

## **A new species-level classification for the *Aechmophrys cerastes* (Hallowell, 1854) species group of Rattlesnakes (Squamata: Viperidae).**

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### **ABSTRACT**

The taxonomy of the Sidewinder Rattlesnakes *Aechmophrys cerastes* (Hallowell, 1854), known in most texts as "*Crotalus cerastes* Hallowell, 1854", has been the subject of significant scrutiny in recent years, including the papers of Douglas *et al.* (2006), Hoser (2009, 2012) and sources cited therein.

Clearly the current taxonomy as used by Beaman and Hayes (2008) does not match the correct phylogeny of the species complex.

This paper revises the taxonomy and nomenclature of the species group based on phylogeny, distribution and morphological differences between relevant populations.

The nominate form originally described as *Crotalus cerastes* Hallowell, 1854, is herein treated as a full species. The previously described subspecies are also herein regarded as being of different species. However the taxonomy of these is different to that previously presented.

With a divergence estimated at just one million years by Douglas *et al.* (2006), the taxa "*Crotalus cerastes laterorepens* Klauber, 1944" and "*Crotalus cerastes cercobombus* Savage and Cliff, 1953" are treated as a single species. The latter is regarded as a subspecies of the former.

Specimens, formerly treated as "*Crotalus cerastes*" or a population of "*Crotalus cerastes cercobombus* Savage and Cliff, 1953" from north-western Sonora, Mexico are herein elevated to full species rank and formally named for the first time.

Likewise the population formerly referred to "*Crotalus cerastes* Hallowell, 1854" from Death Valley, California are also elevated to the rank of full species and formally named for the first time.

The four species recognized herein all have divergences from one another in the vicinity of 2 MYA based on the molecular evidence of Douglas *et al.* (2006) at Fig. 5, are reproductively isolated from one another and so I have no hesitation in describing the two new species according to the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999).

Hoser (2009 and 2012) placed the species "*Crotalus cerastes* Hallowell, 1854" in the genus *Aechmophrys* Coues, 1875 instead of *Crotalus* Linnaeus, 1758. Based on numerous published phylogenies cited in those papers, *Aechmophrys* remains the most logical genus-level assignment for the species group.

**Keywords:** Taxonomy; nomenclature; USA; Mexico; Arizona; California; Death Valley; Sonora; Rattlesnake; *Crotalus*; *Aechmophrys*; *cerastes*; *laterorepens*; *cercobombus*; new species; *adelynhoserae*; *jackyhoserae*.

### **INTRODUCTION**

The Sidewinder Rattlesnake of the south-western United States of America and nearby Mexico is an iconic species group that has been a prominent feature of North American natural history and culture for centuries.

The taxonomy of the Sidewinder Rattlesnakes, *Aechmophrys cerastes* (Hallowell, 1854), known in most texts as "*Crotalus cerastes* Hallowell, 1854", has been the subject of significant scrutiny in recent years, including the papers of Douglas *et al.* (2006), Hoser (2009, 2012) and sources cited therein.

Anyone who has scrutinized these snakes would also be aware that the current taxonomy as used by Beaman and Hayes (2008) does not match the correct phylogeny of the species complex.

This paper revises the taxonomy and nomenclature of the species group based on phylogeny, distribution and morphological differences between relevant populations.

For the first time ever, this paper correlates the relevant species-level divisions, including as identified by Douglas *et al.* (2006), with the three previously named taxa in the species complex, based on holotype locations. Furthermore, by reliance on earlier literature, this paper shows that two well-known populations currently referred to as *Aechmophrys cerastes* (Hallowell, 1854), are in fact unnamed species.

### **MATERIALS AND METHODS**

Douglas *et al.* (2006) provided evidence that the putative species *Aechmophrys cerastes* (Hallowell, 1854), contains five distinctive and geographically disjunct lineages.

One diverged about 1 MYA and the other four some 2 MYA from one another.

It is also well known that three populations of *A. cerastes* have in fact been named and all broadly correspond with three of the lineages identified by Douglas *et al.* (2006).

Prior to the publication of this paper, specimens of all five lineages identified by Douglas *et al.* (2006) were inspected and all showed consistent differences to warrant being recognized as taxonomically distinct and worthy of taxonomic recognition, as in to be formally named according to the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999).

I also note that, notwithstanding the theft of relevant materials from this author in an illegal armed raid on 17 August 2011, which were not returned in breach of undertakings to the court (Court of Appeal Victoria 2014 and VCAT 2015), I have made a decision to publish this paper.

This is in view of the conservation significance attached to the formal recognition of unnamed taxa at all levels and on the basis that further delays may in fact put these presently unnamed or potentially improperly assigned taxa at greater risk of extinction.

This comment is made noting the extensive increase in human population in North America, now well in excess of 300 million and increasing rapidly year on year. There is a conservative forecast of a four-fold increase in human population in the next 200 years (from slightly over 300 million to more than 1 billion) and the general environmental destruction across the continent as documented by Hoser (1989 and 1991) mainly for Australia, but even more applicable to the United States of America and Mexico. This also notes significant destruction of environment and species in low density areas without a large permanent human population. I also note the abysmal environmental record of various National, State and Local governments across the planet over the past 200 years as detailed by Hoser (1989, 1991, 1993 and 1996), making the need to formally name and conserve species even more urgent.

#### RESULTS

As inspection of said species-level taxa, conforming to five distinct lineages identified by Douglas *et al.* (2006) showed consistent morphological differences between the forms, the previously unnamed forms are herein formally named as new species, according to the *International Code of Zoological Nomenclature* (Ride *et al.* 1999).

As mentioned in the abstract, while the name *Crotalus* Linnaeus, 1758 is the most common in use for the genus-level placement of this species complex, Hoser (2009 and 2012), using published molecular data, confirmed that a more sensible placement for the complex is within the genus *Aechmophrys* Coues, 1875 and so this is the preferred usage herein.

Where the relevant species are referred to as being within *Crotalus* in this paper, this is done only due to prior usage of the name for the relevant taxa, or by relevant cited authors and not because I view this as the correct genus-level placement.

The genus *Crotalus* Linnaeus, 1758, with a type Species of *Crotalus horridus* Linnaeus, 1758 is sufficiently divergent from "*Crotalus cerastes* Hallowell, 1854" based on phylogenies cited in Hoser (2009 and 2012) as to be regarded as of a different genus, being the reason for the resurrection of *Aechmophrys* Coues, 1875 by Hoser (2009).

The nominate form originally described as "*Crotalus cerastes* Hallowell, 1854", is herein treated as a full species. It has a type locality as coming from the bank of the Mojave River and Mojave Desert, California, USA.

The subspecies "*Crotalus cerastes laterorepens* Klauber, 1944", with a type locality of The Narrows, San Diego County, California, USA and the readily separated subspecies "*Crotalus cerastes cercobombus* Savage and Cliff, 1953", with a type locality of near Gila Bend, Maricopa County, Arizona, USA, are the only two previously named subspecies within "*Crotalus cerastes*".

A diagnosis to separate this taxon-group (including previously named subspecies) from the other known species of Rattlesnake outside of the "*Crotalus cerastes* Hallowell, 1854" group is in Hoser (2012) pages 7 and 8, noting that in that publication the subgenus *Aechmophrys* (being one of three) is treated as monotypic for *A. cerastes* (Hallowell, 1854), including as then recognized subspecies, just detailed herein.

In this paper and based on the molecular evidence of Douglas *et*

*al.* (2006), previously named subspecies are also herein regarded as being of different species. However the taxonomy of these is different to that previously presented in all other recent publications that recognize the three previously named forms.

With a divergence estimated at just one million years by Douglas *et al.* (2006), the taxa "*Crotalus cerastes laterorepens* Klauber, 1944" and "*Crotalus cerastes cercobombus* Savage and Cliff, 1953" are treated as a single species. As a pair, they represent two closely related lineages, of five identified by Douglas *et al.* (2006). Due to date priority and the rules specified in the *International Code of Zoological Nomenclature* (Ride *et al.* 1999), the latter is regarded as a subspecies of the former.

Specimens, formerly treated as "*Crotalus cerastes*" or a population of "*Crotalus cerastes cercobombus* Savage and Cliff, 1953" from north-western Sonora, Mexico are herein elevated to full species rank and formally named for the first time.

Likewise the population formerly referred to "*Crotalus cerastes* Hallowell, 1854" or "*Crotalus cerastes cerastes* Hallowell, 1854" from Death Valley, California are also elevated to the rank of full species and formally named for the first time.

The four species recognized herein all have divergences from one another in the vicinity of 2 MYA based on the molecular evidence of Douglas *et al.* (2006) at Fig. 5. They are reproductively isolated from one another and so I have no hesitation in describing the two new species according to the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999).

In terms of the following descriptions, it should be noted that the spelling of the species names should not be altered in any way, unless totally mandatory according to the rules of the in force *International Code of Zoological Nomenclature*.

There is a vast body of literature relevant to "*Crotalus cerastes* Hallowell, 1854", including that cited in Hoser (2009 and 2012) and sources cited therein and so it is not re-cited here. They should however be consulted by interested persons and are relied upon as part of and accompanying the relevant material within this paper as necessary.

#### **AECHMOPHRYS ADELYNHOSERAE SP. NOV.**

**Holotype:** A preserved specimen at the California Academy of Science, California, USA, specimen number: CAS HERP 192594, collected at Death Valley National Monument, Inyo County, California, USA, Latitude 36.28 N, Longitude -117.16 W.

This facility allows access to its holdings.

**Paratype:** A preserved specimen at the California Academy of Science, California, USA, specimen number: CAS HERP 192595, collected at Death Valley National Monument, Inyo County, California, USA, Latitude 36.28 N, Longitude -117.16 W.

**Diagnosis:** The genus *Aechmophrys* Coues, 1875, is a group of smaller sized rattlesnakes all with 21-23 mid body scale rows. One subgenus of the group, being the nominate one is separated from all other rattlesnakes by the fact that the outer edges of the supraoculars are extended into raised and flexible hornlike processes that are distinctly pointed at the tip. That is the species group known widely as "*Crotalus cerastes* Hallowell, 1854", or as a "sidewinder" in reference to one of its preferred forms of motion across sand dunes (Hoser 2012).

For *A. polystictus* (Cope, 1865), also placed in this genus but herein placed in the subgenus *Rattlewellsus* Hoser (2012), it is separated from all other rattlesnakes by the presence of two squarish

darker blotches on the upper labials, one at about the eye and running into it and the other anterior to it. *A. polystictus* is further separated from all other rattlesnakes by a dorsal pattern consisting of a series of longitudinal ellipses. It also has a pair of slim intercanthals, each about twice as long as wide.

All other species in the genus *Aechmophrys*, within the subgenus *Cottonus* Hoser, 2009 have a distinct whitish streak running across the upper labials running slightly higher towards the snout, and terminating around the back of the mouth region at the posterior end.

Other rattlesnakes with a similar streak invariably have the streak running through the eye, even if only the lower part, which is not

the case for this genus.

In the rest of *Aechmophrys* that is not part of the subgenus *Cottonus* Hoser, 2009 namely *A. cerastes* (including the four species recognized and/or described herein and all formerly treated as *A. cerastes*) and *A. polystictus*, there is no such line. In *A. cerastes* (including the four species recognized and/or described herein and all formerly treated as *A. cerastes*), at best there is a squarish light blotch under the eye, while in *A. polystictus*, any white line terminates before (posterior to) the eye. *Cottonus* Hoser, 2009 have distinctly smaller and narrower heads than those taxa in the nominate subgenus and likewise as compared to the defined (by Hoser 2009 and Hoser 2012) genera *Crotalus*, *Caudisona* and *Hoserea*.

For separation of *Aechmophrys* from *Crotalus* Linnaeus, 1758, *Uropsophus* Wagler, 1830, *Caudisona* Laurenti, 1768, *Matteoea* Hoser, 2009, *Hoserea* Hoser, 2009 and *Cummingea* Hoser, 2009 see the diagnoses in Hoser (2009 or 2012).

*Aechmophrys* are separated from *Sistrurus* Garman, 1883 and *Piersonus* Hoser, 2009 by the absence of large head shields at the center of the crown of the head. *Uropsophus* is separated from this genus (*Aechmophrys*) by the fact that males have less than 40 subcaudals and females less than 35. The subgenus *Aechmophrys* as defined by Hoser (2012) is herein divided into four species, two of which are formally named in this paper for the first time.

The nominate form for *Aechmophrys* is the species, *A. cerastes* (Hallowell, 1854), as described and diagnosed above.

The second previously named species in the group is *A. laterorepens* Klauber, 1944, (and herein includes the putative taxon "*A. cercobombus* (Savage and Cliff, 1953)" which differs from the species *A. cerastes* and *A. adelynhoserae* sp. nov. by having a black marking instead of a brown marking on the proximal lobe of the rattle-matrix in adults. There are other differences of morphology and pattern as discussed by Klauber (1944).

The subspecies *A. laterorepens cercobombus* (Savage and Cliff, 1953), this being how the putative taxon is treated herein, is separated from the nominate *A. laterorepens*, by having 141 or less ventrals in males and 145 or less in females, versus 142 or more ventrals in males and 146 or more in females and 21 instead of 23 dorsal mid-body scale rows.

*A. jackyhoserae* sp. nov., like the nominate subspecies *A. laterorepens* has 23 dorsal mid-body-scale rows and is separated from *A. laterorepens* by having limited darker brown pigment or speckling on the dorsal surface of the head, versus significant black speckling on the front of the head and obvious patches of darker brown pigment on the upper surface of the head in *A. laterorepens*.

The species *A. adelynhoserae* sp. nov., until now treated as a variant of *A. cerastes* is readily separated from it by colouration, being a very whitish-greyish brown, with faded and obscure dorsal markings, versus usually orangeish to red, rarely greyish brown, and in either event, with well-defined darker dorsal blotches, except in obviously aberrant individuals.

*A. adelynhoserae* sp. nov. is further separated from *A. cerastes* by the size of the (in this case faded) dorsal vertebral blotches at the anterior end of the body, being noticeably larger than the paler interspaces, versus the reverse or equal in *A. cerastes*.

*A. jackyhoserae* sp. nov. is also significantly more faded in colouration than *A. laterorepens* (although not to the extent of *A. adelynhoserae* sp. nov.), and besides being separated from *A. adelynhoserae* sp. nov. and *A. cerastes* by having a black marking instead of a brown marking on the proximal lobe of the rattle-matrix in adults, is also separated from *A. adelynhoserae* sp. nov. by having numerous large black spots or flecks scattered on the flanks, versus fewer or indistinct in *A. adelynhoserae* sp. nov..

*A. jackyhoserae* sp. nov. is also further separated from *A. laterorepens* by the greater preponderance of black spots on the flanks, these being obvious and prominent in the former (*A. jackyhoserae* sp. nov.) and indistinct or absent in the latter (*A. laterorepens*).

**Distribution:** *A. adelynhoserae* sp. nov. is restricted to the region of Death Valley in California and probably immediately adjacent

Nevada. *A. cerastes* occupies the region generally south of Highway 15, running from Los Angeles to Las Vegas in California and including adjacent parts of Nevada and Arizona.

**Etymology:** Named in honour of my daughter, Adelyn Hoser, of Park Orchards, Melbourne, Victoria, Australia, aged 19 as of end May 2018, in recognition of her monumental contributions to wildlife conservation and education in the first 19 years of her life. I note that it is absolutely disgusting that lying thieves like Wolfgang Wüster and Mark O'Shea of the UK have the audacity to condemn myself publicly for naming taxa in honour of family members, who unlike these people have in fact made significant contributions to wildlife conservation, the basis of their vocal complaints being merely that I have named taxa after family members ... as if this is some kind of crime. These thieves have then used this non-existent crime to engage in acts of extreme taxonomic vandalism to illegally rename taxa in breach of the *International Code of Zoological Nomenclature* in PRINO (Peer Reviewed In Name Only) journals that they control (see Hoser 2015a-f and sources cited therein for further details).

#### **AECHMOPHRYS JACKYHOSERAE SP. NOV.**

**Holotype:** A preserved specimen at the Museum of Vertebrate Zoology, UC Berkeley, USA, MVZ Herp Collection, specimen number: 76500, collected at Bahía de Kino, Hermosillo, Sonora, Mexico, Latitude 28.82 N, Longitude -111.94 W.

This is a facility that allows access to its holdings.

**Paratypes:** 1/ A preserved specimen at the San Diego Natural History Museum, San Diego, USA, SDNHM Herpetology Collection, specimen number: 42792, collected at 29.8 miles west-southwest of Hermosillo, Sonora, Mexico, Latitude 28.88 N., Longitude -111.35 W.

2/ A preserved specimen at the Museum of Southwestern Biology, Albuquerque, New Mexico, USA, MSB Amphibian and Reptile Collection, specimen number: 80383, collected at Bahia Kino, Sonora, Mexico, Latitude 28.81 N., Longitude -111.93 W.

**Diagnosis:** The subgenus *Aechmophrys* as defined by Hoser (2012) is herein divided into four species, two of which are formally named in this paper for the first time.

The nominate form for *Aechmophrys* is the species, *A. cerastes* (Hallowell, 1854), as described and diagnosed below.

The second previously named species in the group is *A. laterorepens* Klauber, 1944, (and herein includes the putative taxon "*A. cercobombus* (Savage and Cliff, 1953)" which differs from the species *A. cerastes* and *A. adelynhoserae* sp. nov. by having a black marking instead of a brown marking on the proximal lobe of the rattle-matrix in adults. There are other differences of morphology and pattern as discussed by Klauber (1944).

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*adelynhoserae* sp. nov. and *A. cerastes* by having a black marking instead of a brown marking on the proximal lobe of the rattle-matrix in adults, is also separated from *A. adelynhoserae* sp. nov. by having numerous large black spots or flecks scattered on the flanks, versus fewer or indistinct in *A. adelynhoserae* sp. nov..

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All others in this genus *Aechmophrys*, within the subgenus *Cottonus* Hoser, 2009 have a distinct whitish streak running across the upper labials running slightly higher towards the snout, and terminating around the back of the mouth region at the posterior end.

Other rattlesnakes with a similar streak invariably have the streak running through the eye, even if only the lower part, which is not the case for this genus.

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*Aechmophrys* are separated from *Sistrurus* Garman, 1883 and *Piersonus* Hoser, 2009 by the absence of large head shields at the center of the crown of the head.

*Uropsophus* is separated from this genus (*Aechmophrys*) by the fact that males have less than 40 subcaudals and females less than 35.

**Distribution:** *A. jackyhoserae* sp. nov. is restricted to the Sonora region of Mexico in the general vicinity of the type locality. It is unsure how far north this species ranges, but specimens from Arizona, immediately to the north are of the species *A. laterorepens cercobombus* (Savage and Cliff, 1953).

**Etymology:** Named in honour of my daughter, Jacky Hoser, of Park Orchards, Melbourne, Victoria, Australia, aged 17 as of end May 2018, for her monumental contributions to wildlife conservation and education in the first 17 years of her life. I note that it is absolutely disgusting that lying thieves like Wolfgang Wüster and Mark O'Shea of the UK have the audacity to condemn myself publicly for naming taxa in honour of family members, who unlike these people have in fact made significant contributions to wildlife conservation, the basis of their vocal complaints being merely that I have named taxa after family members ... as if this is some kind of crime. These thieves have then used this non-existent crime to engage in acts of extreme taxonomic vandalism to illegally rename taxa in breach of the *International Code of*

*Zoological Nomenclature* in PRINO (Peer Reviewed In Name Only) journals that they control (see Hoser 2015a-f and sources cited therein for further details).

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#### CONFLICTS OF INTEREST

There are no conflicts of interest in relation to this paper.