

= Aetosaur =

Aetosaurs (aetosaur / e????to??s??r / ; order name Aetosauria / e????to??s??ri? / ; from Greek , ????? (aetos , " eagle ") and ????? (sauros , " lizard ")) are an extinct order of heavily armoured , medium- to large @-@ sized Late Triassic herbivorous archosaurs . They have small heads , upturned snouts , erect limbs , and a body covered by plate @-@ like scutes . All aetosaurs belong to the family Stagonolepididae . Two distinct subdivisions of aetosaurs are currently recognized , Desmatosuchinae and Aetosaurinae , based primarily on differences in the morphology of the bony scutes of the two groups . Over 20 genera of aetosaurs have been described , and recently there has been controversy regarding the description of some of these genera .

Aetosaur fossil remains are known from Europe , North and South America , parts of Africa and India . Since their armoured plates are often preserved and are abundant in certain localities , aetosaurs serve as important Late Triassic tetrapod index fossils . Many aetosaurs had wide geographic ranges , but their stratigraphic ranges were relatively short . Therefore , the presence of particular aetosaurs can accurately date a site that they are found in .

Aetosaur remains have been found since the early 19th century , although the very first remains that were described were mistaken for fish scales . Aetosaurs were later recognized as crocodile relatives , with early paleontologists considering them to be semiaquatic scavengers . They are now considered to have been entirely terrestrial animals . Some forms have characteristics that may have been adaptations to digging for food . There is also evidence that some if not all aetosaurs made nests .

= = Description = =

The head is small relative to the large body , and quite distinctive in shape , being flat and blunt at the front , like the snout of a pig . Some teeth are chisel @-@ shaped , small and leaf @-@ like , indicating a probable herbivorous diet , although peg @-@ like teeth and a keratinous snout have been considered possible adaptations in some species for feeding on colonial insects . A study of the braincase of Stagonolepis robertsoni has shown that there are similarities between it and those of crocodylomorphs , which may indicate a close relationship .

Aetosaurs had a " pillar @-@ erect " erect limb posture similar to that seen in Rauisuchia , a related group of Triassic archosaurs . A pillar @-@ erect limb posture is one where the femur articulates vertically with the acetabulum of the hip , which is angled downward , so that the leg is positioned beneath the body and acts as a pillar bearing weight . While the limb posture is similar to rauisuchians , the feet resemble those of phytosaurs (crocodile @-@ like semiaquatic crurotarsans) in the retention of primitive characteristics . Although the forelimbs are much smaller than the hind limbs , all aetosaurs were quadrupeds .

Aetosaurs were very heavily armored (most certainly as a defense against predators) , with large quadrangular , interlocking bony plates , or osteoderms , protecting the back and sides , belly , and tail . Most osteoderms are heavily pitted on their upper surfaces and smooth on their undersides . Their centers are made of cancellous or spongy bone (also called diploë) and their outer portions are made up of compact bone . In life , these plates were probably covered in horn . Dorsal osteoderms , which are found on the backs of aetosaurs , are often ornamented with radial grooves . Dorsal paramedians , those found along the midline of the animal , are often wide and quadrangular with a small boss called a dorsal eminence on the dorsal surface of each plate . In aetosaurs , paramedian plates often have raised or depressed anterior edges where the plates articulate with the ones in front of them . If the anterior edge is raised , the area is called an anterior bar , while if it is depressed , the area is called an anterior lamina . In lateral plates , which are positioned on either side of the paramedian plates , the dorsal eminence is often enlarged into a prominent spike . This spike is especially noticeable in desmatosuchines such as Longosuchus and Desmatosuchus . Osteoderms are useful in diagnosing aetosaur taxa , and aetosaur species can often be identified from individual scutes based on their ornamentation pattern .

Primitive genera , like the widespread Norian genus Aetosaurus and the Carnian Coahomasuchus ,

tended to be small , about a metre (3 @. @ 2 ft) in length . However , more advanced forms were larger - about 3 metres (9 @. @ 8 ft) in length - with some taxa , such as *Typothorax* and *Paratypothorax* , possessing broad turtle @-@ like bodies , and others , like *Desmatosuchus* , a narrow @-@ bodied genus at least 4 metres (13 ft) long , equipped with large spines over the shoulders , which added to the animal 's defensive armament .

= = History = =

Aetosaur material was first described by Swiss paleontologist Louis Agassiz in 1844 . He named the genus *Stagonolepis* from the Lossiemouth Sandstone in Elgin , Scotland , but considered it to be a Devonian fish rather than a Triassic reptile . This may be because he considered the strata to be part of the Old Red Sandstone , and thus Paleozoic in age . Agassiz mistook the osteoderms for large rhomboidal scales , which he thought were arranged in a similar pattern to those of gars . He also thought that these supposed scales were very similar to those of the lobe @-@ finned fish *Megalichthys* due to their large size .

English biologist Thomas Henry Huxley reconsidered the fish scales described by Agassiz and considered them to belong to a crocodilian . He first proposed this to the Geological Society of London in 1858 , and went into more detail in an 1875 paper in the society 's quarterly journal . By this time , new material had been uncovered from Elgin that indicated that *Stagonolepis* was not a fish , but a reptile . However , *Stagonolepis* was still known primarily by scutes and imprints of scutes , many of which were not well preserved .

More complete aetosaur remains were found from the Lower Stubensandstein of Germany in the 1870s . Among them were complete articulated skeletons of 22 aetosaurs . These specimens were found in a large sandstone outcrop near Stuttgart and were preserved together in an area less than 2 square metres in size . The animals were probably buried under lake sediment soon after they died , with the flow of water repositioning their bodies on the lake bed and putting them in close proximity to one another . In 1877 , German paleontologist Oskar Fraas assigned these specimens to the newly erected genus *Aetosaurus* . Fraas named the genus after the skull 's resemblance to the head of an eagle , with a narrow , elongate skull and a pointed snout .

The first aetosaurs from North America were also being described at this time . American paleontologist Edward Drinker Cope named *Typothorax* in 1875 and *Episcoposaurus* in 1877 , both of which were from New Mexico . However , Cope considered these genera to be phytosaurs , crocodile @-@ like aquatic archosaurs that were also common in the Late Triassic . While new material referable to *Typothorax* has been found in recent years throughout the American southwest , *Episcoposaurus* is no longer considered valid . Cope , along with later paleontologists such as Friedrich von Huene , recognized that remains of the type species *E. horridus* actually belonged to *Typothorax* . Another species , *E. haplocerus* , was reassigned to *Desmatosuchus* in 1953 .

A third North American genus called *Stegomus* was named by Othniel Charles Marsh in 1896 . Marsh had a long @-@ time rivalry with Cope that was made famous in the Bone Wars of the late 19th century , in which the two tried to out @-@ compete one another in the field and in scientific literature . Unlike Cope 's aetosaurs , *Stegomus* was found from the eastern United States in Connecticut . Marsh also recognized *Stegomus* as an aetosaur rather than a phytosaur in his initial description of the genus . Like Cope , many paleontologists tended to consider aetosaur scutes to belong to phytosaurs during this time period .

Aetosauria was first named in 1889 by English naturalist Richard Lydekker and zoologist Henry Alleyne Nicholson . They considered Aetosauria to be one of three suborders of the order Crocodilia , the other two being *Parasuchia* (a Triassic group) and *Eusuchia* (a group including all post @-@ Triassic crocodiles) . At the time , Cope considered Aetosauria to belong to *Rhynchocephalia* , an order of reptiles that includes the living tuatara . He also thought that the tightly fitting osteoderms , which were thought to be fused to the ribs , indicated that aetosaurs were transitional between rhynchocephalians and turtles . Nicholson and Lydekker placed a single family within the suborder , *Aëtosauridæ* . They considered aetosaurs to be similar to living crocodilians apart from their elongated metatarsals , which were compared to those of dinosaurs . In fact , Marsh considered

aetosaurs to be closely related to dinosaurs because both had similar metatarsals .

Aetosaur material continued to be described into the early 20th century , with notable paleontologists such as Barnum Brown and Charles Camp collecting specimens . However , aetosaur remains were still being confused with those of phytosaurs . During this time , aetosaurs were usually considered to be members of Pseudosuchia , a now obsolete group consisting of various Triassic archosaurs including phytosaurs . However , similarities were often observed between aetosaurs and Crocodilia , the group to which aetosaurs were initially referred in the 19th century . While the skull had many features in common with pseudosuchians , parts of the postcranial skeleton , in particular the scutes , seemed to be similar to those of crocodilians .

= = Distribution = =

Aetosaur fossils have been found on all continents except Australia and Antarctica , giving them a nearly worldwide distribution during the Late Triassic . Many aetosaur remains have been found from the Chinle Group in the southwestern United States . Most fossils have been found from Arizona , New Mexico , and Texas . Some remains have also been found from Utah , particularly in Canyonlands National Park and Zion National Park . Aetosaurs are also known from the Newark Supergroup along the East Coast of the United States in states such as Connecticut and North Carolina . Two genera are known from Greenland : Aetosaurus and Paratypothorax . They have been found from the Fleming Fjord Formation in Jameson Land . Longosuchus is the only aetosaur known from Africa , with scutes having been found from the late Carnian Timesgadiouine Formation in Morocco . During the Late Triassic , Morocco would have been in close proximity with the Newark Supergroup of North America in the supercontinent of Pangaea . It is also possible that Desmotosuchus was present in Africa , as fossils have been found from the Zarzaitine Series in Algeria that were referred to the genus .

South American aetosaurs have been found from Argentina , Brazil , and Chile . In Argentina , they are known from the Carnian Ischigualasto Formation . Common genera from Ischigualasto include Aetosauroides and Stagonolepis . In Brazil , fossils have been found in the Santa Maria and Caturrita Formations in Rio Grande do Sul (Paleorrota) . Chilean aetosaurs are represented by one genus , Chilenosuchus , from the Antofagasta Region . Aetosaurs have also been found from India , which , along with South America , was part of Gondwana during the Late Triassic . Early descriptions of aetosaurs included material from the Maleri Formation in south @-@ central India , although it was too inadequate to assign specimens to any particular genus . Based on such descriptions , the Indian aetosaurs most closely resemble Longosuchus and Paratypothorax . Reports of aetosaurs from Madagascar are based on probable crocodylomorph scutes .

Footprints belonging to the ichnogenus Brachychirotherium are often associated with aetosaurs . Brachychirotherium has been found from Rio Grande do Sul in Paleorrota , Brazil as well as Italy , Germany , and the eastern United States . They are also common in the southwestern United States , having been found from Canyonlands National Park and Dinosaur National Monument . Many of these tracks have a narrow gauge (meaning left and right prints are placed closely together) and nearly overstep each other . A 2011 functional analysis of the skeleton of Typothorax coccinarum indicated that it had the range of movement necessary to produce the tracks .

= = Classification = =

= = Taxonomy = =

Aetosaurs belong to Pseudosuchia , a clade of archosaurs that includes living crocodilians and is characterized by the distinctive structure of the ankle bones . Aetosaurs were traditionally referred to a (now obsolete) group called the thecodonts , which included all " primitive " crocodilian relatives that lived in the Triassic . With the rise of phylogenetics , aetosaurs were later placed in a group called Suchia , which included many Triassic crurotarsans as well as later crurotarsans , including

crocodilians .

Originally , all aetosaurs were considered members of the family Stagonolepididae . Early phylogenetic analyses split aetosaurs into two subfamilies , Aetosaurinae and Desmatosuchinae . Aetosaurines are characterized by projections called eminences on the dorsal paramedian osteoderms that are close to the midline of the back . Desmatosuchines have a few more distinguishing characteristics , including grooves on the dorsal paramedians that help them lock to the lateral plates in a tight articulation . Many desmatosuchines have long spikes projecting from the lateral plates . These spikes are especially prominent in Desmatosuchus . Aetosaurines , on the other hand , tend to have less spikes . Many aetosaurines , such as Aetosaurus and Neoaetosauroides , have smooth carapaces and lack spikes altogether . More recent studies (see below) have favored a third group , Typothoracisinae , which like Desmatosuchinae has long spikes , but differs in having more sharply angled joints between osteoderms . Moreover , the genus Aetosauroides is now often classified outside Stagonolepididae as a non -@-@ stagonolepidid aetosaur , making the names Aetosauria and Stagonolepididae no longer synonymous .

= = = = Genera = = = =

= = = Phylogeny = = =

Aetosaur phylogeny was first investigated in 1994 by paleontologist J. Michael Parrish . Aetosauroides , Aetosaurus , Desmatosuchus , Longosuchus , Neoaetosauroides , Stagonolepis , and Typothorax were included in the phylogenetic analysis . Aetosaurs were found to form a clade with rauisuchians , which Parrish termed Rauisuchiformes . Rauisuchiformes also included the superorder Crocodylomorpha , to which living crocodilians belong . Parrish found Aetosauria to be a monophyletic group and thus a true clade consisting of a common aetosaur ancestor and all of its descendants . To phylogenetically define Aetosauria , Parrish identified five synapomorphies , or shared characteristics . The first synapomorphy concerned the jaw , with the premaxilla at its tip being edentulous (toothless) , upturned , and wide to form a " shovel " . Moreover , the dentary bone in the lower jaw is also toothless , upturned , and broad . The reduced size and simple conical shape of the teeth was considered another synapomorphy . Two more synapomorphies of aetosaurs are shared with crocodylomorphs , but were not considered to be an indication of a close phylogenetic relationship ; the body is covered in dorsal and ventral armor to form a complete carapace , and the paramedian osteoderms are much wider than they are long , with distinctive pitting . A final synapomorphy was found in the structure of the limb bones . In all aetosaurs , the limbs are very robust , with large muscle attachments such as the deltopectoral crest of the humerus , the fourth trochanter of the femur , the intracondylar ridge of the tibia , and the iliofibularis trochanter of the fibula .

In Parrish 's phylogenetic analysis , Aetosaurus was found to be the most basal member of the clade , the earliest to diverge after the most recent common ancestor . After Aetosaurus , there is a polytomy of three smaller clades in which it is unknown which clade diverged first from the group . Within this polytomy there was Neoaetosauroides , a clade containing Aetosauroides and Stagonolepis , and another polytomy that included Longosuchus , Desmatosuchus , and a clade containing Paratypothorax and Typothorax .

A later study by paleontologists Andrew B. Heckert and Spencer G. Lucas in 1999 expanded the number of synapomorphies that diagnose Aetosauria to 18 . New synapomorphies included temporal fenestrae , or holes , that opened on the side of the skull rather than the top , lateral osteoderms articulating with the paramedians , and osteoderms covering the limbs . Aetosaurus was still found to be the most basal member , but the phylogeny of more derived aetosaurs differed in that Typothorax and Paratypothorax were split into two different clades with their sister taxa being Desmatosuchus and Longosuchus , respectively . More importantly , a new aetosaur called Coahomasuchus was included in the analysis . Coahomasuchus was found to be a basal aetosaur closely related to Stagonolepis , and also appeared early in the fossil record of aetosaurs .

Previously , basal members were only known from later times , occurring after more advanced aetosaurs .

In 2003 , paleontologists Simon R. Harris , David J. Gower , and Mark Wilkinson examined previous phylogenetic studies of aetosaurs and criticized the way in which they used certain characters to produce cladograms . They concluded that only three hypotheses of aetosaur relationships from previous studies were still true : that *Aetosaurus* is the most basal aetosaur , that *Aetosauroides* is the sister taxon of *Stagonolepis robertsoni* , and that *Longosuchus* and *Desmatosuchus* are more closely related to each other than either is to *Neoaetosauroides* . They also went on to correct the trees from all previous analyses .

More recently , a 2007 analysis by paleontologist William G. Parker resulted in a larger tree of aetosaur phylogenetics with the inclusion of *Heliocanthus* . Based on the tree , Parker defined the clades *Typothoracisinae* and *Paratypothoracisini* , both within *Aetosaurinae* . Parker also gave a revised phylogenetic definition of *Aetosauria* , mentioning that the previous definition , made by Heckert and Lucas in 2000 , was somewhat ambiguous . Heckert & Lucas (2000) defined *Aetosauria* as a stem @-@ based taxon , claiming that *Aetosauria* included all crurotarsans that were more closely related to *Desmatosuchus* than to the immediate sister group of *Aetosauria* . Because the immediate sister group of *Aetosauria* was uncertain , Parker offered a new definition with several non @-@ aetosaur crurotarsan genera rather than one sister group . According to Parker , *Aetosauria* included all taxa more closely related to *Aetosaurus* and *Desmatosuchus* than to *Leptosuchus* , *Postosuchus* , *Prestosuchus* , *Poposaurus* , *Sphenosuchus* , *Alligator* , *Gracilisuchus* , and *Revueltosaurus* .

In 2008 , Parker , along with Michelle R. Stocker and Randall B. Irmis , conducted a new phylogenetic analysis which included the newly described *Sierritasuchus* . Below is the cladogram from Parker et al . (2008) :

A new genus of aetosaur , *Aetobarbakinoides* , was named in 2012 . The phylogenetic analysis in that study found *Aetosaurinae* to be a paraphyletic grouping . As a paraphyletic group , aetosaurines would share a most recent common ancestor that is also the ancestor of other non @-@ aetosaurine aetosaurs , and thus could not form their own clade . Parker 's 2007 analysis accepted this definition . In 2002 , Heckert and Lucas defined *Aetosaurinae* as " a stem @-@ based taxon containing all taxa more closely related to *Aetosaurus* than to the last common ancestor of *Aetosaurus* and *Desmatosuchus* " . The 2012 study placed *Aetosaurus* at the base of the stagonolepidid clade , with traditional aetosaurine taxa placed in successively more derived positions . In the analysis , these taxa are actually more closely related to *Desmatosuchus* than to *Aetosaurus* . Thus , under Heckert and Lucas 's definition *Aetosaurinae* might be restricted to only *Aetosaurus* itself .

Another finding of this study was that *Aetosauroides* lies outside *Stagonolepididae* . If this phylogeny is correct , *Stagonolepididae* and *Aetosauria* would not be equivalent groupings , and *Aetosauroides* would be the first non @-@ stagonolepidid aetosaur . The following cladogram simplified after an analysis presented by Julia B. Desojo , Martin D. Ezcurra and Edio E. Kischlat (2012) .

= = = Evolution = = =

Although aetosaurs are known exclusively from the Late Triassic , their currently accepted position in archosaur phylogeny indicates that they originated from more basal pseudosuchian archosaurs in the Early or Middle Triassic . Given that aetosaurs are highly specialized with many anatomical features not seen in other pseudosuchians , the group 's evolutionary origins are poorly understood . The recent discovery of complete specimens of the Late Triassic pseudosuchian *Revueltosaurus callenderi* indicate that it may have been close to the ancestry of aetosaurs . Several phylogenetic analyses place it as the sister taxon or closest relative of *Aetosauria* . Like aetosaurs , *Revueltosaurus* has two rows of paramedian osteoderms along its back and , in the cheek region of the skull , a maxilla that fits into a groove of the jugal bone . One phylogenetic analysis places *Turfanosuchus dabanensis* , a Middle Triassic pseudosuchian , as the sister taxon of

Revueltosaurus and Aetosauria , potentially making it the earliest known " stem aetosaur " (" stem " meaning that it lies on the branch that includes aetosaurs , but is not itself an aetosaur) .

In 2012 a third " stem aetosaur " was described from the Middle Triassic Manda Beds of Tanzania . It differs from other Middle Triassic pseudosuchians in having a long skull , a small antorbital fenestra that fits into a large antorbital fossa in front of the eye socket , sharp and curved teeth , and osteoderms covering much of its body . Like aetosaurs and Revueltosaurus , it has a maxilla that fits into the jugal . Revueltosaurus , Turfanosuchus , and the unnamed Tanzanian pseudosuchian are all good fits for the hypothesized ancestor of aetosaurs because they both have double rows of leaf @-@ shaped osteoderms along their backs that could potentially have evolved into the tightly fitting paramedian osteoderms of aetosaurs .

= = Paleobiology = =

= = = Early interpretations = = =

In 1904 , American paleontologist Henry Fairfield Osborn described aetosaurs as carnivorous aquatic animals of the order Parasuchia , mentioning that " [Parasuchia] constitutes an independent order , probably freshwater , littoral , carnivorous , short snouted (Aëtosaurus) or long snouted (Phytosaurus , Mystriosuchus) forms , analogous in their habits to the modern Crocodilia " . Early aetosaur remains were often found in clays beside skeletons of aquatic animals such as phytosaurs and terrestrial animals such as dinosaurs and trilophosaurs . This may have led some paleontologists to believe that the animals had died in swampy environments . Because there were a large number of skeletons of animals that would not normally have inhabited swamps in these clays , some paleontologists even suggested that aetosaurs scavenged off the carcasses of animals that became trapped in the swamps and died . Doubts were later raised over this lifestyle , since aetosaur teeth show little indication of carnivory and the weight of the armor suggests that aetosaurs had " a passive mode of life . " However , aetosaurs were still regarded as partly aquatic into the mid @-@ 20th century .

= = = Feeding = = =

Aetosaurs were herbivores , likely feeding on ferns and seed ferns that were common in the Triassic . The upturned shape of their snout suggests that aetosaurs may have dug up roots and tubers . Aetosaurs have several anatomical features that may have been adaptations to digging , including a short radius relative to the humerus (seen in many other digging tetrapods) and a large deltopectoral crest on the humerus that served as an attachment for muscles . Aetosaurs also have large hind feet , or pes , with large claws that were likely used for skritch @-@ digging . One aetosaur , Typothorax , has an entepicondyle on the humerus , which is the origin of forearm pronator and manual flexor muscles often used in digging . Moreover , it has a large olecranon process on the ulna which projects backward past the elbow , giving a large area for the insertion of the triceps muscle . While many studies have suggested that aetosaurs had a fossorial or burrowing lifestyle , aetosaurs have few of the characteristics that fossorial animals have as adaptations to digging . Therefore , it is likely that aetosaurs were able to dig to some extent , possibly rooting for food , but were unable to burrow .

While features of the limbs indicate that aetosaurs probably dug for food , features of the skull and teeth can indicate what kind of food they were eating . Aetosaurs have many derived features not seen in other crurotarsans , which indicate that they are adapted to a different diet . Unlike the sharp , recurved teeth of other triassic archosaurs , aetosaurs had simple , conical teeth . The tips of the jaws were edentulous , or toothless , and probably supported a beak . The teeth have very little wear , suggesting that aetosaurs did not consume stiff and tough plant material . It is more likely that they consumed non @-@ abrasive vegetation such as soft leaves .

Alternative theories have been proposed for the diet of aetosaurs . In 1947 , H J Sawin proposed

that the aetosaur *Longosuchus* was a scavenger based on the close proximity of some specimens to a large number of skeletons that were likely carcasses . A 2009 study of the jaw biomechanics of the South American genus *Neoaeosauroides* suggested that the animal may have fed on larvae and insects without hard exoskeletons . This is because *Neoaeosauroides* lacks serrations or wear facets on the teeth and has a jaw leverage that is not designed for strong forces such as crushing and chopping . The study recognized that northern aetosaurs such as *Desmatosuchus* and *Stagonolepis* did have jaws that would have supported a strong musculature , and were likely better suited to eating plant material .

=== Nests ===

At least some aetosaurs built nests and protected their eggs . In 1996 , geologist Stephen Hasiotis discovered 220 ? million @-@ year @-@ old , fossilized , bowl @-@ like nests in Arizona 's Petrified Forest , in part of the Chinle Formation . The oldest such nests that have been found belonged to phytosaurs and aetosaurs . The nests are compacted and appear very similar to the nests of the modern day crocodiles who guard their nests . The nests were holes dug in the sand in the bank of an ancient river .

A second possible aetosaur nest site is known from northeastern Italy . The nests are preserved as depressions in carbonate rock that are circular or horseshoe @-@ shaped , with high ridges around the sides . They appear to be unusually complex for nests created by Triassic reptiles . Archosaur footprints were found nearby that resembled aetosaurs , although they were not present in the same layer . Because the tracks were found so close to the nests , it is likely that aetosaurs built them .

=== Growth ===

The ages of individual aetosaurs can be determined by examining their osteoderms . Some isolated osteoderms have been claimed to belong to juvenile aetosaurs based on their size and shape but these hypotheses have often been questioned . For example , juvenile osteoderms of *Calptosuchus* were later identified as those of the small @-@ bodied pseudosuchian *Revueltosaurus* (which is not an aetosaur) , and juvenile osteoderms of *Desmatosuchus* have been reinterpreted as those of aetosaur *Acaenasuchus* , which had a relatively small body size at maturity . Studies of the bone structure of paramedian osteoderms indicate that new bone was deposited along the edges of each plate over the course of an aetosaur 's lifetime . This means that lines of arrested growth on the undersides of paramedian osteoderms can be used to determine an individual 's age . Comparing the ages of individual specimens with their total body lengths indicates that aetosaurs increased in length at relatively constant rates , but increased in body mass at different rates depending on whether they had wide bodies like *Typothorax* or narrow bodies like *Aetobarkinoides* . Aetosaurs also seem to have grown more slowly than modern crocodilians . Analysis of the limb bones of aetosaurs indicates that they grew quickly when young and more slowly when adults . This pattern of growth is seen in most other pseudosuchians .

=== Biochronology ===

Because species of aetosaurs typically have restricted fossil ranges and are abundant in the strata they are found in , they are useful in biochronology . Osteoderms are the most common remains associated with aetosaurs , so a single identifiable scute can accurately date the layer it is found in .

One aetosaur , *Typothorax coccinarum* , has been used to define the Revueltian land vertebrate faunachron . A land vertebrate faunachron (LVF) is a time interval that is defined by the first appearance datum (FAD) , or first occurrence , of a tetrapod index fossil and is commonly used to date Late Triassic and Early Jurassic terrestrial strata . Since the FAD of *T. coccinarum* is at the beginning of the Norian stage , the Revueltian LVF starts at the beginning of the Norian around 216 million years ago . The Revueltian ends with the next FAD , which happens to be that of the phytosaur *Redondasaurus* and the start of the Apachean LVF .

Biochrons for aetosaur genera have been developed for dating strata in the Chinle Group of the southwestern United States . Up to 13 genera of aetosaurs are known from the Chinle Group , with most occurring in multiple localities and over short time spans . In 1996 , paleontologists Spencer G. Lucas and Andrew B. Heckert recognized five biochrons based on the presence of aetosaurs throughout the Chinle Group . The number of biochrons grew to 11 in a 2007 study by Heckert and Lucas along with Adrian P. Hunt and Justin A. Spielmann . These biochrons occurred from the Otischalkian LVF to the Apachean LVF and included genera such as Longosuchus , Tecovasuchus , and Typothorax .

= = Naming controversy = =

In 2007 , paleontologists at the New Mexico Museum of Natural History and Science in Albuquerque , New Mexico were accused of plagiarism in some of their published articles dealing with aetosaurs . In late 2006 , the genus Rioarribasuchus was erected as a replacement name for " Desmotosuchus " chamaensis in the museum 's bulletin . However , four years earlier paleontologist William Parker reassigned " D. " chamaensis to the newly named genus Heliocanthus in an unpublished thesis . Because the name was not published , it was considered a nomen nudum until 2007 when it was described in the Journal of Systematic Palaeontology . The authors of the 2006 paper , Spencer G. Lucas , Adrian P. Hunt , and Justin A. Spielmann , were accused of " intellectual theft " by paleontologists Jeff Martz , Mike Taylor , Matt Wedel , and Darren Naish , who claimed that they knew that Parker was eventually going to redescribe the species and formally erect a new genus . According to Martz , Taylor , Wedel , and Naish , the authors rushed to publish their own name before Parker could publish his .

Another controversy occurred after Spielmann , Hunt , and Lucas published a 2006 paper mentioning that the holotype of Redondasuchus was not a left paramedian but a right one . In 2002 , Martz came to the same conclusion in an unpublished thesis . He , along with Taylor , Wedel , and Naish , claimed that this was another form of plagiarism .

These allegations were brought to the attention of the Ethics Education Committee of the Society of Vertebrate Paleontology (SVP) in 2007 , and a response was given in 2008 . In regard to Redondasuchus , the SVP found no plagiarism involved , while in the case of Heliocanthus and Rioarribasuchus , the SVP did not try to resolve the issue .

The entire controversy came to be known as " Aetogate " , in reference to the famous Watergate scandal of the 1970s . It received wide attention from local Albuquerque newspapers and science blogs . It was also the focus of a news article in a 2008 issue of the journal Nature .