez).

Figure 3. Example of a species from the genus *Hypselotriton*: *H. pyrrhogaster* (Photo: Henk Wallays).

Figure 4. Examples of species from the genus *Pachytriton*: A) *P. brevipes*; B) *P. xanthospilos* (Photo: Axel Hernandez).

Identification of the genus *Laotriton* Dubois and Raffaëlli, 2009

Currently there is only one species known within this genus: *Laotriton laoensis.*

Known in trade

CITES App. II *

* subject to a zero annual export quota for wild-taken specimens traded for commercial purposes

Additional morphological characters: Average total length ca.17–20 cm, range 14–25 cm. Distinct dorsal color patter with three yellow to orange to stripes; three tubercular dorsal ridges, one midline and two lateral, extending from top of head to base of tail; dorsal and ventral skin covered with glands and warts; paratoids enlarged, projecting backwards; large orange-red spots of ventral side.

Figure 5. *Laotriton laoensis*. Photo: Paul Bachhausen.

Identification of the genus *Paramesotriton* Chang, 1935

At the time of writing, 14 species were known within this genus (see below). In the meanwhile, a new species was described, *P. malipoensis* (see Frost [2024] for further information), which is not included herein and has not yet been documented in the international pet trade. Nine of the species within this genus were documented in the international pet trade.

CITES App. II

Molecular analyses are recommended at this point for definitive species identification. Nevertheless, see below for an initial aid in morphological identification.

Key to the species of the genus *Paramesotriton:*

from Sparreboom 2014, and Yuan et al. 2016 and 2014, synthetizing the previous work of: Fei et al. 2006; Wu et al. 2009 and 2010a; Gu et al. 2012a and 2012b

1a skin relatively smooth..... **2**

1b very rough skin..... **4**

2a few granular warts on the head and body; normally developed eyes (not reduced) **3**

2b granular warts absent on the head and body; reduced eyes ..... ***P. maolanensis***

Unknown in trade

3a body slender and flat; tail long; vertebral ridge unnoticeable ..... ***P. labiatus***

3b body not slender and flat; tail short; vertebral ridge noticeable ..... ***P. hongkongensis***

4a body small; dorsal ridge with yellow or orange color **5**

4b body robust; dorsal ridge is the same color as other parts of the dorsal surface **8**

5a presence of broad irregular yellow stripes on dorsolateral ridge and the lateral of tail ……**6**

5b absence of broad irregular yellow stripes on dorsolateral ridge and the lateral of tail …….. ***P. aurantius***

6a scent glands absent on snout; vestigial gills and gill filaments absent **7**

6b scent glands on snout; presence of vestigial gills (3 gill filaments behind head) ..... ***P. zhijinensis***

7a no fleshy protuberance present in branchial region ……..... **8**

7b hind part of upper branchial bone points upwards, resulting in a clearly fleshy protuberance on both sides of the branchial region .....***P. longliensis***

Known in trade

8a dorsum olive brown; dorsal tubercles relatively large; dorsal ridge relatively lower ..... ***P. wulingensis***

Unknown in trade

8b dorsum pale yellow; dorsal tubercles relatively small; dorsal ridge relatively higher ..... ***P. caudopunctatus***

Known in trade

9a small, irregular orange-red spots on chin, venter, underside of axillae, and cloaca **10**

9b large irregular orange-red spots on chin, venter, underside of axillae, and cloaca **11**

10a tail gradually tapers from base to tip without expanding posteriorly; tail fins underdevelopment; dorsal and lateral sides of the trunk with many clustered conical warts ..... ***P. qixilingensis***

Unknown in trade

10b tail expands posteriorly to form tail fin; warts small ..... ***P. chinensis***

Known in trade

11a vertebral ridge flat or low; few granular warts ..... ***P. yunwuensis***

11b high vertebral ridge; densely granulated warts **12**

12a digit tips only overlap when forelimbs and hind limbs adpressed **13**

12 b palm and tarsus overlap when forelimbs and hind limbs adpressed ..... ***P. fuzhongensis***

13a extended forelimb reaches midpoint of eye ..... ***P. deloustali***

13b extended forelimb reaches posterior edge of eye only ..... ***P. guangxiensis***

Further characters for each species of this genus (based on Yuan et al. 2014 and Sparreboom 2014):

P. aurantius: A robust newt (11–15 cm) with very rough skin. Dorsal and lateral color of head, body, limbs, and tail dark brown. Vertebral ridge brown, conspicuous, and intermittent. Presence of irregular yellow spots on cheek, lateral sides of dorsum, lateral sides of tail, base of limbs. Numerous small irregular orange-red or yellow spots on the chin, venter, underside of axillae, and cloaca (Yuan et al. 2016).

P. caudopunctatus: Small body size (12–15 cm) with an elongated snout and a prominent orange ridge. Belly color variable from grey brown to orange. Tail of male animals with conspicuous orange to pink spots.

Figure 6. *Paramesotriton caudopunctatus*. Photo: Arnaud Jamin.

P. chinensis: A robust newt (average size 13–15 cm, with a maximum size up to 18 cm) with very rough skin. Belly bluish-black with small irregular yellow-orange spots. No cranial ridges and less prominent dorsolateral ridges.

Figure 7. *Paramesotriton chinensis* as juvenile and adult. Authors: Henry Janssen and Christopher Michaels.

P. deloustali: A large (16–20 cm) newt with warty skin and a large head. Bright orange coloration on belly, throat and skin, covered with a network of black lines.

Figure 8. *Paramesotriton deloustali*. Photo: Henk Wallays.

***P. fuzhongensis*:** A large, stout newt (13–17 cm) skin densely covered with warts. Very similar to *P. chinensis* but larger and covered with more and larger warts. Color of dorsal side dark to olive-brown, medium sized irregular orange-red spots on dark belly.

Figure 9. *Paramesotriton fuzhongensis*. Photo: Joachim Nerz.

P. guangxiensis: A moderately sized (12–14 cm) warty newt. Flat-triangular head, longer than wide. Dorsal side dark brown, belly black with irregular yellow to orange spots.

Figure 10. *Paramesotriton guangxiensis*. Photo: Arnaud Jamin.

P. hongkongensis: A medium-sized (11–14 cm) stocky newt with a dorsal ridge and dorsolateral ridges consisting of glandular warts. The transverse section of the trunk is pentagonal. Dorsal color uniform dark olive to dark brown, ventral coloration bluish-black with irregular orange spots.

Figure 11. *Paramesotriton hongkongensis*. Photo: Frank Pasmans.

P. labiatus: A slender flat-bodied newt of small to medium size (9–14 cm). Skin relatively smooth, granular warts absent on head and body. Head depressed, nearly flat. Dorsal color olive-brown with irregular small black spots. Ventral side paler brown with irregularly shaped orange blotches.

P. longliensis: A robust (10–14 cm) newt with granular skin and prominent vertebral ridges. Head flattened, longer than wide. Dorsal color light brown, ventral side black with scattered, irregular orange-red spots, including one on the underside of the base of each leg.

P. maolanensis: A large-bodied (18–21 cm) newt with smooth skin without granular warts. Head longer than wide, elongated snout. Eyes degenerated. Prominent mid-dorsal ridge. Color brown-black, venter and chin with irregular orange-red spots.

P. qixilingensis**:** A robust newt (13–15 cm) with very rough skin, large clusters of conical dark brown warts covering the dorsum of head, lateral surface of body and dorso-lateral ridges, and

small, irregular and orange-red spots present on ventral surface, chin, underside of axillae, and cloaca (Yuan et al. 2014).

P. wulingensis: A slender medium sized (11–14 cm) warty newt. Body color is a deeper dark-brown, ventral side yellowish with small black spots.

P. yunwuensis*:* A large (15–19 cm), robust newt. Head longer than broad, wider than neck. Parotoids prominent. Dorsal coloration ranges from reddish-brown to olive-brown. Ventral color pattern varies from black background with a few orange blotches to orange background with numerous black flecks.

Figure 12. *Paramesotriton yunwuensis*. Photo: Georges Decomes.

P. zhijinensis: A medium sized (10–13 cm) robust newt. Eyes relatively large and round. Dorsal color is brown-black. Dorsal stripes are variable, sometimes indistinct with tiny little yellow spots. Large, irregular orange-red spots on venter, chin, cloacae and tail. Neoteny is common, with most adult specimen having vestigial gills and gill filaments.

Identification of the genus *Echinotriton* Nussbaum and Brodie, 1982

Currently four species have been described within this genus, but more cryptic diversity is likely to still be uncovered. In this version, the most recently described species, *E. raffaellii*, which was separated from *E. andersoni* (Dufresnes & Hernandez 2022) is not included, as it was not yet described at the time of writing, although it is likely to occur in the trade. According to the current CITES nomenclature reference, this species is still regarded as *E. andersoni*.

Additional morphological characters of the genus: Up to a maximum total length of ca. 16 cm, although averages are likely lower. Curved anterior bony spine on the posterolateral surface of the quadrate bone (Brodie Jr. et al. 1984); relatively flat head, triangular shaped in dorsal view, and usually wider than body; prominent parotoid glands; vertebral ridge wide with oblique ribs; very grainy skin; color uniformly dark brown to black on dorsal and ventral sides, and orange to yellow on the palms and soles of the feet, on the lower caudal keel and cloacal region.

Echinotriton is most similar to *Tylototriton*, but has a stockier body, and shorter limbs, digits and tail, than *Tylototriton* (Sparreboom 2014).

Molecular analyses are recommended at this point for definitive species identification. Nevertheless, see below for an initial aid in morphological identification.

Key to the species of the genus *Echinotriton*:

1a row of secondary warts running along each side of the vertebral ridge, between the vertebral column, and the row of primary warts; rudimentary fifth toe ……..…….. ***E. andersoni***

CITES App. III

Known in trade

1b lacking a row of secondary warts between the vertebral column and the row of primary warts; fifth toe developed normally ……..…. **2**

2a broad head, triangular shaped in dorsal view; wide and segmented spinal ridge; tip of longest finger approaching nostril when forelimb is extended to the snout …..……..….. ***E. chinhaiensis***

CITES App. II

2b very pronounced lateral cephalic crests in front of the parotoids, shaping head as a trapezoid in dorsal view; very wide and segmented spinal ridge; tip of longest finger exceeds tip of snout when forelimb is extended to the snout ……..... ***E. maxiquadratus***

CITES App. II

Further characters for each species of this genus (based on Hernandez 2016 and Sparreboom 2014):

E. andersoni: closely related to, and very similar to *E. chinhaiensis.* Broad and triangular shaped head in dorsal view. It differs from the latter by having rows of secondary warts running along each side of the vertebral crest, between the vertebral column, and the row of primary warts. Rudimentary fifth toe. Two series of ca. 12–15 knob-like dorsolateral rib nodules which may present a yellow-orange coloration.

E. chinhaiensis: broad head, triangular shaped in dorsal view. Low, wide and segmented vertebral ridge that extends anteriorly to a median cephalic ridge, and a V-shaped ridge. Two rows of ca. 8–12 small, square- to knob-like dorsolateral rib nodules that extend to the sides of the tail. The skin is rough except for the snout, lips, fingers and toes, palms and soles, and the lower keel

of the tail. The fifth toe is developed normally. It lacks a row of secondary warts between the vertebral column and the row of primary warts. The tail is shorter than the body.

Figure 13. *Echinotriton chinhaiensis*. Photo: Axel Hernandez.

E. maxiquadratus: very pronounced lateral cephalic crest below the parotoids (i.e. the quadrate bone forms a trapezoid projection behind the month, triangular projection in the other two species). Very wide and segmented spinal ridge. Two series of ca. 8–10 spiny costal warts. The skin is very grainy due to conical-shaped skin tubercles (ridge-like in *E. chinhaiensis*). The fifth toe is normally developed as in *E. chinhaiensis*. Tip of longest finger exceeds tip of snout when forelimb is extended rostrally (vs. approaching nostril in *E. chinhaiensis*). Rib nodules, tip of parotoids and quadrate bone may present coloration, in addition to the yellow-orange coloration on the lower edge of the tail, cloaca and tip of fingers and toes (Hernandez 2016).

Figure 14. *Echinotriton maxiquadratus*. Photo: Zhenqi Wang.

Identification of the genus *Tylototriton* Anderson, 1871

Currently 40 species are described within this genus, mostly within the last decade, and more species are still expected to be uncovered. At the time of writing, 33 species were known, but in the meantime, seven new species have been added: *T. daloushanensis* and *T. tongziensis* from *T. wenxianensis* group; *T. houi*, *T. joe*, *T. umphangensis* and *T. zaimeng* from *T. verrucosus* group; and *T. ngoclinhensis* from *T. asperrimus* group (see Frost 2024 for further information). These new species are not included herein, and are to date not yet specifically documented in the international pet trade.

CITES App. II

Molecular analyses are recommended at this point for definitive species identification. Nevertheless, see below for initial morphological identification aid.

Key to single species and species groups within the genus *Tylototriton:*

1a rib warts connected forming dorsolateral ridges …… **2**

1b distinctly separated rib warts …… **3**

2a three longitudinal reddish brown to yellowish stripes in dorso, including colored tail, paratoids, and tips of fingers and toes …… ***T. kweichowensis***

Known in trade

2b slender body, tail long and thin, tail longer than snout-vent length, characteristic red-orange coloration on posterior part of cephalic edge and on each parotoid …….…… ***T. taliangensis***

2c uniformly black dorsal color ……..…….…… ***T. wenxianensis*** **group** (page 28)

3a color of the ventral tail fin greatly differing from the color of the rest of the tail ……..…… **4**

3b color of the ventral tail fin does not differ greatly from that of tail. Tail appears with somewhat more uniform coloration ……..…… ***T. verrucosus*** **group** (page 40)

4a head and vertebral ridge with yellow to reddish brown ……..……..…..… ***T. panhai***

4b uniform dark ground coloration on body, except for color on ventral side of tail fin, tips of fingers and toes and margin of vent ……..…… ***T. asperrimus*** **group** (page 33)

Further characters for the single species from above:

T. taliangensis: One of the largest species of the genus (total length up to 23 cm). Ground color black with exception of red-orange coloration on edges of parotoids, tips of fingers and toes, cloaca and underside of tail. Head longer than wide, cranial ridges clearly visible, distinct vertebral ridge, dorsolateral glandular ridges inconspicuous with glandular warts of various sizes, very rough skin (Fleck 2013; Hernandez 2016; Sparreboom 2014).

Figure 15. *Tylototriton taliangensis*. Photo: Axel Hernandez

T. panhai: Yellow, orange, or reddish brown markings on dorsal head, upper and lower lips, paratoids, vertebral ridge, rib nodules, tips of fingers and toes, margin of vent slit, and dorsal and ventral edges of tail, black limbs, large and prominent knob-like rib nodules, wide and moderately protruding dorsolateral bony ridges on head, spine not quadrate, vertebral ridge distinct and not segmented (Nishikawa et al. 2013a).

Figure 16. *Tylototriton panhai*. Photo: Axel Hernandez.

T. kweichowensis: Large, robust species with total lengths up to 21 cm. Head with distinct bony ridges in the frontal and interorbital areas, granular skin, prominent glandular vertebral ridge, dorso-lateral warts indistinct and almost fused, dark dorsal color with three longitudinal reddish brown to yellowish stripes including colored tail, paratoids, and tips of fingers and toes (Fang & Chang 1932; Freytag 1936; Hernandez 2016; Sparreboom 2014). This species might be misidentified with *T. yangi* by an inexperienced observer.

Figure 17. *Tylototriton kweichowensis*. Photo: Karl Neubauer.

Figure 18. *Tylototriton kweichowensis*. Photo: Axel Hernandez.

Identification of the *T. wenxianensis* morphological group

At the time of writing, six species were described within this group (see below). Meanwhile, two further species, namely *T. daloushanensis* and *T. tongziensis* were described, which are not dealt with herein and were not yet specifically reported from international pet trade.

Characters of the group: Medium to moderately large in size with total lengths from ca. 11–17.3 cm (Sparreboom 2014; Yang et al. 2014); rib nodules mostly indistinct, flattened and not separated forming two longitudinal (or dorsolateral) ridges (Hernandez 2016), rough skin covered with small warts and glands (Shen et al. 2012), dorsal body blackish brown except for palms, soles, finger and toe tips, vent region and ventral ridge of tail, which is usually yellow to bright orange in color (Hernandez 2016).

Molecular analyses are recommended at this point for definitive species identification. Color variations are known sometimes within the same species, and hybridization is possible. Nevertheless, see below for initial morphological identification aid.

Key to the species of the *T. wenxianensis* group:

1a head subequal in length and width …….. **2**

1b head longer than wide **3**

2a rough skin with tubercles on both dorsal and ventral side uniform in size, and no transverse wrinkles between the ventral tubercles; margin of the cloacal region brownish black in most specimens; presence of both projecting tubercles around the cloacal fissure and villous genital papilla inside the cloacal fissure; comparatively less wider distance between the eyes; bony

ridges on the lateral head surface extend across the inner side of the eyelids ……..... ***T. wenxianensis***

2b extremely rough skin with ventral tubercles more flat than dorsal ones; margin of the cloacal region yellowish to orange; absence of both projecting tubercles around the anal fissure and villous genital papilla inside the anal fissure; presence of a small genital armatures (on the anterior angle of two labial folds) inside the anal fissure of males; relatively wider distance between the eyes; bony ridges on the lateral head surface extend through the upper eyelids ……..... ***T. liuyangensis***

3a finely granular and relative smooth skin; orange to red markings often present on the posterior side of the parotoids ..... ***T. lizhenchangi***

3b granular to very rough skin; orange to red markings absent on the posterior side of the parotoids absent …… **4**

4a vertebral ridge rather wide, its width approximately equal to the eye diameter ..... ***T. broadoridgus***

4b vertebral ridge narrow, its width smaller than the eye diameter **5**

5a the orange coloration at the ventral edge of tail contacted with the orange coloration around the cloaca ..... ***T. anhuiensis***

Unknown in trade

5b the orange coloration at the ventral edge of tail isolated from the orange coloration around the cloaca ..... ***T. dabienicus***

Likely in trade

Further characters for each species of this group:

***T. anhuiensis*:** TL ca. 13 cm in males and females, head length greater than width, bony ridges on head prominent and necked-in, length of the dorsal ridge smaller than eye diameter, tail height larger than width at the base of tail, orange coloration on the digit ends, peripheral area of the cloaca and the lower edge of tail (Qian et al. 2017).

T. broadoridgus: TL ca. 13 cm in males and 15 cm in females, dorsal ridge broad and thick, with width approximately equal to eye diameter, tail height larger than width at the base of tail (due to more developed upper caudal keel), no villous genital papilla found inside the male anal fissure during reproductive season, projecting tubercles around anal fissure and mostly colored in orange, slightly differentiated nodule-like warts, along lateral margin of the trunk, bulge and forming tubercles, and thin and transverse striae present between the tubercles (Shen et al. 2012).

***T. dabienicus*:** TL ca. 14.5 cm in females (Qian et al. 2017), head length much greater than width, limbs short, tips of fore- and hind-limbs do not touch when adpressed along the body, tips of fingers reaching orbital anterior region when stretched forward, margin of cloacal opening orange (Chen et al. 2010).

***T. liuyangensis*:** TL ca. 11–15 cm in males and 14–16 cm in females, rough skin with ventral tubercles looking more flat than dorsal tubercles and presenting many transverse striae between them, small and indistinct dorsolateral ridge of glandular warts, comparatively wide interorbital space, bony ridges on the dorsal side of the head going through the upper eyelids, a comparatively large space between axilla and groin, a small genital armature inside the cloacal opening on the anterior side in male during the breeding season, coloration varies from black to dark brown on dorsum and lighter on ventral side, the lower edge of the tail, cloacal region, and ends of fingers and toes are yellowish orange (Yang et al. 2014).

***T. lizhenchangi*:** TL ca. 15–17 cm in males and 15–16 in females (Sparreboom 2014), head longer than wide, tail longer than the snout-vent length, finely granular and relatively smooth skin, dorsolateral glandular warts indistinct forming two sharp-edged, distinctly raised dorsolateral ridges, ground color mostly black with the exception of the tips of the fingers and toes, the cloacal region, and the underside of the tail being yellowish to reddish, the rear parts of the paratoids may be orange to red (in both sexes), but this character is not always present (Hernandez 2016).

Figure 19. *Tylototriton lizhenchangi.* Photo: Axel Hernandez.

***T. wenxianensis*:** TL ca. 14 cm (Hernandez 2016), lateral glands clearly undifferentiated from each other, tubercles on both dorsal and ventral side rather uniform in size and no transverse wrinkles on the latter, margin of cloacal region colored black in most specimens (Fei et al. 1984), projecting tubercles around anal fissure, villous genital papilla found inside the male anal fissure during reproductive season, tail width larger than height at the base of tail, head length equal to head width (Shen et al. 2012).

Figure 20. *Tylototriton wenxianensis.* Photo: Frank Pasmans.

Identification of the *T. asperrimus* morphological group

At the time of writing, 10 species were described within the group (see below). Meanwhile one additional species, *T. ngoclinhensis,* was described, which is not described in here, and it is not yet reported from the international pet trade.

Characters of the group: This group is characterized by medium-sized newts with total lengths from 100 to 150 mm (Stuart et al. 2010; Ziegler et al. 2018), rough skin covered with small warts and glands, differentiated roundish rib nodules on both sides of the body, dark ground color except for palms, soles, finger and toe tips, vent region and ventral ridge of tail, which is usually yellow to bright orange in color (Bernardes et al. 2020; Fei et al. 1984; Nishikawa et al. 2014). The coloration on the rib nodules and posterior paratoids does not seem to be a valid diagnostic characteristic, as evidence keeps on showing exceptional variation within each species (M. Bernardes pers. obs.).

Molecular analyses are recommended at this point for definitive species identification. Color variations are known sometimes within the same species, and hybridization is possible. Nevertheless see below for initial morphological identification aid.

Key to the species of the *T. asperrimus* group:

from (Lyu et al. 2021)

1a vertebral ridge segmented ……..... ***T. ziegleri***

Known in trade

1b vertebral ridge not segmented **2**

2a orange markings on the parotoid present; anterior half of head and vertebral ridge dark brown, with the same color as the ground coloration of body ..... ***T. notialis***

Unknown in trade

2b orange markings on the parotoid absent **3**

3a head wider than long **4**

3b head longer than wide **5**

4a sagittal bony ridge on head strong ..... ***T. asperrimus***

Known in trade

4b sagittal bony ridge on head obscure ..... ***T. hainanensis***

Unknown in trade

5a orange coloration of the rib nodules present **6**

5b orange coloration of the rib nodules absent **7**

6a smaller body size with TL 118.4–124.5 mm in adult males ..... ***T. sini***

6b larger body size with TL 151.0–172.0 mm in adult males ..... ***T. maolanensis***

7a gular fold absent ..... ***T. vietnamensis***

7b gular fold present **8**

8a snout obtusely rounded in dorsal view; rib nodules light brown ..... ***T. thaiorum***

8b snout truncate in dorsal view; rib nodules uniformly black **9**

9a tips of fingers reaching nostril, rib nodules slightly enlarged (round-like) ..... ***T. sparreboomi***

9b tips of fingers reaching eye, rib nodules slightly smaller, pointy to rounded ..... ***T. pasmansi***

Unknown in trade

Further characters for each species of this group:

T. asperrimus: moderately large body (max TL ca. 13.8 cm; Hernandez 2016) head slightly wider than long, tips of fingers reaching the nostril when laid forward, low dorsal tail fin-fold (Fei et al. 1984), short distance between the eyes, prominent bony ridges on head (Bernardes et al. 2020).

Figure 21. *Tylototriton asperrimus*. Photo: Axel Hernandez.

T. hainanensis: large body (TL up to 14.8 cm; Hernandez 2016), head much wider than long, tips of fingers reaching the eye when foreleg laid forward, dorsal tail fin-fold high (Fei et al. 1984), brownish-black dorsal color (Ziegler et al. 2008).

Figure 22. *Tylototriton hainanensis*. Photo: Axel Hernandez.

T. maolanensis (Note: phylogenetically this species is closer to the *T. wenxianensis* group): TL ca. 16 cm in males and females, head longer than wide, snout truncate in dorsal view, relative length of toes III > IV > II > I > V, the distal tips of the limbs greatly overlapping when the fore- and hind-limbs are pressed along the trunk, fingertips reaching beyond the snout when the forelimbs are stretched forward, orange coloration on distal digit ends, ventral digits, peripheral area of cloaca and the lower margin of tail (Li et al. 2020).

T. notialis: knob-like rib nodules (Stuart et al. 2010), short distance between the eyes, skin with small glandular warts, long limbs (Bernardes et al. 2020), relatively thin and short tail (Nishikawa et al. 2013b).

T. pasmansi*:* TL ca. 12 cm, head slightly longer than wide, distinct mid-dorsal ridge, relatively wide distance between the eyes, tips of fingers reaching the eye when foreleg is laid forward, rib nodules distinct and varying from pointy to more rounded, vertebral ridge high, slightly rough and segmented, dorsal skin more granulose than ventral skin, and skin in middle of abdomen with smooth tubercles shaped like transverse wrinkles, labial and gular folds present (Bernardes et al. 2020).

Figure 23. *Tylototriton p. pasmansi*. Photo: Cuong The Pham.

Figure 24. *Tylototriton pasmansi obsti*. Photo: A. V. Pham.

T. sini: TL between ca. 12 cm (in males) and 14 cm (in females), dorsolateral bony ridges on head low, snout obtusely rounded in dorsal view and rounded in lateral profile, head longer than wide, supratemporal bony ridges and the sagittal ridge on head distinctly visible, tips of fore- and hind limbs overlapping when adpressed along the body, vertebral ridge distinct, relatively smooth and not segmented, rib nodules relatively small, ground coloration dark brown, digits orange with irregular dark brown mottling (Lyu et al. 2021).

T. sparreboomi: TL ca. 12 cm, moderately stout habitus, head clearly longer than wide, wide distance between the eyes, tips of fingers reaching nostril when foreleg adpressed along head,

rib nodules distinct, round and relatively enlarged, vertebral ridge segmented, high and relatively wide, skin tubercles on ventral side shaped like transverse wrinkles, gular fold present, labial fold slightly evident (Bernardes et al. 2020).

Figure 25. *Tylototriton sparreboomi*. Photo: A. V. Pham.

T. thaiorum: medium body size, snout obtusely rounded in dorsal and lateral views, skin rough with fine granules, supratemporal bony ridges on head wide, slightly protruding, beginning at the anterior corner of orbit, sagittal ridge on head low and almost indistinct, tips of fore- and hind-limbs overlapping when adpressed along body, vertebral ridge distinct, rough and not segmented, rib nodules small and poorly distinct, dorsal coloration dark-brown, ventral coloration greyish brown, fingers, toe tips, parts of soles and palms, vent and tail fin bright orange (Poyarkov et al. 2021).

T. vietnamensis: TL ca. 12 cm, skin with fine and sparse glandular warts, slightly flattened and only moderately developed rib nodules, gular fold absent, low vertebral ridge, color uniformly greyish or brownish (Böhme et al. 2005), tip of forelimb reaching to nostril (Nguyen et al. 2009).

Figure 26. *Tylototriton vietnamensis*. Photo: Marta Bernardes.

T. ziegleri: moderately large body, skin distinctly rough, large eyes, vertebral ridge prominent and segmented, tail long and thin, knob-like rib nodules, limbs long and thin, tips of fore- and hind-limbs greatly overlapping when adpressed along body, dorsum usually dark brown or blackish (Nishikawa et al. 2013b), rib nodules prominent to very prominent, bony ridges on head prominent to very prominent (Ziegler et al. 2018).

Figure 27. *Tylototriton ziegleri*. Author Marta Bernardes.

Identification of the *T. verrucosus* morphological group

At the time of writing, 14 species were described within this group (see below). Meanwhile four further species, namely *T. houi*, *T. joe*, *T. umphangensis* and *T. zaimeng* were described from this group, which are not described in here, and were not yet reported from the international pet trade.

Characters of the group: This group is characterized by medium to large newts with adults presenting total lengths from ca. 12 to 20 cm usually with some sort of bright dorsal marking (darker taxa include the most western geographic distributions: *T. himalayanus, T. shanorum, T. kachinorum*, *T. verrucosus*). Their skull bones and parotoids are less distinct than in *T. asperrimus* group (Hernandez 2016).

Molecular analyses are recommended at this point for definitive species identification. Color variations are known sometimes within the same species, and hybridization is possible. Nevertheless, see below for initial morphological identification aid.

Key to the species of the *T. verrucosus* group:

1a head color black with the exception of orange coloration on the posterior part of the parotoids …… ***T. yangi***

Known in trade

1b other head coloration pattern …… **2**

2a orange color of rib nodules connected forming a continuous dorsolateral line ……..…..…….. ***T. pseudoverrucosus***

2b separated orange markings on rib nodules, or rib nodules with the same coloration as dark ground color …….. **3**

3a rib nodules weakly distinct …….. **4**

3b rib nodules well distinct ……..…….. **6**

4a supratemporal bony ridges beginning at anterior corner of the eye ……... ***T. kachinorum***

4b supratemporal bony ridges beginning at loreal region ……..…… **5**

5a gular fold prominent; absence of a glandular ridge on the crown ……..…… ***T. shanorum***

5b gular fold indistinct; presence of a glandular ridge on the crown …… ***T. panwaensis***

6a indistinct glandular ridge on midline of crown ……..……..……..…… **7**

6b distinct ridge on midline of crown ……..…….…… **8**

7a having orange coloration on the limbs and lateral surfaces of the tail ……. ***T. podichthys***

7b lacking orange coloration on the limbs and lateral surfaces of the tail .....***T. ngarsuensis***

8a very distinct grooves on either sides of the tail ……..…… ***T. himalayanus***

8b poorly developed to absent lateral grooves on tail ……..….. **9**

9a narrow vertebral ridge ……..……..….. **10**

9b wide vertebral ridge ……..….. **11**

10a sagittal ridge present on head ……..…… ***T. phukhaensis***

10b sagittal ridge absent on head ……..…….…… ***T. anguliceps***

11a light brown background color ……..…….…….. ***T. pulcherrimus***

11b dark brown to black background color ……..…….…….. **12**

12a yellowish - orange to bright orange color markings on body ……..…….. ***T. shanjing***

12b darker color markings, from orange, reddish brown to dark brown …….. **13**

13a snout truncate; cranial crest narrow; surface of cranial crest rather smooth; skin granules small and sparse ……..……..…. ***T. verrucosus***

13b snout rounded to blunt; cranial crest wide; surface of cranial crest rough; skin granules large and dense ……..…….. ***T. uyenoi***

Further characters for each species of this group:

T. anguliceps – moderately large species with max. TL at 15.8 cm. The species is characterized by a more prominent dorsal granules than both *T. shanjing* and *T. uyenoi*, a prominent middorsal bony ridge and steep and narrow lateral bony edges of the head (vs. less prominent middorsal ridge and gentle and wide lateral bony edges on the head in *T. shanjing* and *T. uyenoi*, and no middorsal ridge and nearly flat lateral bony edges on head in *T. shanorum*), a vertebral ridge distinct and slightly segmented (Le et al. 2015, Hernandez 2016). Ground color black, bright to dark orange markings on head, vertebral ridge, rib nodules, limbs, vent region, part of ventral trunk and whole tail (Le et al. 2015; Nishikawa et al. 2013a).

Figure 28. *Tylototriton anguliceps*. Photo: Porrawee Pomchote.

T. himalayanus – average TL of 15.4 cm in ♂♂ and 17.5 cm in ♀♀ (Sparreboom 2014). The species is diagnosable by having a flat and blunt snout (vs. truncate snout in *T. shanorum*), head is longer than wide (vs. head wider than long in *T. shanorum*), greatly separated dorsolateral bony ridges on head (vs. poorly separated dorsolateral bony ridges in *T. shanorum*, *T. verrucosus* and *T. shanjing*), 16 dorsal warts (vs. 14 dorsal warts in T*. shanorum*), distinct grooves on either sides of tail base (vs. absent grooves in *T. verrucosus*, and poorly developed grooves in *T. shanjing*), being uniformly blackish, dark brown coloration in dorsal region, with lighter tone in dorsolateral region and creamy coloration in ventral surface (Khatiwada et al. 2015).

T. kachinorum – average TL of 14.8 cm for ♂♂ and 16.3 cm ♀♀, medium body size, tail length longer than SVL in both sexes (vs. comparably shorter tail in *T. shanorum*) and lacking lateral grooves (vs. very distinct lateral groves in *T. himalayanus*), truncate snout (vs. rounded snout in *T. ngarsuensis*), wide and protruding supratemporal bony ridges on head, beginning at anterior corner of orbit (vs. beginning at loreal region in *T. shanorum*; beginning posterior to orbit in *T. ngarsuensis*), weak and almost indistinct sagittal ridge on head, long, thin limbs, broadly overlapping when adpressed along body, distinct, wide, and non-segmented vertebral ridge (vs. well-segmented in *T. verrucosus*; narrow and weakly segmented in *T. shanorum*; weakly segmented in *T. ngarsuensis*), 13 or 14 weakly distinct rib nodules (vs. 15 well-distinct rib nodules in *T. ngarsuensis*; 16 large and prominent rib nodules in *T. himalayanus*), and brown to dark-brown background coloration with dull orange-brown to yellowish-brown markings on labial regions, parotoids, rib nodules, whole limbs, vent, and ventral tail ridge (vs. no ventral markings on body and tail in *T. verrucosus*) (Zaw et al. 2019).

T. ngarsuensis – this species is characterized by its large size, relatively short head, absence of glandular ridge on the midline of the crown (vs. presence of a ridge on the crown in *T. verrucosus*), large, rounded rib nodules with diameters equivalent to or greater than eye (vs. small and slightly elongated rib nodules with diameters smaller than eye in *T. shanorum*), thick, glandular, vertebral tubercular ridge (vs. narrow and less glandular ridge in *T. shanorum*), 15 rib nodules (vs. 14 in *T. shanorum*), paratoid ridge beginning posterior to the orbits (vs. beginning in the loreal region in *T. shanorum*), top of head, vertebral ridge, rib nodules, limbs, and side of tail nearly black (vs. red-brown in *T. shanorum*), labial regions, palms, soles, and subcaudal region dark-brown (vs. dull-yellow in *T. shanorum*), and venter and underside of limbs being dark-gray (vs. dull-yellow in *T. shanorum*) (Grismer et al. 2018).

T. panwaensis – is a medium size species, with a relatively short axilla-groin length (vs. longer axilla-groin distance in *T. shanorum*), head relatively short (vs. longer in *T. shanjing*, *T. verrucosus* and *T. shanorum*) and narrow (vs. wider in *T. ngarsuensis*, *T. shanjing*, *T. verrucosus* and *T. shanorum*), relatively shorter forelimb length than *T. shanorum*, longer hind limb length than *T. shanjing* and *T. verrucosus*, indistinct gular fold (vs. prominent in *T. shanorum* and *T. ngarsuensis*), supraorbital ridge beginning in the loreal region (vs. beginning in the postorbital region in *T. ngarsuensis*), presence of glandular ridge on the crown of the head (vs. absence *T. shanorum* and *T. ngarsuensis*), raised vertebral ridge (vs. flat in *T. ngarsuensis*), overlapping

adpressed limbs (vs. not overlapping in *T. ngarsuensis*), top of head dark brown; vertebral ridge, rib nodules, side of tail, labial regions, palms and soles, vent and subcaudal region varying shades of dull orange and dull yellow (probably orange in life) (Grismer et al. 2019).

T. phukhaensis – dorsolateral bony ridges on head narrow (vs. wide in *T. uyenoi*), and rough looking (vs. smooth looking in *T.* cf. *verrucosus* from Thailand), vertebral ridge narrow and weakly segmented (vs. narrow and segmented in *T.* cf. *verrucosus* from Thailand, and wide and segmented in *T. uyenoi*), dorsolateral skin with small and sparse granules (vs. large and dense granules in *T. anguliceps* and *T. uyenoi*), dorsal and ventral head, parotoids, vertebral ridge, rib nodules, limbs, vent, and tail of dull reddish-orange to light brown color (vs. bright to dark orange color in *T. anguliceps* particularly on the ventral trunk) (Pomchote et al. 2020b).

Figure 29. *Tylototriton phukhaensis*. Photo: Porrawee Pomchote.

T. podichthys – average TL of 12–13 cm for ♂♂ and ca. 16.5 cm for ♀♀ (Hernandez 2016). The species is characterized by presenting an indistinct glandular ridge on midline of crown (vs. distinct ridge on midline of crown in *T. verrucosus*, *T. shanjing*, *T. uyenoi* and *T. anguliceps*), distinct rib nodules with diameter equivalent to or greater than that of eye (vs. small, slightly elongated rib nodules in *T. shanorum*), parotoid oriented parallel to body axis in lateral view (vs. parotoid oriented obliquely downward relative to body axis in lateral view in *T. verrucosus* and *T. uyenoi*), thick, glandular vertebral ridge (vs. distinctly narrower and less glandular in *T. shanorum*), rough, glandular skin on cranial crest (vs. smoother in *T. verrucosus*), orange markings separated

between rib nodules and dark coloration on ventral surfaces of limbs and finger tips (Phimmachak et al. 2015a).

T. pseudoverrucosus – max TL of 18.7 cm for ♂♂ and 20.0 cm for ♀♀ (Hou *et al.* 2012). The species exhibits the following characteristics: connected color markings on rib nodules, forming dorsolateral lines (Nishikawa *et al.* 2013a), head depressed and longer than wide, snout square, 12 to 15 indistinct glandular warts, black ground color with exception of orange to red coloration on cephalic and vertebral ridges, most of head, dorsolateral lines (~rib nodules), whole tail and limbs (Hernandez 2016).

Figure 30. *Tylototriton pseudoverrucosus*. Photo: Axel Hernandez.

T. pulcherrimus – is a medium size species with tail size corresponding to 70 to 100 % of snout-vent distance. TL in ♂♂ has been reported as larger than those of ♀♀ (14.48 cm in ♂♂ vs. 13.94 cm in ♀♀). It resembles *T. verrucosus* or *T. shanjing*, but more vividly colored, with reddish brown to dark brown/black on upper side with yellow to orange markings on head edges, vertebral ridge, glandular warts, limbs, whole tail and lateral to ventral parts (Hernandez 2016).

Figure 31. *Tylototriton pulcherrimus*. Photo: Axel Hernandez.

T. shanjing – TL 13.6–15.0 cm in ♂♂ and 14.7–17.0 cm in ♀♀ (Sparreboom 2014). Dark-brown to black dorsal ground color (likely up to red as reported by Rehberg 1986), with color markings in yellowish orange to bright yellow in bony edges of the head, vertebral ridge, dorsolateral glandular warts, limbs, tail and most of ventral side (Nussbaum et al. 1995). The posterior ends of the dorsolateral crests reach the exo-occipital in *T. shanjing* (vs. do not reach in *T. anguliceps* and *T. uyenoi*) (Le et al. 2015).

Figure 32. *Tylototriton shanjing*. Photo: Axel Hernandez.

T. shanorum – it is one of the largest species (TL ca. and 18.7 cm in ♂♂ and 17.6 cm in ♀♀). Head wide, truncate snout, dorsolateral bony ridges on head not very steep or narrow, presenting a rough-like surface, rib nodules moderately prominent, vertebral ridge narrow and weakly segmented, dorsal ground color dark brown to black, anterior head, parotoid, vertebral ridge, rib nodules, limbs, and lateral side of tail dull reddish brown, upper and lower lips, palm and sole, vent region, and ventral side of tail dark yellow (Nishikawa et al. 2014).

Figure 33. *Tylototriton shanorum,* female. Photo: Uwe Gerlach.

T. uyenoi – characterized by its large size (TL ca. 15 cm in ♂♂ and 17.5 cm in ♀♀), rounded snout, dorsolateral bony ridges on head prominent but narrow, vertebral ridge distinct and slightly segmented, dorsolateral glandular warts distinct and prominent, shallow vomerine tooth series. Ground color dark brown, orange to reddish brown color markings on anterior half of head, vertebral ridge, rib nodules, limbs, vent region, and whole tail (Hernandez 2016; Nishikawa *et al.* 2013a; Nishikawa *et al.* 2014). Differs from *T. shanjing* by having darker markings, wider head, longer and higher tail, wider and longer vomerine teeth series (vs. narrower head, shorter and lower tail, and narrower and shorter vomerine teeth series in *T. shanjing*) (Nishikawa et al. 2013a).

Figure 34. *Tylototriton uyenoi*. Photo: Axel Hernandez.

T. verrucosus – this species has an all-brown ground color, with tail and soles of feet slightly lighter than dorsum, pale coloration restricted to ventral ridge of tail, with strongly developed cranial crests (vs. weakly developed cranial crests in *T. asperrimus*) (Nussbaum et al. 1995).

T. yangi – max TL of 15.8 cm for ♂♂ and 17.2 cm for ♀♀ (Hernandez & Hou 2018a) this species shows distinctively warty skin, laterally protruding quadrate regions, rounded snout, prominent vertebral ridge, isolated dorsolateral glandular warts, reddish-orange markings on posterior half of parotoids, middorsal ridge including anterior part on head, dorsolateral knobs on body, ventrolateral sides of trunk, jaw angle, cloacal region, tail, fingers and toes, but lack of markings on the limbs or on the anterior half of head (Hernandez 2016; Nishikawa et al. 2013a; Nishikawa et al. 2015). The species presents an intermediary coloration between *T. kweichowensis* and *T. shanjing* (Raffaëlli 2013).

Figure 35. *Tylototriton yangi*. Photo: Frederic Braux.

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Annex

Annex 1. List of Caudata species currently listed in the CITES Appendices and in the EU Council Regulation No. 338/97. IUCN Red List categories as of March 2023 as following: CR: Critically Endangered; DD: Data Deficient; EN: Endangered; LC: Least Concern; NE: Not Evaluated; NT: Near Threatened; VU: Vulnerable. POC: Province of China.

Genus	Species name	Common name	CITES inclusion year	IUCN Red List	Distribution
Appendix I					
Andrias	A. cheni	Qimen Giant Salamander	2023	DD	China
	A. davidianus	Chinese Giant Salamander	1975	CR	China, Taiwan (POC)
	A. japonicus	Japanese Giant Salamander	1975	NT	Japan, Russian Federation
	A. jiangxiensis	Jiangxi Giant Salamander	2022	DD	China
	A. sligoi	South China Giant Salamander	2019	CR	China
Neurergus	N. kaiseri	Kaiser's Spotted Newt	2010	VU	Iran, Iraq, Turkey
Appendix II					
Ambystoma	A. dumerilii	Achoque	1975	CR	Mexico
	A. mexicanum	Axolotl	1975	CR	Mexico
Echinotriton	E. chinhaiensis	Chinhai Spiny Newt	2019	CR	China
	E. maxiquadratus	Mountain Spiny Newt	2019	CR	China
Laotriton	L. laoensis *	Lao Salamander	2023	EN	Laos
Paramesotriton	P. aurantius	Golden Warty Newt	2019	VU	China
	P. caudopunctatus	Spot.tailed Warty Newt	2019	NT	China

	P. chinensis	Chinese Warty Newt	2019	LC	China
	P. deloustali	Tam Dao Salamander	2019	LC	Vietnam
	P. fuzhongensis	Fuzhong Warty Newt	2019	VU	China
	P. guangxiensis	Guangxi Warty Newt	2019	EN	Vietnam and China
	P. hongkongensis	Hong Kong Warty Newt	2016	NT	China, Hong Kong (POC)
	P. labiatus	Ermi Zhao Warty Newt	2019	NE	China
	P. longliensis	Longli Warty Newt	2019	VU	China
	P. malipoensis	Malipo Warty Newt	2022	DD	China
	P. maolanensis	Maolan Warty Newt	2019	DD	China
	P. qixilingensis	Qixiling Warty Newt	2019	VU	China
	P. wulingensis	Wuling Warty Newt	2019	LC	China
	P. yunwuensis	Yunwu Warty Newt	2019	EN	China
	P. zhijinensis	Zhijin Warty Newt	2019	EN	China
Tylototriton	T. anguliceps	Angular-headed Newt	2019	LC	Vietnam, Thailand, Laos
	T. anhuiensis	Anhui Crocodile Newt	2019	CR	China
	T. asperrimus	Black Crocodile Newt	2019	NT	China
	T. broadoridgus	Sangzhi Knobby Newt	2019	VU	China
	T. dabienicus	Dabie Crocodile Newt	2019	EN	China
	T. daloushanensis	Dalou Crocodile Newt	2022	DD	China
	T. hainanensis	Hainan Crocodile Newt	2019	EN	China
	T. himalayanus	Eastern Himalayan Crocodile Newt	2019	VU	Nepal, India

	T. houi	Hou's Crocodile Newt	2022	DD	China
	T. joe	Planma Crocodile Newt	2022	DD	China
	T. kachinorum	Kachin Crocodile Newt	2019	DD	Myanmar
	T. kweichowensis	Kweichow/ Red-tailed Crocodile Newt	2019	VU	China
	T. liuyangensis	Liuyang Crocodile Newt	2019	EN	China
	T. lizhenchangi	Mangshan Crocodile Newt	2019	CR	China
	T. maolanensis	Maolan Knobby Newt	2019	DD	China
	T. ngarsuensis	Ywangan Crocodile Newt	2019	DD	Myanmar
	T. ngoclinhensis	Ngoc Linh Crocodile Newt	2023	DD	Vietnam
	T. notialis	Laos Crocodile Newt	2019	VU	Laos
	T. panhai	Loei Crocodile Newt	2019	VU	Thailand
	T. panwaensis	Panwa Crocodile Newt	2019	DD	Myanmar
	T. pasmansi	Pasmans Crocodile Newt	2020	DD	Vietnam
	T. phukhaensis	Doi Phu Kha Crocodile Newt	2020	DD	Thailand
	T. podichthys	Luang Phabang Crocodile Newt	2019	LC	Laos
	T. pseudoverrucosus	Southern Sichuan Crocodile Newt	2019	EN	China
	T. pulcherrimus	Hoanglien Mountain Crocodile Newt	2019	DD	China
	T. shanjing	Red knobby newt; Yunnan/ Mandarin Newt	2019	VU	China

	T. shanorum	Taunggyi Crocodile Newt	2019	VU	Myanmar
	T. sini	Sin's Knobby Newt	2021	NE	China
	T. sparreboomi	Sparreboom's Crocodile Newt	2020	DD	Vietnam
	T. taliangensis	Taliang Crocodile Newt	2019	VU	China
	T. thaiorum	Thai Crocodile Newt	2021	NE	Vietnam
	T. tongziensis	Tongzi Knobby Newt	2022	DD	China
	T. umphangensis	Umphang Crocodile Newt	2021	DD	Thailand
	T. uyenoi	Uéno's Knobby nNewt	2019	LC	Thailand
	T. verrucosus	Inthanon Salamander	2019	NT	China, Thailand
	T. vietnamensis	Vietnam Crocodile Newt	2019	VU	Vietnam
	T. wenxianensis	Wenxian Knobby Newt	2019	VU	China
	T. yangi	Tiannan/ Yang's Crocodile Newt	2019	EN	China
	T. zaimeng	Zaimeng Lake Crocodile Newt	2023	DD	India
	T. ziegleri	Ziegler's Crocodile Newt	2019	VU	Vietnam
Appendix III					
Cryptobranchus	C. alleganiensis	Hellbender	2012	VU	United States
Echinotriton	E. andersoni	Anderson's Newt	2021	EN	Japan, Taiwan (POC)
Hynobius	H. amjiensis	Amji Hynobiid	2013	EN	China
Salamandra	S. algira	North African Fire Salamander	2016	VU	Algeria, Marocco, Spain
Annex D					
Bolitoglossa	B. dofleini	Alta Verapaz Salamander	-	NT	Belize, Guatemala, Honduras

Cynops	C. ensicauda	Sword-tailed Newt	-	EN	Japan
Ranodon	R. sibiricus	Semirechensk Salamander	-	EN	China, Kazakhstan

* Lao Salamander - subject to a zero annual export quota for wild-taken specimens traded for commercial purposes.

Species Index